Physics of fundamental Symmetries and Interactions - PSI2016

Report of Contributions

https://indico.psi.ch/e/psi2016

Contribution ID: **130** Type: **Poster**

New Precise Measurement of Muonium Hyperfine Structure at J-PARC

Tuesday, October 18, 2016 5:54 PM (1 minute)

Muonium atom is the bound state of a positive muon and an electron. MuSEUM (Muonium Spectroscopy Experiment Using Microwave) collaboration is an international research group for precise determination of the ground-state hyperfine transition frequency of muonium. Since muonium is purely leptonic and free from the finite-size effect of proton, measurement of its hyperfine structure is a good probe for the stringent test of bound-state QED(Quantum Electrodynamics). MuSEUM experiment also determines the muon mass precisely, which is an input parameter for the muon g-2 experiments proposed both at J-PARC and Fermilab. MuSEUM is hence able to make a great contribution to the search for new physics beyond the standard model through the g-2 experiments. It is also suggested [1] that the experiment is sensitive for CPT and Lorentz violation, by utilising the sidereal rotation of the earth. The final goal of MuSEUM is the ten-fold improvement of the current experimental value of the hyperfine transition frequency of muonium[2].

In the experiment, a muon pulse beam is injected into a krypton gas chamber, where muons form muonium by capturing electrons from the gas atom. Then the muon decays with an asymmetric positron emission which favours the direction of magnetic moment of the muon, upstream of the beam axis. Muon spin flip induced by applied field enhances the number of positron detected by downstream positron counters, hence hyperfine transition is observed.

Recently, MuSEUM have tried the hyperfine resonance search and obtained the first resonance signal at the zero magnetic field. By utilizing three layers of magnetic shield made of permalloy, the field was suppressed less than 100 nT. Detector system including beam profile monitors and decay positron counters worked properly. In the presentation, we discuss the resonance search as well as the future prospects based on the recent progress.

[1]R. Bluhm, et al., PRL84. 1098 (2000)
[2]W. Liu. et al., PRL82 711(1999)

Primary author: UENO, Yasuhiro (University of Tokyo)

Presenter: UENO, Yasuhiro (University of Tokyo)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **131** Type: **Poster**

A strong nuclear effect in low-energy three-body protonium formation reaction

A three-body collision is considered in this work.
Specifically, we compute cross sections and rates of
the protonium formation reaction between an antiproton
and a muonic hydrogen. A more detailed abstract is enclosed.

Primary author: Dr SULTANOV, Renat (BCRL at St. Cloud State University)

Presenter: Dr SULTANOV, Renat (BCRL at St. Cloud State University)

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **132** Type: **Oral**

Testing the Standard Model in beta-decay: status and prospects

Thursday, October 20, 2016 9:00 AM (30 minutes)

Precise measurements of observables in beta decay allow testing the symmetries of the Standard Model or searching for physics beyond at the low-energy and high-intensity frontier. A non-exhaustive overview of this field will be presented based on selected state-of-the-art measurements using a variety of techniques.

With the precision of these measurements reaching the per mille level small Standard Model effects now have to be included as well. The understanding of some of these requires additional measurements be performed in order to maintain optimal sensitivity to weak interaction properties.

Finally, the prospects and future of this type of low-energy weak interaction studies in the era of the Large Hadron Collider will be briefly discussed as well.

Primary author: Prof. SEVERIJNS, Nathal (Katholieke Univ. Leuven)

Presenter: Prof. SEVERIJNS, Nathal (Katholieke Univ. Leuven)

Session Classification: Th - 1

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **133** Type: **Poster**

Search for a violation of the Pauli Exclusion Principle with electrons

Tuesday, October 18, 2016 5:53 PM (1 minute)

The Pauli Exclusion Principle (PEP) is the foundation for our understanding of physics where systems of fermions are concerned. Therefore, it is important to make precision tests of the PEP. In a pioneering experiment, Ramberg and Snow supplied an electric current to a Cu target, and searched for PEP violating atomic transitions of the "fresh" electrons from the current. The non-existence of the anomalous X-rays from such transitions then set the upper limit for a PEP violation. The VIP (VIolation of Pauli Exclusion Principle) experiment improved this method. The experiment and the results will be presented. The preliminary results of the first data taking period of the follow-up experiment VIP2 will be presented.

Primary author: Mr PICHLER, Andreas (Stefan Meyer Insitute)

Presenter: Mr PICHLER, Andreas (Stefan Meyer Insitute)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **134** Type: **Oral**

Precision measurements of fundamental properties of atomic particles

Tuesday, October 18, 2016 11:00 AM (30 minutes)

This contribution will provide an overview on recent applications of precision measurements with cooled and stored ions in Penning traps. One the one hand, precision Penning-trap mass measurements provide indispensable information for atomic, nuclear and neutrino physics as well as for testing fundamental symmetries [1,2]. On the other hand, in-trap measurements of the bound-electron g-factor in highly-charged hydrogen-like ions allow for better determination of fundamental constants and for constraining Quantum Electrodynamics [3,4,5]. Furthermore, ongoing preparations for the experimental comparison of the proton and antiproton g-factors will allow us to achieve a crucial test of the Charge-Parity-Time reversal (CPT) symmetry [6,7]. Among others a 13-fold improvement of the atomic mass of the electron by combining a very accurate measurement of the magnetic moment of a single electron bound to a carbon nucleus with a state-of-the-art calculation in the framework of bound-state Quantum Electrodynamics [4] as well as the most stringent test of CPT symmetry on the baryonic sector by a charge-to-mass ratio comparison of the proton and antiproton [8] will be presented.

Primary author: Prof. BLAUM, Klaus (Max Planck Institut für Kernphysik)

Presenter: Prof. BLAUM, Klaus (Max Planck Institut für Kernphysik)

Session Classification: Tu - 2

Track Classification: Precision measurements of fundamental constants

Contribution ID: **135** Type: **Oral**

Hadronic Weak Interaction studies at the Spallation Neutron Source

Tuesday, October 18, 2016 3:00 PM (30 minutes)

Neutrons have been a useful probe in many fields of science as well as an important physical system for study in themselves. Modern neutron sources provide extraordinary opportunities to study a wide variety of physics topics. Among them is a detailed study of the weak interaction. An overview of studies of the hadronic weak (quark-quark) interactions at the Spallation Neutron Source (SNS) is presented. These measurements, done in few-nucleon systems are finally letting us gain knowledge of the hadronic weak interaction without the contributions from nuclear effects. Two such measurements, NPDGamma and the n+3He experiment, were recently completed on the Fundamental Neutron Physics Beamline at the SNS. Experimental approaches will be described and the current state of the analysis presented.

Primary author: FOMIN, Nadia (University of Tennessee)

Presenter: FOMIN, Nadia (University of Tennessee)

Session Classification: Tu - 3

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **136** Type: **Oral**

Axions, WISPs and More

Tuesday, October 18, 2016 2:30 PM (30 minutes)

In this talk we discuss the current status of searches for very light and very weakly coupled particles. A particular focus will be on the possibility that they are the cold dark matter of the Universe.

Primary author: JAECKEL, Joerg (ITP Heidelberg)

Presenter: JAECKEL, Joerg (ITP Heidelberg)

Session Classification: Tu - 3

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **137** Type: **Oral**

Two-Crystal Focusing Effect of diffracted neutron

Wednesday, October 19, 2016 5:50 PM (20 minutes)

The effect of two-crystal focusing of neutrons at Laue diffraction from large perfect silicon crystals has been studied. This experiment was done at the framework of the project to test the neutron electroneutrality by new technique using the combination of spin-interferometry method SESANS (Spin Echo Small Angle Neutron Scattering) with the Laue diffraction in perfect crystal.
It has been shown that the focusing effect makes it possible to reach an angular resolution better than 0.03″, which is about 0.01 of the width of a Bragg reflection. The numerical estimates obtained for such a resolution show that the statistical sensitivity to the neutron electric charge could be σ(en) ⊠ 1.5 × 10−21·e for the evaluable experimental equipment and neutron beam fluxes. A further improvement of the sensitivity by approximately two orders of magnitude is possible because the own spatial resolution of such a scheme of the experiment can be much higher than the measured value but the more detailed experimental studies at the high flux cold neutron beam are necessary.

Primary author: Dr VORONIN, Vladimir (Petersburg Nuclear Physics Institute)

Presenter: Dr VORONIN, Vladimir (Petersburg Nuclear Physics Institute)

Session Classification: We - 4

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **138** Type: **Oral**

Crystal acceleration effect for cold neutrons in vicinity of Bragg resonance

Wednesday, October 19, 2016 6:10 PM (20 minutes)

A new mechanism of neutron acceleration in the accelerated perfect crystal is proposed and found experimentally. The effect arises due to the resonance energy dependence of neutron refraction index in a perfect crystal for neutron energies, close to the Bragg ones. As a result during the neutron time-of-flight through the crystal the value of deviation from the exact Bragg condition changes and so the refraction index and the velocity of outgoing neutron changes as well.

Primary author: Prof. FEDORV, Valery (PNPI NRC KI)

Presenter: Prof. FEDORV, Valery (PNPI NRC KI)

Session Classification: We - 4

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **139** Type: **Oral**

Lepton flavour violation in RS models with a brane- or nearly brane-localized Higgs

Tuesday, October 18, 2016 12:00 PM (20 minutes)

We perform a comprehensive study of charged lepton flavour violation in Randall-Sundrum (RS) models in a fully 5D quantum-field-theoretical framework. We consider the RS model with minimal field content and a "custodially protected" extension as well as three implementations of the IR-brane localized Higgs field, including the non-decoupling effect of the KK excitations of a narrow bulk Higgs. Our calculation provides the first complete result for the flavour-violating electromagnetic dipole operator in Randall-Sundrum models.
It contains three contributions with different dependence on the magnitude of the anarchic 5D Yukawa matrix, which can all be important in certain parameter regions. We study the typical range for the branching fractions of $\mu \to e\gamma$, $\mu \to 3e$, $\mu N \to eN$ as well as $\tau \to \mu\gamma$, $\tau \to 3\mu$ and the electron electric dipole moment by a numerical scan in both the minimal and the custodial RS model. The combination of $\mu \to e\gamma$ and $\mu N \to eN$ currently provides the most stringent constraint on the parameter space of the model. A typical lower limit on the KK scale T is around $2\,\mathrm{TeV}$ in the minimal model (up to 4~TeV in the bulk Higgs case with large Yukawa couplings), and around $4\,\mathrm{TeV}$ in the custodially protected model, which corresponds to a mass of about 10~TeV for the first KK excitations, far beyond the lower limit from the non-observation of direct production at the LHC.

Primary authors: Dr ROHRWILD, Jürgen (Rudolf Peierls Centre for Theoretical Physics, University of Oxford); Prof. BENEKE, Martin (Physik-Department T31 Technische Universität München); Dr MOCH, Paul (Universität Siegen)

Presenter: Dr MOCH, Paul (Universität Siegen)

Session Classification: Tu - 2

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **140** Type: **Oral**

Relaxation and Frequency shifts; a comparison between simulations and theory for the SNS nEDM experiment.

Monday, October 17, 2016 12:20 PM (20 minutes)

The behavior of a spin undergoing Larmor precession in the presence of fluctuating fields is of interest to a variety of precision measurement experiments. The fluctuating fields cause frequency shifts and relaxation which according to Redfield theory are related to their power spectrum. Recently it was shown that scattering with energy exchange from an ensemble of scatterers in thermal equilibrium can be incorporated into the continuous time random walk to more accurately predict the behavior of dilute gases. It was found that the results in the 'thermalization' model for 1,2 and 3 dimensions are in perfect agreement contrary to the previously studied 'frozen' models. The results are compared to simulations of the SNS nEDM conditions where in the ballistic regime a strong deviation from Redfield theory is observed for mostly specular wall collisions. The Torrey equation can be solved exactly for purely specular case and the solution can be modified according to the average time between wall collisions of trajectories to allow for diffuse wall collisions. This allows accurate analytic predictions of the Monte Carlo simulations, and presumably the SNS nEDM experiment.

Primary author: Dr SWANK, Christopher (Caltech)

Presenter: Dr SWANK, Christopher (Caltech)

Session Classification: Mo - 2

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **141** Type: **Oral**

Measurements of Neutron and Nuclear Beta Decay Using Highly-Segmented Silicon Detectors In a Magnetic Spectrometer

Thursday, October 20, 2016 12:20 PM (20 minutes)

High precision measurements of the beta spectrum from neutron and nuclear decay are a sensitive probe for beyond standard model physics. In particular, exotic scalar and tensor couplings can produce Fierz terms which introduce a characteristic distortion to the standard model spectrum, inversely proportional to the beta energy. Employing silicon detectors, with understood charge collection and linearity, allows for precision measurements at low energies to probe the most sensitive regions of the decay spectra. As a part of the Nab experiment at the Spallation Neutron Source in Oak Ridge and an R\&D program for the UCNB experiment at the Los Alamos Neutron Science Center, we have developed a magnetic beta spectrometer system which features 4π collection of the emitted betas from our fiducial volume, and reconstruction of the beta decay spectra using highly segmented silicon detectors. Our Si detectors are uniquely tailored to beta decay measurements, being 1.5 to 2 mm thick, having an active diameter of roughly 11.5 cm read out in 127 separate pixels, with $\sim$3 keV FWHM energy resolution and thresholds below 10 keV. We present an overview of recent measurements in neutron and nuclear decay, including measurements of ^{45}Ca decay made in collaboration with the Weak Interactions group at KU Leuven University, and focus on some of the expected sources of systematic uncertainty for high precision measurements planned or underway. In particular, by simulating the expected measured signal, we can get a handle on the transport effects as well as the systematics associated with the energy deposition and charge collection effects in our detectors. This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, the National Science Foundation, the Los Alamos National Laboratory LDRD program, and the Office of Workforce Development for Teachers and Scientists.

Primary author: Dr WEXLER FOR THE NAB & UCNB COLLABORATIONS, Jonathan (North Carolina State University)

Presenter: Dr WEXLER FOR THE NAB & UCNB COLLABORATIONS, Jonathan (North Carolina State University)

Session Classification: Th - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **142** Type: **Poster**

Novel measurement of tau-neutrino production by DsTau at the CERN SPS

Tuesday, October 18, 2016 6:17 PM (1 minute)

The tau-neutrino CC cross section has never been well measured. There has only been one measurement, by the DONuT experiment, with a systematic uncertainty larger than 50%, mainly due to uncertainties in the Ds differential production cross section in high energy proton interaction. The DsTau collaboration proposes to study tau-neutrino production and the energy distribution by analyzing Ds -> tau events in 400 GeV proton interactions. By employing state-of-the-art emulsion particle detector technologies, we will analyze 10^8 proton interactions and detect the double kink topology of Ds -> tau -> X decays. Using this new measurement, we will re-evaluate the tau-neutrino cross section with the data from DONuT and test lepton universality in neutrino CC interactions. Furthermore, it will provide useful data for future tau-neutrino experiments. In this talk, we report an overview of the experiment and the planned prototype test in 2016.

Primary authors: Dr ARIGA, Akitaka (University of Bern); Dr ARIGA, Tomoko (University of Bern)

Co-authors: Prof. KODAMA, Koichi (Aichi University of Education); Prof. NAKAMURA, Mitsuhiro (Nagoya University); Prof. SATO, Osamu (Nagoya University); Prof. AOKI, Shigeki (Kobe University)

Presenter: Dr ARIGA, Tomoko (University of Bern)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **143** Type: **Poster**

Searches for Lepton number violation and resonances in the K+- −>pi mu mu decays at the NA48/2 experiment

Tuesday, October 18, 2016 6:18 PM (1 minute)

The NA48/2 experiment at CERN collected in 2003-2004 a large sample of charged kaon decays with multiple charged particles in the final state.
A new upper limit on the rate of the lepton number violating decay K+- −> pi-+ mu+- mu+- obtained from this sample is reported.
Searches for two-body resonances in the K+- −>pi mu mu decays (including heavy neutral leptons and inflatons) in the accessible
range of masses and lifetimes are presented.

Primary author: LAZZERONI, Cristina (University of Birmingham, UK)

Presenters: LAZZERONI, Cristina (University of Birmingham, UK); Dr FANTECHI, Riccardo (CERN EP and INFN Pisa)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **144** Type: **Poster**

Neutral pion form factor measurement by the NA62 experiment

Tuesday, October 18, 2016 6:16 PM (1 minute)

The NA62 experiment at CERN collected a large sample of charged kaon decays with a highly efficient trigger for decays into electrons in 2007. The kaon beam represents a source of tagged neutral pion decays in vacuum. A measurement of the electromagnetic transition form factor slope of the neutral pion in the time-like region from ~1 million fully reconstructed pi0 Dalitz decay is presented. The limits on dark photon production in pi0 decays from the earlier kaon experiment at CERN, NA48/2, are also reported.

Primary author: LAZZERONI, Cristina (University of Birmingham, UK)

Presenter: LAZZERONI, Cristina (University of Birmingham, UK)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **145** Type: **Oral**

Search for K+ to pi+ nu nu at NA62

Tuesday, October 18, 2016 5:00 PM (20 minutes)

K+->pi+nunu is one of the theoretically cleanest meson decay where to look for indirect effects of new physics complementary to LHC searches. The NA62 experiment at CERN SPS is designed to measure the branching ratio of this decay with 10% precision. NA62 took data in pilot runs in 2014 and 2015 reaching the final designed beam intensity. The quality of data acquired in view of the final measurement will be presented.

Primary authors: LAZZERONI, Cristina (University of Birmingham, UK); Dr FANTECHI, Riccardo (CERN EP and INFN Pisa)

Presenter: FANTECHI, R.

Session Classification: Tu - 4

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **146** Type: **Poster**

Measuring the Leptonic Dirac CP Phase with Muon Decay at Rest

Tuesday, October 18, 2016 6:14 PM (1 minute)

With the 1-3 mixing angle measured at reator neutrino experiments Daya Bay and RENO, there are still three unknown oscillation variables: the neutrino mass hierarchy, the octant of the atmospheric mixing angle, and the leptonic CP phase. Of these three, the CP phase is the most difficult to be measured precisely and important for distinguishing flavor symmetries. I will first review the status of CP measurement and then introduce a new proposal with muon decay at rest (muDAR). Currently, accelerator neutrino experiments such as T2K, NOvA, and DUNE are the most promising for CP measurement. Nevertheless, they suffer
from several problems of degeneracy, efficiency, sensitivity, and theoretical armbiguities such as non-unitarity mixing (NUM) and
non-standard interaction (NSI). The situation can be improved by adding a muon decay at rest (muDAR) source. With T2(H)K running in neutrino mode and muDAR in anti-neutrino mode, both using the same detector, the CP measurement becomes more precise can break the degeneracy between \delta and 180^o - \delta. Most importantly, muDAR can guarantee the CP sensitivity against NUM and NSI. The same configuration can also apply to next-generation medium baseline reactor neutrino experiments like JUNO and RENO-50, enhancing their physics potential from just mass hierarchy to also CP. With only one source and no extra detectors, this dessign is much better than DAEdLAS which requires 3 sources, but only 20% duty factor and 4 times higher luminosity for each.

Primary author: Dr GE, Shao-Feng (Max-Planck-Institut fuer Kernphysik, Germany)

Presenter: Dr GE, Shao-Feng (Max-Planck-Institut fuer Kernphysik, Germany)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **147** Type: **Poster**

A tracking detector for the P2 experiment

Tuesday, October 18, 2016 6:31 PM (1 minute)

The P2 experiment at the new electron accelerator MESA in Mainz aims for a determination of the weak mixing angle at low momentum transfer with unprecedented precision. To this end, the parity violating asymmetry in electron proton scattering is studied with integrating Cherenkov detectors at very high rates of scattered electrons. In order to determine the average momentum transfer and precisely study systematics effects which could lead to false asymmetries, a tracking detector is required. We propose to build such a detector from high-voltage monolithic active pixel sensors (HV-MAPS), which are well suited to deal with the enormous rates of scattered electrons and photons and put a minimum amount of material into the beam path. The poster discusses the challenges of the measurements and the proposed detector and reconstruction solutions.

Primary author: Prof. BERGER, Niklaus (Mainz University, Nuclear Physics)

Presenter: Prof. BERGER, Niklaus (Mainz University, Nuclear Physics)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **148** Type: **Oral**

The Mu3e experiment

Thursday, October 20, 2016 3:50 PM (20 minutes)

The Mu3e experiment at PSI searches for the lepton flavour violating decay of the positive muon to two positrons and an electron, aiming for a sensitivity of 1 in 10^16 muon decays. This requires a novel detector concept based on ultra thin high-voltage monolithic active pixel sensors (HV-MAPS) complemented by scintillating fibres and tiles for precise timing measurements. The poster will discuss the status of the first phase of the experiment, which aims at a sensitivity of 1 in 10^15 muon decays using an existing surface muon beam line at PSI.

Primary author: Dr BERGER, Niklaus (Mainz University, Nuclear Physics)

Presenter: Dr BERGER, Niklaus (Mainz University, Nuclear Physics)

Session Classification: Th - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **149** Type: **Oral**

New results from NOvA

Tuesday, October 18, 2016 4:40 PM (20 minutes)

NOvA is a long-baseline neutrino oscillation experiment at Fermilab. It uses two functionally-identical detectors at a distance of 810 km to measure electron-neutrino appearance and muon-neutrino disappearance in the NuMI muon
neutrino beam.
These measurements address the remaining unknowns in neutrino oscillations: the mass hierarchy, the 23 octant and possibly the CP violation in the leptonic sector.
I will present the current status of the NOvA experiment and new results after two years of data taking equivalent to 6.05 × 10^20 POT for a full 14 kton detector exposure.

Primary author: Dr BRUNETTI, Giulia (Fermilab)

Presenter: Dr BRUNETTI, Giulia (Fermilab)

Session Classification: Tu - 4

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **150** Type: **Poster**

A Potassium magnetometry based current source for the nEDM experiment at PSI

Tuesday, October 18, 2016 5:41 PM (1 minute)

A permanent electric dipole moment of the neutron (nEDM) would be a source of CP violation and could shed some light on beyond standard model physics (BSM). Such BSM models predict an nEDM in the range 10-27 – 10-29 e cm while the standard model prediction is much lower (around 10-31 e cm). The search for an nEDM and the setting of new limits on its value is done with the Ramsey method of time separated oscillatory fields.
This method requires a very well known magnetic field during the measurement cycles. This is typically done via magnetometers in the experimental volume which monitor the stability and the evolution of the magnetic field. The main field B0 is produced by a dedicated current source. Thus the stability of B0 is fundamentally limited by the stability of the current source.
In the spirit of continual improvement of the experiment, we plan to build a new ultra-stable current source for our experiment. The idea is to use a commercial very low noise current source and to stabilize its output via a feedback loop. This feedback loop will be installed outside of the nEDM experimental volume. A dedicated coil will be placed in series to the main coil (producing B0). There Potassium magnetometers will monitor drifts in current through drifts in the magnetic field. The feedback loop will correct for such drifts thus stabilizing the output current.

Primary author: Mr KOSS, Peter (KU Leuven)

Presenter: Mr KOSS, Peter (KU Leuven)

Session Classification: Poster Session

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **151** Type: **Oral**

Progress toward a new beam measurement of the neutron lifetime

Tuesday, October 18, 2016 9:30 AM (20 minutes)

Neutron beta decay is the simplest example of nuclear beta decay. A precise value of the neutron lifetime is important for consistency tests of the Standard Model and Big Bang nucleosysnthesis models. There is currently a disagreement between measurements of the neutron lifetime made using the cold neutron beam method and ultracold neutron storage methods. A new measurement of the neutron lifetime using the beam method will be performed at the National Institute of Standards and Technology Center for Neutron Research. The projected uncertainty of this new measurement is 1 s. An overview of the measurement and the technical improvements will be discussed.

Primary author: Dr DEWEY, Maynard (NIST)

Presenter: Dr DEWEY, Maynard (NIST)

Session Classification: Tu - 1

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **152** Type: **Oral**

NLO prediction for μ → evνγ and μ → eeevν decays in the SM

Wednesday, October 19, 2016 12:40 PM (20 minutes)

We present the differential decay rates and the branching ratios of the μ → evνγ and μ → eeevν decays in the SM at next-to-leading order. These two rare decay modes of the muon are among the source of background in the experiments searching for charge lepton flavour violating (CLFV) decays μ → eγ and μ → eee. Indeed, the SM decays are indistinguishable from the CLFV ones except for the energy carried away by neutrinos. I will discuss the importance of radiative corrections for CLFV searches.

Primary author: Dr FAEL, Matteo (Bern Universität)

Co-authors: Prof. GREUB, Christoph (Universität Bern); Dr PASSERA, Massimo (INFN - Padova (Italy))

Presenter: Dr FAEL, Matteo (Bern Universität)

Session Classification: We - 2

Contribution ID: **153** Type: **Poster**

Detector characterization and background studies for β-decay experiments

Tuesday, October 18, 2016 5:42 PM (1 minute)

Neutron β-decay experiments provide access to important parameters of the Standard Model and are also sensitive to new physics Beyond the Standard Model. Modern neutron decay experiments aim to measure decay correlation parameters with a high sensitivity and therefore require very precise particle detection in either energy, time-of-flight, or both. The Nab experiment, which is under construction at the SNS at the Oak Ridge National Laboratory, will measure the a" andb" decay correlations by detecting 30 keV protons and up to 750 keV electrons, with a resolution of 3 keV. This will be achieved by using thick, large-area, and highly segmented (127 pixels) silicon detectors with a 100 nm thick dead layer. To reduce noise in the detector and the front end electronics, the detectors must be actively cooled. A prototype cooling system will be presented along with results from performance tests. Characterization of a small scale detector and electronics has been conducted at the Los Alamos National Laboratory on the UCNB experiment and a measurement of the ^{45}Ca β spectrum. Ongoing analysis and background studies from recent running will also be presented.

Primary author: Mr BIRGE, Noah (University of Tennessee, Knoxville)

Presenter: Mr BIRGE, Noah (University of Tennessee, Knoxville)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **154** Type: **Poster**

Tracking for the Mu3e experiment

Tuesday, October 18, 2016 5:45 PM (1 minute)

The Mu3e experiment is designed to search for the lepton flavour violating decay $\mu^+ \to e^+e^-e^+$.$The first phase of the expe$
$Scherrer Institute providing10^8muons per second, allowing to reach the sensitivity of$ 10^{-15}$.
The muons are stopped and decay at rest on a target that is placed inside two double layers of \SI{50}{\micro\m} thin pixel sensors. Timing information is provided by three layers of scintillating fibres, placed just before the outer double layers, and a scintillating tile detector. The detector geometry allows to record additional hits when particles bend back in the magnetic field which allows to improve momentum resolution. To cope with the high event rate and occupancy it is necessary to have a fast and efficient track reconstruction. The track reconstruction uses a novel fit algorithm that only takes into account the multiple scattering allowing fast online reconstruction on a graphics processor (GPU) based filter farm. The details of the multiple scattering fit and the algorithms for online and offline reconstruction are discussed. The performance of the tracking and time reconstruction, using the fibre and tile detectors, is presented.

Primary author: Dr KOZLINSKIY, Alexandr (Mainz University KPH)

Co-authors: Prof. SCHOENING, Andre (University Heidelberg, Institute of Physiscs); VOM BRUCH, Dorothea (Institut fuer Kernphysik, Universitaet Mainz); Mr KIEHN, Moritz (Universität Heidelberg); Prof. BERGER, Niklaus (Mainz University, Insititute for Nuclear Physics)

Presenter: Dr KOZLINSKIY, Alexandr (Mainz University KPH)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **155** Type: **Oral**

Status of the TREK/E36 Experiment at J-PARC

Tuesday, October 18, 2016 5:20 PM (20 minutes)

A precision test of lepton universality in the leptonic decay ratio for positive kaons $R_K = K_{e2}/K_{\mu 2}$ has been carried out with stopped kaons at J-Parc by the TREK Collaboration (Experiment E36). The Standard Model (SM) prediction for R_K is very precise with an uncertainty of $\Delta R_K/R_K$ = 4 x 10^{-4}. An observed deviation from this would be an indication of New Physics beyond the SM. Simultaneously, E36 looked for possible light U(1) gauge bosons and sterile neutrinos below 300 MeV/c^2, which could be associated with dark matter or explain established muon-related anomalies such as the muon $g-2$ and the proton radius puzzle. The TREK-E36 detector was installed in 2014, at the J-PARC K1.1BR kaon beamline. It consists of a toroidal spectrometer, that affords high resolution tracking, in concert with a kaon stopping target, a multi-element CsI(TI) photon detector, and particle ID detector array. Commissioning was carried out in 2015 and production data taking was completed by the end of 2015. The offline analysis is now in progress. The status and recent progress of the experiment will be presented.

Primary author: Prof. DJALALI, Chaden (University of Iowa)

Co-author: E36, J-Parc ((for the TREK Collaboration)

Presenters: Prof. DJALALI, Chaden (University of Iowa); Prof. HASINOFF, Michael (Univ of British Columbia)

Session Classification: Tu - 4

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **156** Type: **Oral**

Fundamental physics with precision magnetometers

Thursday, October 20, 2016 9:30 AM (30 minutes)

Symmetries and conservation laws determine the interactions between particles and the structures in which matter organizes itself. Some of the most fundamental symmetries in physics are the space-time symmetries of Lorentz transformations - where the laws of physics are unchanged under boosts and rotations - and CPT - the combination of charge conjugation (C), parity inversion (P) and time reversal (T). Precision measurements using "atomic clocks" have flourished in recent years as attempts to find cracks in the well established Standard Model of particle physics by searching for tiny violations of empirical symmetry laws. Polarized 3He and 129Xe are ideally suited for pushing the limits of sensitivity due to the extraordinarily long phase-coherence time of their precessing spins of about 100h. A resulting spin clock would be about 6 orders of magnitude more sensitive than modern Cs-fountain clocks and could access frequency shifts in the pHz range. This sensitivity gain will open a new area for precision experiments where the observables are tiny changes in the clock transition filtered out by the symmetry properties of the relevant interaction potential.

The talk discusses the benefits of long spin coherence times in searching for fundamental symmetries in nature and some practical applications in ultra-sensitive magnetometry.

Primary author: Prof. HEIL, Werner (Institute of Physics)

Presenter: Prof. HEIL, Werner (Institute of Physics)

Session Classification: Th - 1

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **157** Type: **Poster**

Measurement of the weak magnetism form factor in 6He decay

Tuesday, October 18, 2016 5:46 PM (1 minute)

The Fierz interference term constitutes a very sensitive probe to searches for exotic scalar and tensor couplings in beta decay. It can directly be determined through measurements of the beta spectrum shape. To this end, the 6He decay happens to have a similar kinematic sensitivity than neutron decay despite its end-point is 4.5 larger; the electromagnetic and radiative corrections can be calculated accurately and, since the 6He ground state is member of an isospin triplet, hadronic contributions to the weak currents can be calculated using CVC. In this contribution we describe an experiment, performed at the National Superconducting Cyclotron Laboratory, that measures the shape of the beta energy spectrum in 6He decay. The technique is based on the implantation of the nuclei of interest in suitable detectors, eliminating thereby the major systematic ect in such measurements related to the back-scattering of beta particles in surrounding matter and detectors. The first goal is to measure the weak magnetism form factor, which has never been measured in 6He decay, and which will provide a sensitivity test of the technique. The status of the data analysis will be presented.

Primary author: Ms HUYAN, XUEYING (National Superconducting Cyclotron Laboratory/Michigan State University)

Co-authors: Prof. GADE, ALEXANDRA (National Superconducting Cyclotron Laboratory/Michigan State University); Prof. SIMON, ANNA (University of Notre Dame); Dr BAZIN, DANIEL (National Superconducting Cyclotron Laboratory); Dr WEISSHAAR, DIRK (National Superconducting Cyclotron Laboratory); Dr MINAMISONO, Kei (National Superconducting Cyclotron Laboratory); Mr HUGHES, MAXIMILIAN (National Superconducting Cyclotron Laboratory/Michigan State University); Prof. NAVILIAT-CUNCIC, OSCAR (National Superconducting Cyclotron Laboratory/Michigan State University); Prof. VOYTAS, PAUL (Wittenberg University); Prof. LIDDICK, SEAN (National Superconducting Cyclotron Laboratory/Michigan State University); Dr NOJI, SHUMPEI (National Superconducting Cyclotron Laboratory); Dr PAULAUSKAS, STANLEY (University of Tennessee)

Presenter: Ms HUYAN, XUEYING (National Superconducting Cyclotron Laboratory/Michigan State University)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **158** Type: **Poster**

Neutral currents in muonic atoms

Tuesday, October 18, 2016 6:38 PM (1 minute)

Searching for neutral current effects in muonic atoms is an old idea. A muon around a nucleus in the 2S state gets a small parity violating
admixture from the 2P state, which then allows E1-M1 interference in the 2S-1S transition. For nuclei around Z=40, the experimental challenge is to deal with the intense background from nP-1S transitions and electrons from Michel decays. We investigate the feasibility of a parity violation experiment, utilizing large solid-angle segmented germanium detectors to get the background from the atomic cascade under control.

Primary author: Dr WAUTERS, Frederik (Johannes Gutenberg-Universität Mainz)

Presenter: Dr WAUTERS, Frederik (Johannes Gutenberg-Universität Mainz)

Session Classification: Poster Session

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **159** Type: **Oral**

Search for new gravity-like interactions and test of the equivalence principle using slow neutrons

Thursday, October 20, 2016 12:00 PM (20 minutes)

We report updates of experimental constraints on new gravity-like interactions by measuring the angular distribution of cold neutrons scattering off atomic xenon gas. The results improved previous upper limit on Yukawa-type parametrization space in the 4 to 0.04 nm range by a factor of up to 10[1]. We also discuss about our plans of a test of the weak equivalence principle and a new force search in the micron range, using a neutron quantum bouncing system[2].
[1] Y. Kamiya, K. Itagaki, M. Tani, G. N. Kim, and S. Komamiya, PRL 114, 161101 (2015)
[2] G. Ishikawa, S. Komamiya, Y. Kamiya et al., PRL 112, 071101 (2014)

Primary author: Dr KAMIYA, Yoshio (International Center for Elementary Particle Physics, The University of Tokyo)

Presenter: Dr KAMIYA, Yoshio (International Center for Elementary Particle Physics, The University of Tokyo)

Session Classification: Th - 2

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **160** Type: **Oral**

Electric Dipole Moments: A Look Beyond the Standard Model

Monday, October 17, 2016 11:30 AM (30 minutes)

Searches for the permanent electric dipole moments of atoms, nucleons, and nuclei provide one of the most powerful probes of CP-violation beyond the Standard Model. I survey the opportunities for discovering BSM CP-violation with the present and next generation EDM searches; discuss the complementary of searches using different systems; and highlight the implications of these searches for explaining the origin of the cosmic matter-antimatter asymmetry.

Primary author: Prof. RAMSEY-MUSOLF, Michael (U. Massachusetts Amherst)

Presenter: Prof. RAMSEY-MUSOLF, Michael (U. Massachusetts Amherst)

Session Classification: Mo - 2

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **161** Type: **Poster**

Radiative Decay Counter for Ultimate Sensitivity of MEG II Experiment

Tuesday, October 18, 2016 6:29 PM (1 minute)

abstract is attached

Primary author: Mr IWAI, Ryoto (University of Tokyo)

Presenter: Mr IWAI, Ryoto (University of Tokyo)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **162** Type: **Oral**

The muon g-2: status from a theorist's point of view

Wednesday, October 19, 2016 11:00 AM (30 minutes)

I will present recent developments in the Standard Model prediction of the muon g-2 and the long-standing discrepancy with its measured value

Primary author: Prof. PASSERA, Massimo (INFN)

Presenter: Prof. PASSERA, Massimo (INFN)

Session Classification: We - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **163** Type: **Oral**

Spectroscopy of exotic atoms

Monday, October 17, 2016 9:30 AM (30 minutes)

In this talk an overview of some recent spectroscopy measurements and planned activities in the field of exotic atoms will be presented. Exotic bound states such as muonic and pionic atoms, muonium, positronium and antiprotonic helium are systems which offer the
possibility to test bound-state QED, to perform test of fundamental symmetries, to extract fundamental constants such as masses and coupling constants, to determine nuclear parameters such as charge radii and quadrupole moments, and other parameters related with the strong and the weak interactions. This talk will be devoted to
laser spectroscopy of muonic atoms and the related proton radius puzzle, but it will also cover some aspects of other exotic atoms to show the richness and the liveliness of this field.

Primary author: Dr ANTOGNINI, Aldo (Paul Scherrer Institute and ETHZ, Switzerland)

Presenter: Dr ANTOGNINI, Aldo (Paul Scherrer Institute and ETHZ, Switzerland)

Session Classification: Mo - 1

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **164** Type: **Oral**

Time-Reversal Invariance Violation in Nuclei

Monday, October 17, 2016 5:10 PM (20 minutes)

Time Reversal Invariance Violating (TRIV) effects in neutron transmission through a nuclei target are discussed. We explore the possibility to search TRI violation using two important advantages of neutron nuclei interactions: the possibility of the enhancement of TRIV observables by many orders of magnitude, and the relatively large number of the nuclear targets, which provides the assurance of avoiding possible "accidental" cancelations of TRIV effects due to unknown structural factors related to the strong interactions. The absence of final state interactions for the set of specific observables makes these neutron experiments complementary to electric dipole moment (EDM) measurements. The comparison of expected results in neutron scattering at new high flux Spallation Neutron Sources with the existing limits on neutron, nuclear and atomic electric dipole moments (EDMs) shows that TRIV observables in neutron scattering can essentially improve the current limits on the TRIV interactions.

Primary author: Prof. GUDKOV, Vladimir (University of South Carolina)

Presenter: Prof. GUDKOV, Vladimir (University of South Carolina)

Session Classification: Mo - 4

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **165** Type: **Poster**

CALIPSO : a moderated positron calibration source for proton spectroscopy

Tuesday, October 18, 2016 6:28 PM (1 minute)

Proton spectroscopy in neutron beta decay gives a complementary access to λ (ratio of the weak coupling constants g_A⁄g_V) and enables new searches for physics beyond the Standard Model. In experiment, low-energy protons (E_k≤751.4 eV) are usually guided and selected using electromagnetic fields. Precise knowledge of the electrostatic potentials is mandatory as it can drastically bias proton selection. For instance, electrostatic potentials have to be known with an accuracy of a few mV in aSPECT and in PERC to reach the aspired precision. Furthermore, as experimental conditions can directly impact the field (temperature effect on electrode position and work function, surface condition, charging traps…), it is mandatory that the electrostatic measurements are performed in-situ.
For such applications we are developing CALIPSO, a source of moderated positrons. Positron moderation in a suitable material with negative positron work function produces a beam of positively charged particles with a very low energy spread (~30 meV) and a well-defined emission angle. Simulations were performed and showed that such a source is sensitive enough to compare two potentials down to ~10 mV. Our goal is to build a source of moderated positrons that fulfills all the requirements of proton spectroscopy experiments, such as compatibilities with UHV and high magnetic fields.
I will present the concept, experimental setup and simulations of the CALIPSO source.

Primary author: Mr VIROT, Romain (Institut Laue-Langevin)

Co-author: SOLDNER, Torsten (Institut Laue Langevin)

Presenter: Mr VIROT, Romain (Institut Laue-Langevin)

Session Classification: Poster Session

Contribution ID: **166** Type: **Oral**

A novel neutron EDM search using a pulsed beam

Monday, October 17, 2016 6:00 PM (15 minutes)

The search for a finite CP-violating neutron electric dipole moment (nEDM) is motivated in order to understand the observed large matter-antimatter asymmetry in our universe. It has become a worldwide endeavour which is followed by various research teams setting up experiments for improved measurements. Recently, a novel concept to measure a nEDM has been brought forward [Phys. Rev. C 88, 045502 (2013)]. It foresees to employ a pulsed neutron beam instead of the well-established use of storable ultracold neutrons (UCN). The technique takes advantage of the high peak-intensity and the intrinsic time structure of next-generation pulsed spallation sources to directly measure the previously limiting relativistic effect. Such an experiment, e.g. set up at the planned European Spallation Source in Sweden, would be complementary to planned experiments with UCN and could compete with their sensitivities. In this presentation, I will describe this alternative approach and first preliminary experiments performed at the spallation neutron source SINQ at the Paul Scherrer Institute in Switzerland.

Primary author: Dr PIEGSA, Florian (ETH Zürich)

Presenter: Dr PIEGSA, Florian (ETH Zürich)

Session Classification: Mo - 4

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **167** Type: **Oral**

Positronium and Muonium 1S-2S Laser Spectroscopy

Monday, October 17, 2016 3:50 PM (20 minutes)

We report the status of our experiments aiming to improve the determination of the 1S-2S transition frequency of positronium and muonium atoms.

Primary author: Dr CRIVELLI, Paolo (ETH Zurich, Institute for Particle Physics)

Presenter: Dr CRIVELLI, Paolo (ETH Zurich, Institute for Particle Physics)

Session Classification: Mo - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **168** Type: **Oral**

Searching for ultralight dark matter with atomic spectroscopy and magnetic resonance

Thursday, October 20, 2016 11:00 AM (30 minutes)

Axions, axion-like particles (ALPs), dilatons, and other ultralight (masses from 10-4 down to 10-23 eV) particles have been discussed as possible candidates for dark matter. An interesting feature of these ideas is that they lead to predictions of potentially observable transient and oscillating effects. I will describe how we are looking for these as well as the relation of such experiments to tests of fundamental
symmetries (P, CP, T, CPT …). For up-to-date information on our various experiments in this area (CASPEr, GNOME, differential atomic-dysprosium clock, etc.), please refer to the web pages [1,2].

[1] https://budker.uni-mainz.de/
[2] http://budker.berkeley.edu/

Primary author: Prof. BUDKER, DMITRY (Helmholtz Institute Mainz)

Presenter: Prof. BUDKER, DMITRY (Helmholtz Institute Mainz)

Session Classification: Th - 2

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **169** Type: **Oral**

Entering the Precision Era: Antihydrogen Symmetry Tests with ALPHA

Wednesday, October 19, 2016 9:30 AM (20 minutes)

The ALPHA experiment at CERN aims to address some of the most fundamental issues in modern physics using trapped antihydrogen atoms. Following our successful trapping on antihydrogen [1,2], ALPHA has been performing measurements on the properties of antihydrogen atoms, including a proof of principle of a hyperfine splitting measurement [3], and a search for an anomalous very weak force [4]. Recently, we reported a new limit on antihydrogen charge neutrality [5,6] at the 10^-9 level, which in turn provides a limit on electron-to-positon charge ratio at the similar precision, improving the Particle Data Group limit by a factor of 40. Thus, antihydrogen measurements are entering a precision era. Currently, we are aiming at performing the first laser spectroscopy measurement on antihydrogen, and at the same time, constructing a new device ALPHA-g for a measurement of the gravitational force on antihydrogen to test Einstein's Equivalence Principle. In this talk, I will give the current status and the future prospects on fundamental studies with ALPHA.

References:
[1] G.B. Andresen et al., Nature 468, 673 (2010).
[2] G.B. Andresen at al., Nature Physics 7, 558 (2011).
[3] C. Amole et al., Nature 483, 439 (2012).
[4] C. Amole et al., Nature Comm. 4, 1785 (2013).
[5] C. Amole et al., Nature Comm. 5, 3955 (2014).
[6] M. Ahmadi et al., Nature 529, 373 (2016).

Primary author: Dr FUJIWARA, Makoto (TRIUMF)

Presenter: Dr FUJIWARA, Makoto (TRIUMF)

Session Classification: We - 1

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **170** Type: **Oral**

Gauge flavor symmetry, flavor structure and flavor violation

Tuesday, October 18, 2016 9:00 AM (30 minutes)

I discuss the gauge flavor symmetry (SU(3) and its modifications) between three fermion families. The mass hierarchy between families and
the pattern of mixing angles is determined by the breaking pattern of this symmetry which can also lead to predictive schemes. I shall discuss the properties of flavor gauge bosons which should generically induce flavor-nondiagonal couplings, the questions what types of flavor-violating processes they can mediate and how light they can be and whether they can be directly discovered at the LHC.

Primary author: Prof. BEREZHIANI, Zurab (Univ. L'Aquila and Gran Sasso National Laboratories)

Presenter: Prof. BEREZHIANI, Zurab (Univ. L'Aquila and Gran Sasso National Laboratories)

Session Classification: Tu - 1

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **171** Type: **Poster**

Development of an optical dipole force trap system towards search for an electron EDM using laser-cooled francium

Tuesday, October 18, 2016 6:04 PM (1 minute)

The electron permanent electric dipole moment (EDM) which violates time reversal symmetry is a sensitive tool for exploring the new physics beyond the Standard Model. In order to measure the value precisely, francium atom which has a large enhancement factor of about 900 for the electron EDM is a good candidate. To measure the electron EDM, it is important to have large interaction time between atoms and the applied electric field and it is also necessary to suppress spatial nonuniformity of electric and magnetic fields. The technique of cooling and trapping neutral atoms by laser lights is one of the best methods to achieve them. Therefore, we are planning an experiment to search for the electron EDM with francium atoms trapped in red-detuned optical dipole force trap (ODT).
We have already succeeded in optical dipole force trapping of rubidium atoms which have similar chemical properties to that of francium. However, the loading efficiency from magneto-optical trap (MOT) to ODT was only about 0.01 %. The temperature of the atomic cloud in MOT measured by time of flight method was about millikelvin. To overcome this issue, we plan to use polarization gradient cooling method to lower the temperature and employ a high-power fiber laser of 50 W for ODT. In this poster, we present the results of optimizing various parameters for increasing the atomic density in MOT and the current status of ODT development.

Primary author: Mr SAKAMOTO, Kosuke (Tohoku University)

Co-authors: Ms UCHIYAMA, Aiko (Tohoku University); Prof. HATAKEYAMA, Atsushi (Tokyo University of Agriculture and Technology); Dr KAWAMURA, Hirokazu (Tohoku University); Dr TANAKA, Kazuo (Tohoku University); Dr HARADA, Ken-ichi (Tohoku University); Prof. ITOH, Masatoshi (Tohoku University); Ms YOSHIOKA, Risa (Tohoku University); Ms ITO, Saki (Tohoku University); Dr AOKI, Takatoshi (University of Tokyo); Dr INOUE, Takeshi (Tohoku University); Dr DAMMALAPATI, Umakanth (Tohoku University); Prof. SAKEMI, Yasuhiro (University of Tokyo)

Presenter: Mr SAKAMOTO, Kosuke (Tohoku University)

Session Classification: Poster Session

Contribution ID: **172** Type: **Oral**

The aSPECT Experiment - an overview and latest results

Tuesday, October 18, 2016 10:10 AM (20 minutes)

The aSPECT retardation spectrometer measures the beta–neutrino angular correlation coefficient a in free neutron-decay. This measurement can be used to determine the ratio gA/gV of the weak coupling constants, as well as to search for physics beyond the Standard Model.
In 2013 aSPECT had a successful beam time at the Institut Laue-Langevin. The goal of this beam time is to improve the current uncertainty of a from Delta a/a = ~5% to about ~1%. The data analysis is being finalized and the quantitative determination of the uncertainties is ongoing. This is includes systematic tests and measurements of a using different experimental settings during the beam time, additional offline measurements, e.g. of the work-function fluctuations of the electrodes, and field and tracking simulations.
In this talk an overview of the analysis and the systematic uncertainties is presented. Preliminary estimates for the uncertainties will be given where available.

Primary author: Dr BECK, Marcus (for the aSPECT collaboration - Helmholtz-Institut Mainz and Johannes Gutenberg Universität Mainz)

Presenter: Dr BECK, Marcus (for the aSPECT collaboration - Helmholtz-Institut Mainz and Johannes Gutenberg Universität Mainz)

Session Classification: Tu - 1

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **173** Type: **Oral**

A cold neutron beam facility for particle physics at the ESS

Monday, October 17, 2016 5:45 PM (15 minutes)

Pulsed beams have tremendous advantages for precision experiments with cold neutrons. In order to minimize and measure systematic effects, they are used at continuous sources in spite of the related substantial decrease in intensity. At the pulsed neutron source ESS, such experiments will gain up to a factor of 30 in event rate, and novel concepts become feasible. Therefore, the cold neutron beam facility for particle physics ANNI was proposed as part of the ESS instrument suite. ANNI's pulse structure will be particularly useful for three classes of experiments:
- Precision measurements of correlations in neutron beta decay will probe a broad band of new physics models beyond the Standard Model at mass scales from 1 to 100 TeV. To this end, ANNI will include an ep/n separator that collects charged neutron decay products from a long volume and guides them to secondary spectrometers (and that can be installed at the users' discretion).
- For the first time, the tiny effects of hadronic weak interaction will be resolved for calculable systems and studied systematically.
- Beam methods to measure electromagnetic properties of the neutron will provide a systematically different and competitive approach to measurements with ultracold neutrons.
Scientific case, design considerations, concept and expected performances of ANNI will be presented and ways towards a possible realization discussed.

Primary author: SOLDNER, Torsten (Institut Laue Langevin)

Co-authors: Dr MÄRKISCH, Bastian (TU München); Dr THEROINE, Camille (TU München); Dr KONRAD, Gertrud (TU Wien, Atominstitut, Austria); ABELE, Hartmut (Atominstitut); Dr SCHMIDT, Ulrich (Physikalisches Institut der Uni Heidelberg)

Presenter: SOLDNER, Torsten (Institut Laue Langevin)

Session Classification: Mo - 4

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **174** Type: **Poster**

Neutronics Studies for the Nab Experiment

Tuesday, October 18, 2016 6:01 PM (1 minute)

The Nab experiment aims to measure the neutron beta decay electron-neutrino correlation coefficient "a" and the Fierz interference term "b". Measurement of "a" to a relative uncertainty of 10^{-3} provides λ, the ratio of axial to vector coupling constant, at roughly the same precision level as the vector coupling determined from the superallowed decays. A measurement of "b" with an uncertainty of 10^{-3} would reach physics beyond standard model. In Nab, the parameter "a" is extracted from the proton momentum and electron energy using an asymmetric magnetic spectrometer and two large-area highly pixilated Si detectors . To achieve 10^{-3} accuracy, there must be comparatively low background rates to our signal. Background is primarily reduced by using coincidence detection for our signal. However, further reduction is still necessary. Neutron and gamma radiation produce a reaction rate in the Si detectors, which can cause false coincidences. Proper shielding is also needed to reduce dose levels in worker accessible areas. The majority of this background and dose can be reduced by properly collimating the beam such that neutrons primarily see materials that do not produce penetrating radiation upon capture, such as ^6Li. However, collimation using ^6Li creates additional sources of fast neutrons from secondary reactions that must be considered when designing the shielding. The shielding is modeled using MCNP6 (Monte Carlo N-Particle 6). Lead and stainless steel are used to shield gammas, while neutrons are shielded using ^6Li and borated polyethylene. I will present a design that optimizes the use of shielding materials to reduce gamma, cold and fast neutron background and dose.

Primary author: SCOTT, Elizabeth Mae (University of Tennessee)

Presenter: SCOTT, Elizabeth Mae (University of Tennessee)

Session Classification: Poster Session

Contribution ID: **175** Type: **Poster**

Experiments using two Bradbury Nielsen gates

Tuesday, October 18, 2016 6:03 PM (1 minute)

We developed fast switchable Bradbury Nielsen gates for the manipulation of low energy protons and hydrogen atoms. Using a system of two coupled gates operated with a variable time delay, we have built an electronic chopper with opening times in the order of 10-500ns. First use of such a system has been a pulsed proton beam of 500 eV energy with a variable energy spread, which is determined by the time of flight convoluted with frame opening. Post-acceleration can be used to produce a high-energy beam (20 keV in our experiment) with very small relative energy spread. Such a set up can also be used as velocity filter for metastable hydrogen atoms. An application foreseen is the detection of the bound beta decay of the neutron.

Primary authors: Dr GUTSMIEDL, Erwin (Physik-Department, Technische Universität München, 85748 Garching, Germany); Dr SCHOTT, Wolfgang (TUM)

Co-authors: Prof. MÄRKISCH, Bastian (Physik-Department, Technische Universität München, 85748 Garching, Germany); Mr ROICK, Christoph (Physik-Department, Technische Universität München, 85748 Garching, Germany); Mr KONOROV, Igor (Physik-Department, Technische Universität München, 85748 Garching, Germany); Mrs BERNERT, Karina (Physik-Department, Technische Universität München, 85748 Garching, Germany); Mr HUBER, Stefan (Physik-Department, Technische Universität München, 85748 Garching, Germany); Prof. PAUL, Stephan (Physik-Department, Technische Universität München, 85748 Garching, Germany)

Presenter: Dr SCHOTT, Wolfgang (TUM)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **176** Type: **Oral**

Fundamental weak interaction studies with electron beams

Tuesday, October 18, 2016 11:30 AM (30 minutes)

Sensitive tests of the standard model are
possible through high precision determinations of the
weak mixing angle using parity violation electron scattering.
The precision which can be reached at very low Q^2
is comparable with the measurements obtained from LEP
which are at present still the most precise determinations.
Mass scales of new interactions upt to 50 TeV are tested.
The present status at the different experiments and the
physics reach will be discussed. Parity violating electron scattering
can in addition be employed for a variety of other topics like
neutron skin measurements and others.

Primary author: Prof. MAAS, Frank (Helmholtz Institute Mainz, GSI and Mainz University)

Presenter: Prof. MAAS, Frank (Helmholtz Institute Mainz, GSI and Mainz University)

Session Classification: Tu - 2

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **178** Type: **Oral**

Storage ring proton EDM experiment and some systematic error studies

Tuesday, October 18, 2016 3:30 PM (20 minutes)

Storage ring proton EDM experiment aims to search for 10^{-29} e·cm sensitivity. The experiment is designed for two polarized counter-rotating beams to be stored at magic momentum inside an all-electric ring for 1000 seconds, and 10^4 injections. Simulations show that some ring designs easily lead to 1000 seconds of spin coherence time. Besides, the magnetic field as well as the geometric phase effect does not seem to be an issue. On the other hand, radial and vertical DC magnetic field can be measured to fT level making use of the beam dynamics and SQUID-based BPMs.

Primary author: Dr HACIOMEROGLU, Selcuk (Institute for Basic Science, Korea)

Presenter: Dr HACIOMEROGLU, Selcuk (Institute for Basic Science, Korea)

Session Classification: Tu - 3

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **179** Type: **Poster**

Development of a dual isotope rubidium co-magnetometer toward electron EDM search using laser-cooled francium

Tuesday, October 18, 2016 5:57 PM (1 minute)

The permanent electric dipole moment (EDM) of an elementary particle is a good candidate to search for the physics beyond the standard model. Francium (Fr) is a radioactive heavy alkali metal and has a large enhancement factor of the electron EDM. The atomic EDM is measured by comparing the difference in the atomic resonance frequency in an external electric field parallel and anti-parallel to the applied magnetic field. Laser cooling and trapping technique has advantages over atomic beam experiment and can suppress systematic errors.
At Cyclotron and Radioisotope Center (CYRIC), Tohoku University, an experimental search for the electron EDM using laser cooled and trapped francium atoms is in progress. In the experiment, the produced francium atoms will be first trapped in a magneto-optical trap (MOT) and transferred to an optical dipole force trap where the EDM measurement will be performed.
For the sensitive EDM search, measurements of the applied magnetic field and the light shifts are required. Rubidium (Rb) has two stable, abundant isotopes. We plan to use cold Rb atoms as a co-magnetometer. The dual Rb isotope co-magnetometer can measure the magnetic field and the light shift simultaneously. This requires a dual isotope Rb MOT. For this, light sources and experimental setup for the dual isotope Rb MOT are being developed. In this presentation, the progress of the development is presented.

Primary author: Ms UCHIYAMA, Aiko (Tohoku University)

Co-authors: Dr KAWAMURA, Hirokazu (Tohoku University); Dr TANAKA, Kazuo (Tohoku University); Dr HARADA, Ken-ichi (Tohoku University); Mr SAKAMOTO, Kosuke (Tohoku University); Prof. ITOH, Masatoshi (Tohoku University); Ms YOSHIOKA, Risa (Tohoku University); Ms ITO, Saki (Tohoku University); Dr INOUE, Takeshi (Tohoku University); Dr DAMMALAPATI, Umakanth (Tohoku University); Prof. SAKEMI, Yasuhiro (University of Tokyo)

Presenter: Ms UCHIYAMA, Aiko (Tohoku University)

Session Classification: Poster Session

Contribution ID: **180** Type: **Poster**

Towards precision beta-decay measurements with laser-cooled argon-35

Tuesday, October 18, 2016 6:08 PM (1 minute)

Laser cooling and trapping techniques enjoy a solid reputation as powerful and elegant providers of well-localized, backing-free sources. Not only does this hold true within the atomic physics and quantum optics communities, but also beyond. Most notably, these techniques have recently joined the toolbox of low-energy, high-precision tests of the Standard Model. Our work with argon falls within the subset of nuclear beta decay studies, which have historically played a key role in establishing and testing our understanding of weak-interaction physics. In this framework, precision measurements of the beta asymmetry correlation parameter in the beta decay of Ar-35 have been identified as one promising probe for physics beyond the Standard Model.

Our current work focuses on the development of a test magneto-optical trap (MOT) setup for Ar-40 as a preliminary step towards cooling and trapping Ar-35 atoms. In particular, much effort is being put into optimizing the efficiency of our source apparatus, which is crucial to achieving high enough statistics in the final trap. We present the current status of the experimental realization of our setup.

Measuring the beta asymmetry correlation parameter requires highly spin-polarized samples. Therefore, in parallel to our experimental work, we are numerically investigating methods for generating, controlling and precisely measuring the degree of spin polarization of a sample of Ar-35 atoms. We also aim at being able to quickly switch between a polarized and a non-polarized sample so as to better understand systematic effects. We report on the progress of our theoretical modeling.

Primary author: Ms LENAERS, Florence (Université de Liège)

Co-authors: Dr GLOVER, Rohan (Griffith University); Prof. BASTIN, Thierry (Université de Liège)

Presenter: Ms LENAERS, Florence (Université de Liège)

Session Classification: Poster Session

Contribution ID: **181** Type: **Poster**

The neutron lifetime experiment tSPECT

Tuesday, October 18, 2016 6:09 PM (1 minute)

The decay of the free neutron into a proton, electron and antineutrino is the prototype of semi-leptonic weak decays and plays a key role in particle physics and astrophysics. The most precise measurement of the neutron lifetime to date use ultra-cold neutrons (UCN) stored in material vessels. Their accuracy is limited by systematic errors, mainly caused by anomalous losses of UCN during storage at the vessel walls. With the magnetic storage of neutrons these systematic limitations can be avoided and an accuracy of 0.3s for the lifetime of the neutron can be reached. In Mainz the neutron experiment tSPECT has been set up, which uses a combination of magnetic multipole fields for radial storage and the superconducting aSPECT magnet for longitudinal storage of UCN. In a first phase the goal is to measure the neutron lifetime with a precision of ~1s. In this presentation, the status of tSPECT and the results of the first comissioning measurements will be presented.

Primary author: Mr KARCH, Jan Peter (Institute of Physics, University of Mainz)

Co-authors: Dr GEPPERT, Christopher (University of Mainz); Mr HAACK, Jan (University of Mainz); Mr KAHLENBERG, Jan (University of Mainz); Mrs ROSS, Kim (University of Mainz); Dr EBERHARDT, Klaus (University of Mainz); Dr BECK, Marcus (Helmholtz-Institut Mainz and Johannes Gutenberg Universität Mainz); Dr KARPUK, Sergej (University of Mainz); Prof. HEIL, Werner (Institute of Physics); Dr SOBOLEV, Yury (Institut fuer Physik, Johannes-Gutenberg Universitaet, Mainz)

Presenter: Mr KARCH, Jan Peter (Institute of Physics, University of Mainz)

Session Classification: Poster Session

Contribution ID: **182** Type: **Oral**

Testing fundamental interactions with few electron atoms and molecules

Monday, October 17, 2016 10:00 AM (30 minutes)

Hydrogenic systems like H, μH, muonium, and positronium
are being considered for the determination of fundamental physical constants and for low-energy tests of the Standard Model.
The precision of these tests, however, is limited either
by a short natural life-time or by uncertainties in the nuclear structure. Additionally, the mean square charge radius observed for the proton structure in electronic and muonic hydrogen differs significantly, and the source of this disagreement remains unknown. This so-called proton radius puzzle results in large uncertainty in the Rydberg R_∞ constant.

I propose to perform high-precision calculations for two- and three-electron systems, such as helium- and lithium-like ions, and H_2 molecule. Together with ongoing and planned high precision measurements, this will lead to the improved determination of the absolute nuclear charge radii. Moreover, combined with the muonic determination of nuclear charge radii, this will allow low energy tests of the Standard Model and improved determination of fundamental physical constants.

Primary author: Prof. PACHUCKI, Krzysztof (Institute of Theoretical Physics, University of Warsaw)

Presenter: Prof. PACHUCKI, Krzysztof (Institute of Theoretical Physics, University of Warsaw)

Session Classification: Mo - 1

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **183** Type: **Oral**

Precision measurements of fundamental properties of the antiproton - BASE Experiment

Wednesday, October 19, 2016 10:10 AM (20 minutes)

Comparisons of the fundamental properties of protons and antiprotons constitute sensitive tests of CPT invariance being of one of the most fundamental symmetries in the Standard Model.

The Baryon Antibaryon Symmetry Experiment (BASE) located at the antiproton decelerator of CERN is dedicated to determine the proton-to-antiproton charge-to-mass ratio and the magnetic moment of the antiproton with highest precision.

Based on alternating cyclotron frequency measurements on single negatively charged hydrogen ions and single antiprotons in an advanced Penning trap we reported very recently on a comparison of the proton-to-antiproton charge-to-mass ratio with a fractional precision of 69 parts per trillion.

Currently we focus on the high-precision measurement of the magnetic moment of the antiproton. Its value can be determined by measuring the frequency ratio of the spin-precession to cyclotron frequency of a single particle. By using the elegant double-trap measurement scheme we performed the currently most precise measurement of the proton magnetic moment with a fractional precision of 3.3 parts per billion. This scheme is directly applicable to the antiproton and currently being implemented into the BASE setup to determine the antiproton magnetic moment with p.p.b. precision and to thus provide a 1000-fold improved test of CPT invariance.

An overview of the recent results and the current progress of the BASE experiment is presented in this talk.

Primary author: Dr SMORRA, Christian (CERN)

Co-authors: Dr MOOSER, Andreas (RIKEN); Mr NAGAHAMA, Hiroki (RIKEN/University of Tokyo); Prof. WALZ, Jochen (Universität Mainz/Helmholtz Institut Mainz); Prof. BLAUM, Klaus Blaum (Max Planck Institut für Kernphysik); Mr BORCHERT, Matthias (Universität Hannover); Mr GEORG, Schneider (Institut für Physik - Universität Mainz); Dr SELLNER, Stefan (RIKEN); Dr ULMER, Stefan (RIKEN); Mr HIGUCHI, Takashi (RIKEN/University of Tokyo); Dr QUINT, Wolfgang (GSI); Prof. YAMAZAKI, Yasunori (RIKEN); Prof. MATSUDA, Yasuyuki (University of Tokyo)

Presenter: Dr SMORRA, Christian (CERN)

Session Classification: We - 1

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **184** Type: **Oral**

The LANL UCN Program: status and news

Monday, October 17, 2016 11:00 AM (30 minutes)

In this talk, we present an overview of the science program at the Los Alamos spallation-driven solid-deuterium ultra-cold neutron (UCN) source, describe the performance of the source, and give the status of the source upgrade now underway. Experiments in operation or development include the UCNTau neutron lifetime experiment, UCNB/Nab detector development for measurement of neutron beta decay parameters with cold and ultra-cold neutrons, SNS-nEDM storage cell performance tests, and development of the new LANL nEDM experiment. The present source upgrade involves replacing the entire cryogenic part of the UCN source, including the deuterium converter volume and the polyethylene moderator, as well as replacing the entire UCN transport system and installing a new UCN beam port, to be dedicated to the new LANL-nEDM experiment. The status and outlook of the experimental efforts and of the operation of the facility will be presented.

Primary author: SAUNDERS, Alexander (Los Alamos National Lab)

Presenter: SAUNDERS, Alexander (Los Alamos National Lab)

Session Classification: Mo - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **185** Type: **Oral**

UCNtau: a measurement of the neutron lifetime using ultra-cold neutrons stored in an asymmetric magnetic trap

Tuesday, October 18, 2016 9:50 AM (20 minutes)

Recent measurements of the neutron lifetime have individually reported uncertainties of about 1 s but disagree by as much 7 s, resulting in a shift of about 6.5 sigma in the accepted value over recent years. Measurements based on the decay in flight of cold neutron beams appear to yield longer lifetimes than those based on counting surviving ultra-cold neutrons after storage in material-walled traps. The present storage experiments are challenged by the existence of multiple neutron loss mechanisms in the trap that act with characteristic times similar to the neutron lifetime, such as absorption or upscatter of the neutrons on the material trap walls and escape of unbound neutrons from quasi-stable orbits within the trap. The efficiency of detection of the surviving trapped neutrons can vary with time due to evolution of neutron population into different regions of phase space within the trap. Therefore, a new experiment, UCNtau, has been developed at Los Alamos National Lab to eliminate these systematic effects by storing the ultra-cold neutrons in an asymmetric magneto-gravitational trap, in which the neutrons: 1) do not interact with any material surface during their storage time in the trap; 2) rapidly populate all of the energetically accessible phase space; and 3) are detected rapidly at the end of the storage time by a novel in-trap active time-sensitive detector. The trap consists of a bowl-shaped Halbach array of neodymium-iron permanent magnets capable of repelling neutrons with a kinetic energy of up to 50 neV and is closed on the top by gravity. The neutron detector consists of a scintillator coated with boron which is lowered into the trap from above to individually detect the surviving neutrons. We will present preliminary results of the recent Los Alamos accelerator cycle, including a summary of the experiment's assessed sources of systematic uncertainty and statistical reach. Our immediate goal is to reach sufficient precision to resolve the difference between the beam and bottle experiments.

Primary author: Dr MORRIS, Christopher (Los Alamos)

Presenter: Dr MORRIS, Christopher (Los Alamos)

Session Classification: Tu - 1

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **186** Type: **Poster**

Detection of low-energy protons within the neutron β-decay spectrometer aSPECT

Tuesday, October 18, 2016 6:10 PM (1 minute)

The antineutrino-electron angular correlation coefficient a is related to the proton recoil spectrum by kinematics. aSPECT measures the integral proton spectrum using magnetic adiabatic collimation and electrostatic retardation. Data acquisition for a 1% measurement of coefficient a was performed during a beam-time in 2013 at the Institut Laue-Langevin in Grenoble.
As protons are emitted at low-energy (E_{p,max} = 751.4 eV), the detection occurs after a post-acceleration of the particles (-15 kV) onto a Silicon Drift Detector. The signal is then treated by dedicated electronics. In the 2013 measurements a shaper with non-linear amplification was used in order to avoid saturation effects.
In order to quantify the systematic effects related to the proton detection, the electronics chain and the event signals were investigated in details. Correlations between subsequent events were also investigated. Methods to improve the pulse-height resolution of the events, to identify and to correct pile-up were developed and tested.
Preliminary results are presented on this poster.

Primary author: Dr MAISONOBE, Romain (Institut Laue-Langevin)

Co-authors: Mr WUNDERLE, Alexander (Institute of Physics, Uni Mainz); Mr SCHMIDT, Christian (Johannes Gutenberg-Universität Mainz); Dr GLUCK, Ferenc (Karlsruher Institut für Technologie, Karlsruhe, Germany); Dr KONRAD, Gertrud (TU Wien, Atominstitut, Austria); Dr BECK, Marcus (Helmholtz-Institut Mainz and Johannes Gutenberg Universität Mainz); Dr SIMSON, Martin (Institut Laue-Langevin); Prof. ZIMMER, Oliver (Institut Laue Langevin); Mr VIROT, Romain (Institut Laue-Langevin); Dr BAESSLER, Stefan (Department of Physics, University of Virginia, Charlottesville, USA); SOLDNER, Torsten (Institut Laue Langevin); Prof. HEIL, Werner (Institute of Physics)

Presenter: Dr MAISONOBE, Romain (Institut Laue-Langevin)

Session Classification: Poster Session

Contribution ID: **187** Type: **Oral**

Particle Physics with AMO Methods

Monday, October 17, 2016 2:30 PM (30 minutes)

The most precise measurement of the property of an elementary particle was measured, using AMO methods in a university laboratory, in order to test the most precise prediction of the Standard Model of particle physics. The incredible precision of the Standard Model's prediction of what is measured is arguably the Standard Model's greatest triumph. At the same time, the Standard Model predicts that no matter universe should result from a big bang. The Standard Model is thus the great triumph and the great frustration of modern physics. Recent progress in several low energy tests of the Standard Model and its basic symmetries will be discussed.

Primary author: Prof. GABRIELSE, Gerald (Harvard University)

Presenter: Prof. GABRIELSE, Gerald (Harvard University)

Session Classification: Mo - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **188** Type: **Oral**

Low emittance muon source for muon g-2/EDM at J-PARC

Wednesday, October 19, 2016 3:50 PM (20 minutes)

The anomalous magnetic moment of the muon, a_mu = (g_mu - 2)/2, has been measured to 0.54 ppm at BNL (E821), and when compared to the Standard Model (SM) calculation of similar precision, a discrepancy of about 3 sigma remains unexplained. A similar method will be used at FNAL (E989) with the goal of achieving a factor of four increase in experimental precision.

An independent method is being exploited for the J-PARC muon g-2/EDM experiment (E34). It uses a smaller high-precision storage ring for 300 MeV/c muons with no requirement for electric field focusing. Storage is achieved due to the extremely small momentum spread of the beam, maintained through acceleration of room-temperature thermal muons. The method offers many advantages, and relies on a thermal muon source derived from laser ionization of muonium atoms emitted from silica aerogel structures. The yields and properties of the muonium in vacuum are being studied at TRIUMF as well as at RIKEN/RAL and J-PARC.

The status of the muonium experiments will be presented, showing the substantial increase in thermal muonium yield from laser-ablated aerogel materials and the current understanding based on model-independent analysis as well as comparison with simulations based on muonium diffusion.

Primary author: Dr MARSHALL, Glen (TRIUMF)

Presenter: Dr MARSHALL, Glen (TRIUMF)

Session Classification: We - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **189** Type: **Poster**

Testing Space-Time Non-Commutativity with High Precision Spectroscopy

Tuesday, October 18, 2016 6:13 PM (1 minute)

Atomic spectroscopy has evolved considerably in recent years and it is passed from the stage of just a confirmation experiment of atomic theories to that of an indicator for new paths to understand the nature, as has been demonstrated by the results of R. Pohl et al., Nature 466, 213 (2010) and A. Antognini et al., Science 339, 417 (2013). We use the experimental results of the spectroscopy of hydrogen-like systems to place limits on one of the extensions of the Standard Model which is the theory of non-commutativity. We study hydrogen-like atoms ions, as well as exotic ones such as muon-systems in the framework of this theory.

Primary author: Dr MOUMNI, Mustafa (University of Biskra; Algeria)

Co-author: Prof. BENSLAMA, Achor (University of Constantine1)

Presenter: Dr MOUMNI, Mustafa (University of Biskra; Algeria)

Session Classification: Poster Session

Contribution ID: **190** Type: **Oral**

The Mu2e Experiment

Thursday, October 20, 2016 3:30 PM (20 minutes)

The Mu2e Experiment at Fermilab will search for coherent, neutrinoless conversion of muons into electrons in the field of a nucleus with a sensitivity improvement of a factor of 10,000 over previous experiments. Such a charged lepton flavor-violating reaction probes new physics at a scale inaccessible with direct searches at either present or planned high energy colliders. The experiment both complements and extends the current search for muon decay to electron+gamma at MEG and searches for new physics at the LHC. We will present the physics motivation for Mu2e, the novel design of the muon beamline and the detector, and the current status of the experiment.

Primary author: GAPONENKO, Andrei (Fermilab)

Presenter: GAPONENKO, Andrei (Fermilab)

Session Classification: Th - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **191** Type: **Poster**

Development of a double-cusp trap for ground-state hyperfine spectroscopy of antihydrogen atoms

Tuesday, October 18, 2016 5:50 PM (1 minute)

The ASACUSA collaboration has developed a scheme for a high precision spectroscopy of the ground-state hyperfine splitting of antihydrogen atoms to test CPT symmetry.
A Rabi-type spectroscopic technique is planned to be utilized with a key apparatus, a cusp trap.
After a successful production of a flow of antihydrogen atoms from the prototype cusp trap, a new novel double-cusp trap has been developed, which is a combination of two anti-Helmholtz magnetic field configuration and an electrostatic nested well configuration by multiple ring electrodes.
The double-cusp trap is expected to improve the polarization and focusing of antihydrogen beams.
To efficiently synthesize antihydrogen atoms, an ultraslow antiproton beam from the MUSASHI antiproton trap is adiabatically transported and injected to positron plasma confined in the double-cusp trap.
Ongoing experiments of antihydrogen synthesis and the expected characterization of antihydrogen beams will be discussed.

Primary author: Dr KURODA, Naofumi (University of Tokyo)

Co-authors: Dr RADICS, Balint (ETH Zürich); Prof. LODI RIZZINI, Evandro (Università di Brescia); Dr HIGAKI, Hiroyuki (Hiroshima University); Dr BREUKER, Horst (CERN); Prof. VENTURELLI, Luca (Università di Brescia); Dr LEALI, Marco (Università di Brescia); Ms TAJIMA, Minori (University of Tokyo); Dr DUPRÉ, Pierre (RIKEN); Dr ULMER, Stefan (RIKEN); Mr MATSUDATE, Takuya (University of Tokyo); Mr KOBAYASHI, Tatsuhito (University of Tokyo); Dr MASCAGNA, Valerio (Università di Brescia); Dr MÄCKEL, Volkhard (SMI); Prof. YAMAZAKI, Yasunori (RIKEN); Dr KANAI, Yasuyuki (RIKEN); Dr MATSUDA, Yasuyuki (University of Tokyo); Dr NAGATA, Yugo (Tokyo University of Agriculture and Technology)

Presenter: Dr KURODA, Naofumi (University of Tokyo)

Session Classification: Poster Session

Contribution ID: **192** Type: **Oral**

Status of atomic parity violations experiments

Thursday, October 20, 2016 10:00 AM (30 minutes)

Observing atomic parity violation in atomic systems provides a unique possibility for testing the predictions of the Standard Model at low momentum transfer. The nuclear spin independent part of the weak interactions permits the extraction of the weak mixing angle or Weinberg angle. A sensitivity beyond the most sensitive determination of this parameter in atomic system, i.e. in a cesium atomic beam, requires well chosen atomic systems, such as Ba+ and Ra+ ions or atomic Fr, as well as an excellent understanding of the atomic spectra of these systems. The status of the experimental and theoretical efforts which promise a fivefold improvement over the current best measurement in Cs will be discussed.

Primary author: Dr WILLMANN, Lorenz (Van Swinderen Institute, Groningen University)

Presenter: Dr WILLMANN, Lorenz (Van Swinderen Institute, Groningen University)

Session Classification: Th - 1

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **193** Type: **Oral**

Frequency-based decay electron spectroscopy to probe the neutrino mass scale and chirality-flipping interactions

Tuesday, October 18, 2016 4:20 PM (20 minutes)

The Project 8 collaboration has recently demonstrated the novel technique of Cyclotron Radiation Emission Spectroscopy (CRES) and aims to perform a high precision measurement of the beta decay spectrum of tritium around the endpoint region (Q = 18.6 keV) to investigate the anti-electron neutrino mass scale. I will present first measurements using 83mKr and the phased program towards ameasurement using atomic tritium which has mass sensitivity potentially below 50meV/c2. In addition I will discuss the possibility to extend CRES into the high energy range (MeV) and its possible application to a sensitive search for chirality-flipping interactions in the beta decay spectrum of 6He (Q = 3.5MeV).
Major financial support by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics to the University of Washington under Award Number DE-FG02-97ER41020 is acknowledged.

Primary author: Prof. FERTL, Martin (University of Washington)

Presenter: Prof. FERTL, Martin (University of Washington)

Session Classification: Tu - 4

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **194** Type: **Poster**

Snapshots of a Quantum Bouncing Ball realized with the qBounce gravity spectrometer

Tuesday, October 18, 2016 6:12 PM (1 minute)

One class of gravity experiments within the qBounce project focuses on the realization of a Quantum Bouncing Ball, i.e. a measurement of the time evolution of a neutron bouncing above a horizontal plane.

We have measured, the spatial probability distribution of this Schrödinger wave packet for different observation times with a spatial resolution of about 1.8µm.

We illustrate the role of interference weaving the quantum carpet of several quantum states. After a first quantum reflection, several snapshots show the fall of the wave packet.

Primary author: Mr THALHAMMER, Martin (Atominstitut TU-Wien)

Co-authors: ABELE, Hartmut (Atominstitut); Dr GELTENBORT, Peter (Institut Laue-Langevin); Dr JENKE, Tobias (Universitätsassistent); Mr RECHBERGER, Tobias (Atominstitut, TU Wien)

Presenter: Mr THALHAMMER, Martin (Atominstitut TU-Wien)

Session Classification: Poster Session

Contribution ID: **195** Type: **Poster**

The new magnetic field optimisation procedure of the nEDM experiment at PSI

Tuesday, October 18, 2016 5:48 PM (1 minute)

The neutron Electric Dipole Moment experiment at the Paul Scherrer Institute is currently the most sensitive in the world.
One of the main improvements that made this possible is the new algorithm that was developed to optimise the magnetic field.
Using a combination of both offline magnetic field maps and online monitoring with an array of Cs magnetometers, the currents applied to a set of 30 coils are tuned such that the longitudinal homogeneity of the field is prioritised over the transversal homogeneity, while at the same time keeping systematic effects related to transversal components under control.
The magnetic field configurations thus obtained result in a Ramsey contrast (visibility) of typically 0.75 to 0.8, whereas previously the experiment was ran at a visibility of 0.55 to 0.60. As such, the sensitivity of our experiment is effectively increased by 30%.

Primary author: Ms WURSTEN, Elise (KU Leuven)

Presenter: Ms WURSTEN, Elise (KU Leuven)

Session Classification: Poster Session

Contribution ID: **196** Type: **Poster**

Precise central unit of the DAQ system for the n2EDM experiment at PSI

Tuesday, October 18, 2016 5:49 PM (1 minute)

An upgraded version of the neutron EDM experiment at the Paul Scherrer Institute is in preparation. All systems used in the present experiment version will be designed anew. The data acquisition system must be changed because of higher complexity and assumed better general quality of the whole system. The central part of the DAQ system performs three main tasks: (1) precise timing of the scheduled measurement steps, (2) generation of oscillating pulses which rotate spins of neutrons and co-magnetometer atoms, (3) precise recording of the co-magnetometer signal.
Test system based on the PXI platform was collected, programmed and tested. Details of that system and results of performed tests will be presented, together with conclusions regarding the use of such system for high-precision measurements.

Primary authors: Dr ZEJMA, Jacek (JUC); Dr KREMPEL, Jochen (ETH Zürich); Mr RAWLIK, Michał (ETH Zürich)

Presenters: Dr ZEJMA, Jacek (JUC); Dr KREMPEL, Jochen (ETH Zürich); Mr RAWLIK, Michał (ETH Zürich)

Session Classification: Poster Session

Contribution ID: **197** Type: **Oral**

A Measurement of the Electron-Antineutrino Correlation in Free Neutron Beta Decay

Thursday, October 20, 2016 12:40 PM (20 minutes)

The aCORN Collaboration has analyzed data taken on the NG-6 beamline at the NIST (National Institute of Standards and Technology) Center for Neutron Research and achieved the most precise measurement to date of the angular correlation (a-coefficient) between the electron and antineutrino emitted in free neutron beta decay. Such a measurement provides a test of the Electroweak Standard Model and, with the neutron lifetime, a determination of the weak vector and axial vector coupling constants. aCORN employs a novel asymmetry method that leads to smaller systematic uncertainties compared to previous experiments that obtained the a-coefficient from the shape of the recoil proton energy spectrum.

A brief description of the aCORN method, apparatus, result, and systematic effects will be presented. Additionally, as the experiment is nearing the end of its data collection time on the more intense beamline NG-C, an overview of this new data set will be provided.

This work supported by NSF, NIST and DOE.

Primary author: Prof. KOMIVES, Alexander (DePauw University)

Presenter: Prof. KOMIVES, Alexander (DePauw University)

Session Classification: Th - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **198** Type: **Oral**

Neutron Lifetime Measurement at J-PARC/MLF/BL05

Tuesday, October 18, 2016 12:20 PM (20 minutes)

The neutron lifetime (880.3 ± 1.1 [sec] [Particle Data Group]) is one of the most important parameters for the Big Bang Nucleosynthesis, which predicts nucleosynthesis in the early universe. So far it has been measured by two different methods, penning trap and UCN bottle, and they got recent value 888.0 ± 2.1 [sec] and 879.6 ± 0.8 [sec] respectively. Although both methods decide the lifetime at O(0.1)% precision independently, there is a 3.8 sigma(8.4 [sec]) discrepancy. Therefore we need new approaches which can resolve this problem. Our method, "Electron Counting", is one of such approaches. In this method, we count the number of electrons which emitted by neutron beta decay using Time Projection Chamber (TPC). Not only counting electrons, we count the number of 3He(n,p)3H reactions to determine neutron flux using same detector at the same time. Our method has different kinds of systematic uncertainties from previous two methods, thus our results directly contribute to resolve current discrepancy. We acquired the first physics data set at J-PARC/MLF/BL05 in 2016 spring. The statistical uncertainty is about O(10)% precision on neutron lifetime. This talk will report the recent results of obtained data set.

Primary author: TOMITA, Tatsuhiko (Kyushu University)

Co-authors: MORISHITA, Aya (Kyushu University); OTONO, Hidetoshi (RCAPP, Kyushu University); OIDE, Hideyuki (CERN); SUMINO, Hirochika (The University of Tokyo); SHIMIZU, Hirohiko (Nagoya University); TAKETANI, Kaoru (KEK); HIROTA, Katsuya (Nagoya University); MISHIMA, Kenji (KEK); YOKOHASHI, Mami (Nagoya University); KITAGUCHI, Masaaki (KMI, Nagoya University); NAGAKURA, Naoki (The University of Tokyo); SUMI, Naoyuki (Kyushu University); KITAHARA, Ryunosuke (Kyoto University); YAMASHITA, Satoru (ICEPP, The University of Tokyo); IEKI, Sei (The University of Tokyo); YAMADA, Takahito (The University of Tokyo); INO, Takashi (KEK); YOSHIOKA, Tamaki (RCAPP, Kyushu University); SHIMA, Tatsushi (RCNP, Osaka University); SEKI, Yoshichika (JAEA); IWASHITA, Yoshihisa (ICR, Kyoto University)

Presenter: TOMITA, Tatsuhiko (Kyushu University)

Session Classification: Tu - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **199** Type: **Oral**

Prospects of Intensity and Precision Frontier

Wednesday, October 19, 2016 11:30 AM (30 minutes)

While we have been longing for the signals of new physics beyond the standard model, there is no convincing indication yet at the high energy frontier, LHC. There is an increasing importance in exploring intensity and precision frontier especially to shape a possible new physics by further investigating the flavor dynamics and by testing symmetries in the nature.
In this talk, we try to cover the worldwide efforts at such frontiers, e.g. PSI, Fermilab, and KEK/J-PARC and more to provide an updated perspective of the quest for new physics searches at low energies.

Primary author: Prof. SAITO, Naohito (J-PARC / KEK)

Presenter: Prof. SAITO, Naohito (J-PARC / KEK)

Session Classification: We - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **200** Type: **Poster**

Development of ^{129}Xe and ^{131}Xe co-existing masers with external feedback for the search for Xe atomic EDM

Tuesday, October 18, 2016 6:15 PM (1 minute)

Due to its almost undetectablly small magnitudes predicted from the Standard Model (SM), detection of a non-zero electric dipole moment (EDM) is expected to prove the existence of new physics beyond the SM. Even so, the expected signals for an EDM are extremely small, and thus an elaborate scheme for the suppression of errors in its measurement is essential. As for the atomic EDM of Xe, which is an objective of the present work, the current upper limit of 4.1×10^{-27}ecm corresponds to a ~40 nHz accuracy under the application of a 10 kV/cm electric field. In order to improve this upper limit, we in this work propose the use of a co-existing ^{129}Xe and ^{131}Xe spin maser complex running in an external feedback scheme. The ^{129}Xe and ^{131}Xe spins, which cohabit in the same cell volume, sense the same magnetic field and thus the effects of a long-term drift in the magnetic field are cancelled out. In particular, the systematic error arising from the interactions with polarized Rb atoms is largely eliminated thanks to their very similar strengths of coupling to Rb, as opposed to the case of a ^{129}Xe-^{3}He combination. Our external feedback scheme will ease difficulties arising from the shorter relaxation time and quadrupole frequency splitting of ^{131}Xe. In this presentation, we will report on the first operation of the ^{131}Xe maser, and its stability, and discuss future perspectives for our planned Xe EDM measurement.

Primary author: Dr SATO, Tomoya (Department of Physics, Tokyo Institute of Technology; RIKEN Nishina Center for Accelerator-Based Science)

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Presenter: Dr SATO, Tomoya (Department of Physics, Tokyo Institute of Technology; RIKEN Nishina Center for Accelerator-Based Science)

Session Classification: Poster Session

Contribution ID: **201** Type: **Poster**

Performance of MEG II Positron Timing Counter Based on Commissioning Run Result

Tuesday, October 18, 2016 6:30 PM (1 minute)

We have developed a positron timing counter (TC) for the MEG II experiment which aims to search for μ+⟶e+γ decay with the world's highest sensitivity.
The TC is segmented into 512 small scintillation counters with 6 SiPMs at the both ends. Since the positron time is measured by several counters (~9 on average), an excellent timing resolution is expected.

We constructed and installed a part of the final TC including calibration system with laser and performed an engineering run at piE5 beam line in PSI in 2015 winter and 2016 summer.
The positron timing measurement was success and we already achieved an excellent overall resolution of 31.5 ps with 10 hits as a preliminary result.
In this talk the expected final performance of TC based on the commissioning run will be discussed. Furthermore, a developed analysis algorithm, contribution of a positron tracker, and laser calibration will be presented.

Primary author: Ms NISHIMURA, Miki (The University of Tokyo)

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Presenter: Ms NISHIMURA, Miki (The University of Tokyo)

Session Classification: Poster Session

Contribution ID: **202** Type: **Oral**

Recent results on CP and CPT violation with the BABAR detector

Monday, October 17, 2016 3:30 PM (20 minutes)

The B factories have been built to study CP violation in the B-meson system and probe the flavor sector of the Standard Model (SM) via measurement of the elements of the Cabibbo-Kobayashi-Maskawa matrix.
We present today recent results on CP violation in B- and D-meson decays obtained with the BABAR detector. Among these the first observation of mixing-induced CP violation in B0->D_CP(*)h0 decays, where h0 is a light neutral meson, and the neutral D meson is reconstructed in decays to two-body CP eigenstates K+K-, K0Spi0 and or K0Somega. This measurement has been obtained with a simultaneous analysis of the combined data sets of Belle and BABAR.
We also present a new determination of three CPT-sensitive parameters Re(z), Im(z) and |A/Abar|, where A and Abar are the amplitudes for B0 -> c cbar K0 and B0bar -> c cbar K0bar decays, respectively. This analysis makes use of the CP-violating parameters Ci and Si measured by BABAR in a previous analysis that brought to the observation of violation of time-reversal symmetry in B0 -> J/psi K0 decays.

Primary author: Dr ANULLI, Fabio (INFN Rome)

Presenter: Dr ANULLI, Fabio (INFN Rome)

Session Classification: Mo - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **203** Type: **Poster**

Development of the measurement system toward the electron EDM search with laser cooled Fr atoms

Tuesday, October 18, 2016 5:51 PM (1 minute)

The permanent electric dipole moment (EDM) is a suitable observable to test theoretical models beyond the standard model (SM) of particle physics. We plan to search for the electron EDM by using the laser cooled francium (Fr) atoms. The features of the laser cooled Fr atoms are as follows. The Fr atom has the largest enhancement factor of the electron EDM in the alkali atoms. Although the Fr atom has no stable isotope, some isotopes have enough life time to perform the EDM search experiment. The laser cooled atoms can suppress the statistical error and some systematic errors. The laser cooled Fr factory is being constructed at Cyclotron and Radioisotope center, Tohoku University.
The high electric field application is one of the key issues to the EDM search experiment. We are now developing the electric field application system using the stable Rb atom. We employ the glass plate coated with tin-doped indium oxide as transparent electrodes in order to enable the optical access. By measuring the DC Stark shift of the Rb atoms trapped in the magneto-optical trap, the strength of the electric field applied to the laser cooled atoms was evaluated. Furthermore, toward the pilot EDM experiment using the laser cooled Rb atoms, the both electric and magnetic fields application system is also being developed. In this presentation, we will report the present status of the EDM measurement system.

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Presenter: Dr INOUE, Takeshi (Tohoku University)

Session Classification: Poster Session

Contribution ID: **204** Type: **Poster**

Realization of Ramsey-type Gravity Resonance Spectroscopy within qBounce

Tuesday, October 18, 2016 6:05 PM (1 minute)

We present the status of gravity resonance spectroscopy (GRS): The neutron serves as a measuring tool and as an object for gravity research. We show that GRS allows to test Newton's inverse square law at short distances and to search for dark matter and dark energy candidates. We use a method based on frequency measurements which have shown spectacular sensitivity in the past. Our method also bypasses electromagnetic interactions like van der Waals or Casimir forces. Implementing a Ramsey-like setup, it is also possible to probe neutron's electric neutrality. Experimental data on transition frequencies of the quantum gravitational bound states of ultracold neutrons help to solve cosmological puzzles in terrestrial table top experiments.

Primary author: Mr RECHBERGER, Tobias (Atominstitut, TU Wien)

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Presenter: Mr RECHBERGER, Tobias (Atominstitut, TU Wien)

Session Classification: Poster Session

Contribution ID: **205** Type: **Oral**

A New Search for Neutron-Anti-Neutron Oscillations

Monday, October 17, 2016 6:15 PM (15 minutes)

Neutral particle oscillations have proven to be extremely valuable probes of fundamental physics. Kaon oscillations provided us with our first insight into CP-violation, fast B oscillations provided the first indication that the top quark is extremely heavy, B oscillations form the most fertile ground for the continued study of CP-violation, and neutrino oscillations suggest the existence of a new, important energy scale well below the GUT scale. An open question is whether neutrons oscillate to anti-neutrons, violating baryon number conservation. The construction of the European Spallation Source in Lund, with first beam expected in 2019, together with modern neutron guiding techniques, should make it possible to build an experiment with approximately three orders of magnitude improvement in sensitivity to the neutron oscillation probability. This exciting possibility will be described.

Primary author: BROOIJMANS, Gustaaf (Columbia University)

Presenter: BROOIJMANS, Gustaaf (Columbia University)

Session Classification: Mo - 4

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **206** Type: **Poster**

The calibration methods for the MEG experiment and its upgrade

Tuesday, October 18, 2016 6:20 PM (1 minute)

The MEG experiment has recently established the most stringent upper limit on the branching fraction of the mu -> e gamma decay (< 4.2 x 10e-13 at 90% C.L.). It is a factor 30 improvement over the previous limit set by the MEGA experiment and also the strongest bound on any forbidden decay particle. An upgrade of the experiment is ongoing aiming at a better sensitivity by an order of magnitude. One of the key elements to achieve a such as ambitious goal is to continuously and carefully calibrate and monitor each sub-detector. The main calibration and monitoring methods for the MEG experiment and its upgrade will be presented.

Primary author: PAPA, Angela (Paul Scherrer Institute)

Presenter: PAPA, Angela (Paul Scherrer Institute)

Session Classification: Poster Session

Contribution ID: **207** Type: **Poster**

The fibre tracker R&D for the Mu3e experiment

Tuesday, October 18, 2016 6:19 PM (1 minute)

The Mu3e Scintillating Fibre (SciFi) detector is a cylindrical time of flight (ToF) device which complements the central silicon tracking system. It consists of a scintillating fibre (SciFi) hodoscope with a radius of 6 cm and a length of 36 cm. The expected time resolution is of several 100 ps and a detection efficiency close to 100% is foreseen. The main purpose of the ToF system is to measure precisely the arrival time of particles in order to allow for the matching with hits detected in the silicon detectors. This will help to reject pile-up events (accidental backgrounds) and allow for a charge (direction of propagation) measurement for tracks passing through the silicon tracker more than once (re-curling tracks). The ToF system will operate at very high particle rates up to several MHz per channel. The status of the detector R&D will be presented. Current measurements show very promising results which well fulfill the requests of the experiment: A very high detection efficiency for minimum ionizing particles with a single fiber layer (> 95%), and a full efficiency for multilayer configurations (> 99%); timing resolutions of the order of 500 ps (multilayer configuration); optical cross-talk between fibers at a negligible level (< 1%), for which spatial resolutions < 50 μm are foreseen (multilayer configuration).

Primary author: PAPA, Angela (Paul Scherrer Institute)

Presenter: PAPA, Angela (Paul Scherrer Institute)

Session Classification: Poster Session

Contribution ID: **208** Type: **Poster**

The aSPECT experiment – current status of the analysis

Tuesday, October 18, 2016 6:22 PM (1 minute)

The aSPECT retardation spectrometer measures the beta-neutrino angular correlation coefficient a in free neutron beta decay. This measurement can be used to determine the ratio g_A/g_V of the weak coupling constants, as well as to search for physics beyond the Standard Model.
In spring/summer 2013 aSPECT had a successful beam time at the Institut Laue-Langevin. The goal of this beam time is to improve the current uncertainty of a from to about 1%. The data analysis is in its final stage and will be finished soon. In order to achieve an uncertainty of 1% the systematics of aSPECT have to be understood accordingly. This understanding is gained via systematic tests and measurements of a with different parameter settings for the spectrometer during the beam time. Additionally, auxiliary measurements have been performed to determine the effect on the systematics, e.g. work-function fluctuations of the electrodes, the magnetic field ratio of the spectrometer and detailed tests of the detector electronics.
In this poster an overview of these auxiliary measurements and their results is given. Further, the analysis of various systematics, e.g. potential saturation of the DAQ, pile-up, background from residual gas, energy dependent projection of decay protons, and the influence of these systematics on a is shown. Additionally, the concept of an analysis using a multi-dimensional fit is explained.

Primary author: Mr WUNDERLE, Alexander (Johannes Gutenberg-Universität Mainz)

Co-authors: Mr SCHMIDT, Christian (Johannes Gutenberg-Universität Mainz); Mr STIPP, David (Johannes Gutenberg-Universität Mainz); Mr BECKMANN, Edward (Johannes Gutenberg-Universität Mainz); Dr GLÜCK, Ferenc (Karlsruher Institut für Technologie); Dr KONRAD, Gertrud (TU Wien, Atominstitut, Austria); Mr HAACK, Jan (Johannes Gutenberg-Universität Mainz); Mr KAHLENBERG, Jan (Johannes Gutenberg-Universität Mainz); Mrs ROSS, Kim (Johannes Gutenberg-Universität Mainz); Dr BECK, Marcus (Helmholtz-Institut Mainz and Johannes Gutenberg Universität Mainz); Dr SIMSON, Martin (Institut Laue-Langevin); Prof. ZIMMER, Oliver (Institut Laue Langevin); Mr HORN, Rishi (Johannes Gutenberg-Universität Mainz); Dr MAISONOBE, Romain (Institut Laue-Langevin); Mr VIROT, Romain (Institut Laue-Langevin); SOLDNER, Torsten (Institut Laue Langevin); Prof. HEIL, Werner (Institute of Physics)

Presenter: Mr WUNDERLE, Alexander (Johannes Gutenberg-Universität Mainz)

Session Classification: Poster Session

Contribution ID: **209** Type: **Poster**

The aSPECT experiment – Investigation of systematic uncertainties by Monte Carlo simulations

Tuesday, October 18, 2016 6:21 PM (1 minute)

The aSPECT retardation spectrometer measures the beta–neutrino angular correlation coefficient a in free neutron beta-decay. This measurement can be used to determine the ratio gA/gV of the weak coupling constants, as well as to search for physics beyond the Standard Model.
In 2013 aSPECT had a successful beam time at the Institut Laue-Langevin. The goal of this beam time is to improve the current uncertainty of a from Delta a/a = ~5% to about ~1%. The data analysis is in its final stage and nearly finished. In order to achieve an uncertainty of 1%, the systematics of aSPECT have to be understood accordingly. This is achieved by systematic tests and measurements of a with different parameter settings for the spectrometer during the beam time. Additionally, offline measurements have been performed to determine the effect on the systematics, e.g. the detector's edge effect, electrodes' work function fluctuations and the magnetic field ratio. These measurements are used as input for on-going simulations of the spectrometer to understand and reduce the systematic uncertainties further.
In this poster the current status of the electromagnetic field and particle tracking simulations is presented. This includes an overview of the simulation tools and the methods to investigate systematics, e.g the detectors' edge effect and the effect of the measured electrodes' work function fluctuations, and their influence on a.

Primary author: Mr SCHMIDT, Christian (Institute of Physics, Uni Mainz)

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Presenter: Mr SCHMIDT, Christian (Institute of Physics, Uni Mainz)

Session Classification: Poster Session

Contribution ID: **210** Type: **Oral**

The MuSun Experiment: First analysis of production data

Wednesday, October 19, 2016 3:00 PM (20 minutes)

Using a unique cryogenic time projection chamber as an active stopping target, the MuSun experiment has acquired the 10^{10} fully reconstructed muon decay events necessary to measure the rate of muon capture on the deuteron to better than 1.5\% precision. Once completed, the analysis will lead to a benchmark result in calibrating weak interactions in the two nucleon system, relevant for calculating fundamental nuclear reactions within modern effective field theories. MuSun employs a technique to extract the capture rate via measurement of the deviation of the negative muon lifetime in deuterium gas from the positive muon lifetime. Such a technique requires excellent gas purity, knowledge of the μd hyperfine state prior to capture, and verification that each muon stopped within the gas target. Advanced muon tracking algorithms have been developed to reduce systematic effects associated with muon catalyzed fusion interference, in addition to methods to estimate gas purity. These analysis tools are now being applied to the first high statistics production dataset from the 2014 run, consisting of 5×10^9 events. An overview of systematics will be presented, along with the status of the first analysis of production data.

Primary author: Ms RYAN, Rachel (University of Washington)

Co-author: THE MUSUN COLLABORATION, The MuSun Collaboration (University of Washington, PNPI, Boston University, University of Kentucky, Regis University)

Presenter: Ms RYAN, Rachel (University of Washington)

Session Classification: We - 3

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **211** Type: **Oral**

Ultracold neutrons at the Institut Laue Langevin in Grenoble, France

Wednesday, October 19, 2016 4:40 PM (20 minutes)

Due to their outstanding property to be storable and hence observable for long periods of time (several hundreds of seconds) in suitable material or magnetic traps, ultra-cold neutrons (UCN) with energies around 100 neV are an unique tool to study fundamental properties of the free neutron.
The ultracold neutron (UCN) and very cold neutron (VCN) facility PF2 (Physique Fondamentale 2) is one of two public installations at the Institut Laue Langevin (ILL) where fundamental properties of the free neutron can be studied. It came into operation in 1985 (TU Munich in collaboration with the ILL) and is ILL's only user instrument located on level D of the reactor building. Its close distance to the reactor core necessitates important safety measures, especially after the Fukushima event. After 30 years of successful and reliable operation, PF2 is still amongst the strongest UCN user source in the world, providing densities of up to 30 UCNs per cm3 with speeds less than 8 ms-1 at the different experimental positions. It also provides a unique beam of VCNs peaking around 10 nm. PF2 is a "high current DC source" with a constant flux and able to fill any experimental volume without load on the source. It offers four UCN beam positions, three in time sharing mode, and one VCN beam position to the users. While the user groups bring their dedicated equipment to the corresponding beam positions, the PF2 crew adapts it to the beam position, also ensuring smooth operation of the groups operating experiments in parallel at the various beam ports of PF2.
Since some years ILL is developing a next generation UCN source based on the production of UCNs in superfluid helium at an external beam of cold neutrons. Prototype sources showed very encouraging results so that within ILL's modernization programme a new facility "SuperSUN" will be built in the near future.
The latest achievements on the way to this new user facility will be presented.

Primary author: Dr GELTENBORT, Peter (Institut Laue-Langevin)

Co-authors: Prof. ZIMMER, Oliver (Institut Laue Langevin); Dr JENKE, Tobias (Institut Laue Langevin)

Presenter: Dr GELTENBORT, Peter (Institut Laue-Langevin)

Session Classification: We - 4

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **212** Type: **Poster**

MEG II experiment: Upgraded Liquid Xe Detector with SiPM readout

Tuesday, October 18, 2016 5:44 PM (1 minute)

The MEG II experiment is an upgraded experiment of MEG at PSI. MEG II aims to search the cLFV decay $\mu \to e + \gamma$ with one order of magnitude better sensitivity than MEG. Because the sensitivity is strongly affected by the accidental backgrounds, the resolutions of the detectors must be improved in MEG II.
The energy resolution of the γ detector is especially important for the $\mu \to e + \gamma$ search. The γ detector in MEG was a 900 l liquid Xe surrounded by 2-inch round 846 PMTs. This detector has been upgraded for MEG II by replacing 216 PMTs at γ entrance face with 4092 SiPMs (12 mm square shaped). Thanks to the better uniformity and the higher granularity of the scintillation photon readout, the energy and position resolutions are expected to improve by a factor of 2.
The SiPM for this upgrade was newly developed in collaboration with Hamamatsu Photonics K.K. It is sensitive to the ultra-violet scintillation light from Xe (photon detection efficiency > 15%), and the sensitive area is much larger than the standard ones. After a mass test of all SiPM chips, they were installed to the cryostat.
The detail of the upgraded detector, such as the alignment and readout of 4092 SiPMs and an operation of new cryogenic system, will be described in this presentation.

Primary author: Dr IEKI, Kei (University of Tokyo)

Presenter: Dr IEKI, Kei (University of Tokyo)

Session Classification: Poster Session

Contribution ID: **213** Type: **Oral**

Status report on the UCN/nEDM project at TRIUMF

Monday, October 17, 2016 12:00 PM (20 minutes)

A permanent non-zero electric dipole moment (nEDM) violates CP-symmetry. Beyond Standard Model theories predict nEDMs very close to the current upper limit of 3x10^(-26)ecm.
Those predictions result from CP-violating processes, which in turn can be related to the matter-antimatter asymmetry observed in our universe. Thus the search for an nEDM contributes to understanding the Baryon asymmetry, as well as it has a high discovery potential for Beyond Standard Model physics.
The tool of choice to investigate the nEDM are ultracold neutrons (UCN), since they have such low energies that they can be stored in traps and allow observation times of hundreds of seconds.

The goal of the UCN project at TRIUMF is to determine the nEDM to the 10^(-27)ecm level of precision. The distinct feature of TRIUMFs UCN facility is the combination of a neutron spallation source with a superfluid helium UCN converter - unique among all existing and planned UCN sources worldwide.
This presentation shall give an update on the current status of the UCN facility at TRIUMF and progress towards the design of a next-generation nEDM apparatus.

Primary author: Dr FRANKE, Beatrice (TRIUMF, Vancouver, Canada)

Presenter: Dr FRANKE, Beatrice (TRIUMF, Vancouver, Canada)

Session Classification: Mo - 2

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **214** Type: **Oral**

New insights into the proton radius puzzle and nuclear structure from muonic deuterium

Wednesday, October 19, 2016 12:00 PM (20 minutes)

In 2010 the CREMA collaboration measured the rms charge radius of the proton via laser spectroscopy of the 2S-2P Lamb shift in muonic hydrogen [1, 2]. Very recently the charge radius of the deuteron was determined [3]. Both measurements yield very precise charge radii but both values result 7 standard deviations away from the expected values, given by CODATA [4]. Follow-up measurements of the Lamb shift in muonic helium-3 and -4 ions have also been performed [5]. However, the data analysis is still ongoing and the theory needed for the extraction of the charge radii is not complete yet.
In this talk our recent result, the new deuteron charge radius will be discussed. Furthermore an outlook towards our upcoming results from muonic helium will be given. For muonic deuterium as well as for muonic helium an update on the recent progress in theory is presented where remaining questions are discussed and apparent inconsistencies between different sources especially in the two-photon exchange (TPE) contributions are resolved. These TPE contributions are of particular interest as they limit the accuracy of the extracted charge radii.
The results shown in this talk shed new light on the proton radius puzzle and give new insights in nuclear structure contributions.

[1] R. Pohl et al. - The size of the proton, Nature 466, 213 (2010)
[2] A. Antognini et al. - Proton Structure from the Measurement of 2S-2P Transition Frequencies of Muonic Hydrogen, Science 339, 417 (2013)
[3] R. Pohl et al. - Laser spectroscopy of muonic deuterium, Science 353, 6300 (2016).
[4] P.J. Mohr et al. - CODATA recommended values of the fundamental physical constants: 2010, Rev. of Mod. Phys. 84, 1527 (2012)
[5] A. Antongnini et al. - Illumination the proton radius conundrum: the μHe+ Lamb shift, Can.J.Phys. 89, 47-57 (2011)

Primary author: Mr KRAUTH, Julian J. (MPQ Garching)

Presenter: Mr KRAUTH, Julian J. (MPQ Garching)

Session Classification: We - 2

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **215** Type: **Poster**

VUV-sensitive MPPCs for liquid xenon detector in MEG II experiment

Tuesday, October 18, 2016 5:43 PM (1 minute)

The MEG II experiment is an upgrade of the MEG experiment to search for the charged lepton flavor violating decay of muon, $\mu^+ \to e^+\gamma$. The performance of the liquid xenon (LXe) γ-ray detector will be greatly improved with a highly granular scintillation readout realized by replacing 216 photomultiplier tubes (PMTs) on the γ-ray entrance face with 4092 Mult i-Pixel Photon Counters (MPPCs). For this purpose, we have developed a new t ype of large area MPPC which is sensitive to the LXe scintillation light in vacuum ultraviolet (VUV) range, in collaboration with Hamamatsu Photonics K. K. This MPPC is a discrete array of four $6 \times 6\,\mathrm{mm}^2$ chip, and a sufficiently short time constant for a single photoelectron waveform is achieved by connecting them in series. An excellent performance of MPP C has been confirmed in our test including high photon detection efficiency (> 15%) for LXe scintillation light. In this presentation, the performance o f our VUV-sensitive MPPC obtained from these tests will be reported.

Primary author: Mr OGAWA, Shinji (The University of Tokyo)

Presenter: Mr OGAWA, Shinji (The University of Tokyo)

Session Classification: Poster Session

Contribution ID: **216** Type: **Poster**

Thin scintillating fibers coupled to SiPMs for fast beam monitoring and timing purposes

Tuesday, October 18, 2016 5:40 PM (1 minute)

Thin scintillating fibers of 250 μm size coupled to silicon photomultipliers form the basis of a fast, versatile and modular detector technology usable in magnetic fields and vacuum. In view of the upcoming cLFV experiments MEGII and Mu3e, we will present its application for the purpose of beam monitoring and timing measurement. The challenge of these detectors lies in the ability to detect minimum ionizing paritcles at high efficiency while keeping the material budget to a minimum. Several detector prototypes have been tested along positron, muon and pion beams, showing that they are able to deliver prompt beam snapshots, to identify particles through charge discrimination and to provide timing resolutions of O(600 ps) at an efficency of > 95 %.

Primary author: RUTAR, Giada

Co-author: PAPA, Angela (Paul Scherrer Institut)

Presenter: RUTAR, Giada

Session Classification: Poster Session

Contribution ID: **217** Type: **Poster**

NoMoS: Beyond the Standard Model Physics in Neutron Decay

Tuesday, October 18, 2016 5:47 PM (1 minute)

The New Frontiers Group 'NoMoS' of the Austrian Academy of Sciences aims to search for traces of new physics in neutron beta decay with novel experimental techniques.
Precision measurements in neutron decay allow searching for physics beyond the Standard Model. An accuracy of 1E-4 in the observables corresponds to energy scales of 1 – 100 TeV for new particles and interactions; far above the production threshold at the LHC. To achieve this accuracy, a new technique is developed: R×B spectroscopy. An R×B spectrometer measures the momentum of charged particles by their drift in a circular magnetic field. This precision method will be applied to determine several correlations between decay products in neutron decay.
For measurements at ultimate statistics, the R×B spectrometer will be installed at PERC, a new facility at the FRM II in Garching/Germany that collects electrons and protons from a large neutron decay volume. A final goal is to measure or set limits on the Fierz term. This term is zero in the Standard Model and has not yet been measured with neutrons. A non-zero value would indicate the existence of exotic scalar or tensor currents, resulting from the exchange of yet unknown charged Higgs bosons, sleptons, or leptoquarks.
Besides the physics motivation, the measurement concept and physics programme of NoMoS are presented.

Primary author: Dr KONRAD, Gertrud (SMI Wien & Atominstitut)

Co-authors: Mr BROUSSE, Clément (SMI Wien & ECAM Strasbourg); Mr FILLUNGER, Harald (SMI Wien); Prof. ABELE, Hartmut (Atominstitut); Mr BOSINA, Joachim (SMI Wien & Institut Laue Langevin); Dr ZMESKAL, Johann (SMI Wien); Dr SUZUKI, Ken (SMI Wien); Dr PITSCHMANN, Mario (Atominstitut); Mr KLOPF, Michael (Atominstitut); Dr SOLDNER, Torsten (Institut Laue Langevin); Dr WANG, Xiangzun (Atominstitut)

Presenter: Dr KONRAD, Gertrud (SMI Wien & Atominstitut)

Session Classification: Poster Session

Contribution ID: **218** Type: **Poster**

High-Precision Mass Measurements with PENTATRAP

Tuesday, October 18, 2016 5:52 PM (1 minute)

The high-precision Penning-trap mass spectrometer PENTATRAP [1] is currently being commissioned at the Max-Planck-Institut für Kernphysik, Heidelberg. It aims at mass-ratio measurements of stable and long lived highly charged ions with a relative uncertainty of below 10-11, a precision so far only achieved for a few relatively light elements [2].
A unique feature of PENTATRAP is the experimental setup consisting of five cylindrical Penning traps [3], making simultaneous storage of several ion species, the reduction of the systematic errors and simultaneous in-situ calibration as well as reference measurements possible. The mass-ratio measurement is carried out by determining the free-space cyclotron frequency in the strong homogeneous magnetic field of a superconducting magnet. Long storage times due to a cryogenic environment and dedicated image current detection systems [4] with single ion sensitivity will lead to high-precision determinations of cyclotron frequencies in all traps.
Mass data at this level of precision have numerous applications, especially for tests of fundamental interactions and their symmetries, among others in neutrino physics research [5]. One such example is the determination of the Q-value of the electron capture transition in 163Ho to 163Dy in the sub-eV range, where PENTATRAP can contribute to initiatives aiming for an electron-neutrino mass measurement with a few 100 meV uncertainty using microcalorimetric techniques. The later work will be carried out for example within the ECHo collaboration [6], which investigates the de-excitation spectrum following the electron capture in 163Ho. In order to determine the mass, 163Ho needs to be ionized. As this isotope can only be produced in minute quantities a new ion source with lower losses during the ionization process, an electron beam ion trap including the wire-probe technique [7], is being set up at the moment.
The status of PENTATRAP, its technical developments as well as its applications will be presented.

Primary authors: Mr RISCHKA, Alexander (Max-Planck-Insitute für Kernphysik); Ms SCHÜSSLER, Rima (Max-Planck-Insitute für Kernphysik)

Co-authors: Mr SCHWEIGER, Christoph (Max-Planck-Institut für Kernphysik); Mr BEKKER, Hendrik (Max-Planck-Institute für Kernphysik); Dr CRESPO, José (Max-Planck-Institut für Kernphysik); Prof. BLAUM, Klaus Blaum (Max Planck Institut für Kernphysik); Mr DOOR, Menno (Max-Planck-Institut für Kernphysik); Mr FILIANIN, Pavel (Max-Planck-Institut für Kernphysik); Dr ELISEEV, Sergey (Max--Planck-Institut für Kernphysik); Dr ULMER, Stefan (RIKEN); Mr STURM, Sven (Max-Planck-Institut für Kernphysik); Dr NOVIKOV, Yuri (Petersburg Nuclear Physics Institute)

Presenters: Mr RISCHKA, Alexander (Max-Planck-Insitute für Kernphysik); Ms SCHÜSSLER, Rima (Max-Planck-Insitute für Kernphysik)

Session Classification: Poster Session

Contribution ID: **219** Type: **Oral**

Latest results of the ASACUSA antihydrogen program

Wednesday, October 19, 2016 9:50 AM (20 minutes)

The goal of the ASACUSA CUSP collaboration at the Antiproton Decelerator of CERN is to measure the ground-state hyperfine splitting of antihydrogen using an atomic spectroscopy beamline. The collaboration has recently succeeded in detecting 80 antihydrogen atoms 2.7 meters away from their production trap in a magnetic field free region [1]. This successful detection constitutes a milestone toward precision spectroscopy of antimatter atoms in a beam. In parallel to the progress on the antihydrogen production, the spectroscopy beamline has been tested with a source of hydrogen. This led to the most precise measurement of the hydrogen hyperfine splitting in a beam (ppm level) [2]. Unlike for hydrogen, the antihydrogen experiment is complicated by the difficulty of synthesizing enough cold anti atoms in ground state. However, a measurement of the hyperfine splitting of antihydrogen 3 orders of magnitude worse than what was achieved with the same spectroscopy setup with hydrogen would already provide a stringent test of CPT symmetry. My talk will present the latest developments and results with an emphasis on the spectroscopy apparatus. The coming years program will also be discussed.
[1] N. Kuroda et al., Nature Commun. 5, 3089 (2014).
[2] Diermaier et al., to be published

Primary author: Dr MALBRUNOT, Chloé (CERN)

Presenter: Dr MALBRUNOT, Chloé (CERN)

Session Classification: We - 1

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **220** Type: **Oral**

qBOUNCE, a Quantum Bouncing Ball Gravity Spectrometer

Wednesday, October 19, 2016 5:00 PM (30 minutes)

This talk focuses on the control and understanding of a gravitationally interacting elementary quantum system using the techniques of resonance spectroscopy. It offers a new way of looking at gravitation at short distances based on quantum interference. The ultra-cold neutron reflects from a mirror in well-defined quantum states in the gravity potential of the earth allowing the application of gravity resonance spectroscopy (GRS). GRS relies on frequency measurements, which provide a spectacular sensitivity. The neutron gives access to all parameters: distance, mass, curvature, energy-momentum tensor, and torsion.

Primary author: ABELE, Hartmut (Atominstitut)

Presenter: ABELE, Hartmut (Atominstitut)

Session Classification: We - 4

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **221** Type: **Oral**

Commissioning of new DC muon beam line, MuSIC-RCNP at Osaka University

Wednesday, October 19, 2016 12:20 PM (20 minutes)

We have constructed a new DC muon beamline, MuSIC (MUon Science Innovative muon beam Channel) at Research Center for Nuclear Physics (RCNP), Osaka University. The MuSIC comprises the world's most efficient DC muon source using the first pion capture solenoid system and muon beam transport magnets from the solenoid end to an experimental port.
We are now commissioning the beamline and alreadyobtained in-flight decay and surface muon beams in 2015. The surface muon beam yield is about 10^4 muon/(sec·1μA proton beam) and the in-flight decay muon yield is 10^4 −10^5 muon/(sec·1μA proton beam). We also measured beam profiles and spin precession amplitudes to calculate spin polarization of the muon beam.
After the beamline commissioning, we are planning variety of scientific programs, especially for muonic X-ray measurements with negative muons for nuclear physics, chemistry, and astrophysics. Condensed matter physics with μSR measurements also will be carried out. A design of new experimental apparatus for the μSR measurements is now in progress.
In our presentation, we will introduce the MuSIC beamline including results of the beamline commissioning and the status of development of the μSR apparatus, and then we will discuss future prospects for the MuSIC-RCNP beamline.

Primary author: Dr TOMONO, Dai (Osaka University)

Co-authors: Mr NANBU, Akihiro (Osaka University); Prof. TANIGUCHI, Akihiro (Kyoto University Research Reactor Institute); Dr SATO, Akira (Osaka University); Mr YOSHIDA, Go (Osaka University); Dr SAKAMOTO, Hideyuki (Osaka University); Dr NINOMIYA, Kazuhiko (Osaka University); Dr TAKAHISA, Keiji (Research Center for Nuclear Physics, Osaka University); Prof. HATANAKA, Kichiji (Research Center for Nuclear Physics, Osaka University); Prof. IEIRI, Masaharu (KEK); Dr MINAKAWA, Michifumi (KEK); Prof. FUKUDA, Mitsuhiro (Research Center for Nuclear Physics, Osaka University); Dr STRASSER, Patrick (KEK); Prof. MORINOBU, Shunpei (Research Center for Nuclear Physics, Osaka University); Mr SAITO, Takeshi (University of Tokyo); Dr MATSUZAKI, Teiichiro (RIKEN Nishina Center); Dr HIGEMOTO, Wataru (Advanced Science Research Center, Japan Atomic Energy Agency); Prof. MIYAKE, Yasuhiro (KEK-IMSS, J-PARC MUSE); Prof. MORI, Yoshiharu (Kyoto University Research Reactor Institute); Dr KAWASHIMA, Yoshitaka (esearch Center for Nuclear Physics, Osaka University); Prof. KUNO, Yoshitaka (Osaka University); Mr NAKAZAWA, Yu (Osaka University); Prof. SHIMOMURA, koichiro (KEK IMSS)

Presenter: Dr TOMONO, Dai (Osaka University)

Session Classification: We - 2

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **222** Type: **Oral**

Searches For Exotic Interactions with Slow Neutons

Monday, October 17, 2016 4:40 PM (30 minutes)

The ability of slow neutrons to interact coherently with macroscopic amounts of matter and with negligible decoherence opens an experimental window on certain aspects of beyond Standard Model physics. This talk will present results of some recent experiments which fit within this general category.

Primary author: SNOW, William (Indiana University)

Presenter: SNOW, William (Indiana University)

Session Classification: Mo - 4

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **223** Type: **Oral**

Measurement of muonic hydrogen 1S hyperfine splitting at RIKEN-RAL

Wednesday, October 19, 2016 3:20 PM (30 minutes)

All the hierarchy down to hadron, matter can be divided into constituent particles, but hadron like proton, which have finite size and consist from infinite number of quarks and gluons, cannot be subdivided. Thus, how they are formed and the internal structures are the matter of interest for long time. Recently, the proton charge radius was measured by Lamb-shift of muonic hydrogen atom. This muon measurement is 10 times more accurate than that of electron measurements, and remarkably smaller. This unacceptable discrepancy triggers a question "what about the magnetic-radii of proton?" If this discrepancy is real, we might need to modify the Standard Theorem, and the modification could affect to the magnetic radius as well. We plan a laser spectroscopy on hyperfine splitting of muonic hydrogen. The muonic hydrogen ground state is spin-singlet 1S (F = 0), in which muon and proton spins are combined in opposite direction so that it is totally un-polarized. However, we can re-polarize muonic atoms to 1S (F = 1) by irradiating circular-polarized laser having wavelength exactly at hyperfine splitting energy of the atom (laser pumping), and apply μSR technique to detect the re-polarization (probe). The hyperfine splitting energy is sensitive to the proton electro-magnetic form factor, so we can study the internal structure of the proton by using muon. Muon has 200 times better sensitivity to the proton radius than electron, because it locates much closer to the proton (atomic size is 1/207 of the ordinary hydrogen atom). Combining with muonic hydrogen Lamb-shift measurement, we can identify whether there is any further mystery exist or not in proton spatial size, radii.

Primary author: Prof. IWASAKI, Masahiko (RIKEN)

Presenter: Prof. IWASAKI, Masahiko (RIKEN)

Session Classification: We - 3

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **224** Type: **Oral**

Light and weakly coupled dark sectors, and muon physics

Thursday, October 20, 2016 3:00 PM (30 minutes)

I give an overview of some puzzling results involving muons (g-2, muonic hydrogen Lamb shift, semileptonic
decays of B-mesons etc). Their theoretical explanations often invoke new physics
in form of light and weakly coupled particles, that is possible to test in high intensity experiments. Many new ideas for such tests have been proposed over the recent years, some followed up by concrete experimental efforts. A selection of such ideas/results will be given.

Primary author: Prof. POSPELOV, Maxim (Perimenter Institute / Univ. of Victoria)

Presenter: Prof. POSPELOV, Maxim (Perimenter Institute / Univ. of Victoria)

Session Classification: Th - 3

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **225** Type: **Oral**

Fundamental physics with antihydrogen

Wednesday, October 19, 2016 9:00 AM (30 minutes)

Two decades after the first production of (relativistic) antihydrogen atoms, and a good decade after the first production of "cold" antihydrogen, first measurements of the properties of antihydrogen have recently begun. Together with the start-up of an additional dedicated low energy antiproton decelerator (ELENA), and the development of a wide range of techniques that permit precise atomic measurements, the study of antihydrogen atoms is set to start in earnest. This presentation will provide an overview of the present status and outlook for fundamental physics with antihydrogen atoms.

Primary author: DOSER, michael (cern)

Presenter: DOSER, michael (cern)

Session Classification: We - 1

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **226** Type: **Oral**

Atomic-Physics Searches for Dark Energy

Monday, October 17, 2016 3:00 PM (30 minutes)

We will present new techniques to detect these particles, relying on interferometry with cold atoms in vacuum. The low density of such atoms compared to bulk matter avoids triggering some screening mechanisms, while the high sensitivity of the interferometer overcomes other screening mechanisms by brute force. We will show limits ruling out substantial regions of parameter space for chameleons and symmetrons [Science 349, 849 (2015)] and argue that an interferometer with 10,000 fold improved sensitivity will be able to search the gamut of screened scalar fields. A positive identification would revolutionize particle physics and cosmology, but even a null result would have important implications for our understanding of the dark sector.

Primary author: Prof. MÜLLER, Holger (UC Berkeley)

Presenter: Prof. MÜLLER, Holger (UC Berkeley)

Session Classification: Mo - 3

Track Classification: Searches for symmetry violations and new forces

Contribution ID: **227** Type: **Oral**

Flavour Physics in and beyond the Standard Model

Thursday, October 20, 2016 11:30 AM (30 minutes)

In this talk I review the status of flavour physics. I first discuss the theoretical progress of the Standard Model calculations and how they compare to the experimental measurements of BELLE, BABAR, LHCb and MEG. While most observables are in excellent agreement with the theory predictions, in the last years hints for lepton flavor non-universality in channels with muons and tau leptons accumulated. I discuss the implications of these anomalies for model building and their implications for other new physics searches like mu->e+gamma and mu->3e.

Primary author: CRIVELLIN, Andreas (PSI)

Presenter: CRIVELLIN, Andreas (PSI)

Session Classification: Th - 2

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **229** Type: **Oral**

Present status and future experiments in fundamental muon physics

Wednesday, October 19, 2016 2:30 PM (30 minutes)

Current and planned experiments using muons as a probe, or as particle to be studied in and of itself, continue to shed light on fundamental physics many decades after its discovery. We continue to be fascinated by the atomic physics implications of the muonic Lamb shift measurements on the proton radius, the nuclear astrophysics implications related to determining the muon capture rate in deuterium, and the highly-sensitive particle physics tests centered on charged lepton flavor violation (LFV) searches and on the comparison of the muon's anomalous magnetic moment to the Standard Model prediction. Innovative and new experimental efforts at J-PARC, Fermilab, and PSI are all being prepared now. These will improve the precision on muonium hyperfine splitting and on the muon g-2 significantly. They will explore new clues related to the proton radius puzzle. They will make an unprecedented assault on LFV with a next-generation μ⟶eɣ experiment, an ambitious μ⟶eee initiative, and two major μ⟶e conversion experiments; the latter aim for up to four orders of magnitude sensitivity improvements compared to previous limits. The aim of this talk will be to briefly paint this broad overview – other speakers will provide details – and then focus on the new g-2 experiment that will start within the next year.

Primary author: Prof. HERTZOG, David (University of Washington)

Presenter: Prof. HERTZOG, David (University of Washington)

Session Classification: We - 3

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **230** Type: **Poster**

Development of a high-brightness muonium beam

Tuesday, October 18, 2016 6:02 PM (1 minute)

Muonium is the bound state of an antimuon with an electron (mu+e-). Muonium is an ideal tool to perform precision measurements of fundamental parameters. This poster presents our ideas to develop a high-brightness muonium source at the Paul Scherrer Institut (PSI). The muonium beam will be produced by deflecting a slow, high-brightness muon beam (currently under development by muCool collaboration) into the vertical direction and letting it impinge on a thin film of superfluid helium at 100 mK. Inside the superfluid helium muonium is formed with high efficiency and once it diffuses to the surface emitted into vacuum as a beam. Such a high-brightness muonium source enables various interesting measurements as , e.g., the detection of the 1s-2s energy interval of muonium or the gravitational interaction of muonium – a test of the gravitational interaction of antimatter and 2nd generation particles.

Primary author: Mr RITJOHO, Narongrit (PhD at Paul Scherrer Institut)

Co-authors: ANTOGNINI, Aldo Sady (Paul Scherrer Institut); KNECHT, Andreas (Paul Scherrer Institut); KIRCH, Klaus Stefan (Paul Scherrer Institut)

Presenter: Mr RITJOHO, Narongrit (PhD at Paul Scherrer Institut)

Session Classification: Poster Session

Contribution ID: **232** Type: **Poster**

News on the laser based Hg Co-magnetometer for the nEDM experiment at PSI

Tuesday, October 18, 2016 6:11 PM (1 minute)

At the Paul Scherrer Institut an international collaboration searches for a permanent electric dipole moment of the neutron, which is a sensitive probe for physics beyond the Standard Model. This experiment requires very sensitive magnetometers to correct for systematic errors related to magnetic field fluctuations. We present progress on a co-magnetometer which detects the spin precession frequency of 199-Hg atoms in the same volume as the neutrons. 204-Hg discharge lamps, used so far, are replaced by a new laser system, which results in higher sensitivity of the magnetometer.
This work is supported by the SNF under grant 200020_144473.

Primary author: Ms KOMPOSCH, Sybille (ETHZ)

Presenter: Ms KOMPOSCH, Sybille (ETHZ)

Session Classification: Poster Session

Contribution ID: **233** Type: **Poster**

Monte Carlo simulations for the neutron EDM experiment at TRIUMF

Tuesday, October 18, 2016 6:32 PM (1 minute)

UCN source and nEDM experiment are currently under construction at TRIUMF. This poster presents simulations and development of the Monte Carlo program PENTrack, for the nEDM experiment. The latest modifications of PENTrack make it possible to run full Ramsey cycle simulations. This is an invaluable tool for analyzing the systematic and statistical errors associated with the nEDM experiment. The subsequent simulations look at shifts in the Larmor frequency due to inhomogenieties in the magnetic fields. The poster will show the principle of the simulation code, and present first results from PENTrack.

Primary author: Mr CHRISTOPHER, Nicholas (TRIUMF UCN Collaboration)

Presenter: Mr CHRISTOPHER, Nicholas (TRIUMF UCN Collaboration)

Session Classification: Poster Session

Contribution ID: **234** Type: **Poster**

Magnetometry for a next generation neutron EDM experiment

Tuesday, October 18, 2016 5:58 PM (1 minute)

Experiments searching for the electric dipole moment of the neutron (nEDM) require a stable and homogeneous main magnetic field. Statistical errors in such experiments can be dominated by fluctuating magnetic fields if the relevant magnetic-field parameters cannot be measured with sufficient precision and accuracy. Improvements in nEDM sensitivity are thus not possible without improving the magnetometry systems that measure the magnetic field parameters. In addition, systematic errors in nEDM experiments strongly depend on the profile of the magnetic field, since many such errors are related to magnetic-field gradients. We report on our strategy to suppress statistical and systematic errors in our next-generation nEDM experiment using magnetometers based on Hg, Cs [1,2], and 3He[3,4].

[1] S. Afach, G. Ban, G. Bison, et al. Highly stable atomic vector magnetometer based on free spin precession. Opt. Exp. 23 (17):22108–15, 2015.
[2] Z. D. Grujic, P. A. Koss, G. Bison, and A. Weis. A sensitive and accurate atomic magnetometer based on free spin precession. Eur. Phys. J. D, 69(5), 2015.
[3] H.-C. Koch, G. Bison, Z.D. Grujić, et al. Design and performance of an absolute 3He/Cs magnetometer. Euro. Phys. J. D, 69 (8), 2015.
[4] H.-C. Koch, G. Bison, Z.D. Grujić, et al. Investigation of the intrinsic sensitivity of a 3He/Cs magnetometer. Euro. Phys. J. D, 69 (11), 2015.

*for the nEDM collaboration.

Primary author: Dr BISON, Georg (Paul Scherrer Institut)

Presenter: Dr BISON, Georg (Paul Scherrer Institut)

Session Classification: Poster Session

Contribution ID: **235** Type: **Poster**

Neutron interferometry constrains dark energy chameleon fields

Tuesday, October 18, 2016 5:59 PM (1 minute)

Observational cosmology has determined the dark matter and dark energy density parameters to an accuracy of two significant figures. While dark energy explains the accelerated expansion of the universe, dark matter is needed in order to describe the rotation curves of galaxies and the large-scale structure of the universe. However, the true nature of dark energy and the content of dark matter remain a mystery. The two most obvious candidates for dark energy are either Einstein's cosmological constant or quintessence theories, where the dynamic vacuum energy changes over time.
Worldwide efforts are undertaken to shed light on this unsatisfactory situation. Here, the neutron plays a key role, as many different neutron experiments allow to test hypothetical dark matter and dark energy scenarios in the lab.
Here, we present phase shift measurements for neutron matter waves in vacuum and in low pressure Helium using a method originally developed for neutron scattering length measurements in neutron interferometry. These measurements are used to search for phase shifts associated with a coupling to scalar fields. Stringent experimental limits for a scalar chameleon field are set.

Primary author: Dr JENKE, Tobias (Institut Laue-Langevin)

Co-authors: Dr IVANOV, A.N. (ATI Vienna); Dr PIGNOL, Guillaume (LPSC Grenoble); Dr LEMMEL, H. (ATI Vienna); ABELE, Hartmut (Atominstitut); Dr PITSCHMANN, M. (ATI Vienna); Dr POTOCAR, T. (ATI Vienna)

Presenter: Dr JENKE, Tobias (Institut Laue-Langevin)

Session Classification: Poster Session

Contribution ID: **236** Type: **Poster**

Muon Beam Monitoring Using Luminophore Foils at PSI

Tuesday, October 18, 2016 6:00 PM (1 minute)

The Paul Scherrer Institut will host two next generation charged lepton flavor violation experiments, MEG~II and Mu3e, utilizing the world?s highest intensity continuous muon beams at more than 10^8~μ^+/s. Critical to these experiments is online monitoring of the muon beam rate and profile throughout data-taking. A novel technique using a 5~μm luminophore layer of CsI(Tl) deposited on PET/MYLAR foils and directly imaged using a CCD is presented. Results from recent test beams at the PiE5 beamline using 28~MeV/c muons are also presented, showing luminophore foils provide a fast measurement of beam quality with negligible impact.

Primary author: HODGE, Zachary Donovan (Paul Scherrer Institut)

Presenter: HODGE, Zachary Donovan (Paul Scherrer Institut)

Session Classification: Poster Session

Contribution ID: **237** Type: **Poster**

Measurement of Direct Muon Atomic Radiative Capture in Lead

Tuesday, October 18, 2016 6:06 PM (1 minute)

Parity violating processes are expected in muon interactions with nuclei, with possible new physics contributions dominating, but are as of yet unobserved. The use of muons captured directly into the 2S state of a high Z (\textgreater~30) material and measurement of the $2S_{1/2}$-$1S_{1/2}$ transition photon angular asymmetry would provide a measurement of any parity violation. As a prerequisite for such a parity violation search, measurement of the photon stemming from the muon atomic radiative capture process into the 2S or 1S state, which has never before been measured, would be required as a first step. This has been conducted at the Paul Scherrer Institut using a 36 MeV/c~μ^- beam on a thin lead target, and the results of this measurement are presented.

Primary author: HODGE, Zachary Donovan (Paul Scherrer Institut)

Presenter: HODGE, Zachary Donovan (Paul Scherrer Institut)

Session Classification: Poster Session

Contribution ID: **238** Type: **Poster**

High precision analytical description for beta spectroscopy probing (Beyond) Standard Model physics.

Tuesday, October 18, 2016 5:55 PM (1 minute)

Precise knowledge of the nuclear beta spectrum shape forms a sensitive instrument in the pursuit of Beyond Standard Model (BSM) physics. It opens up possibilities for scalar and tensor current searches and allows for a study of nuclear structure dependent effects through the weak magnetism interaction [N. Severijns et al. Rev. Mod. Phys. 78, 991 (2006)]. The latter is a contamination of the strong interaction, and forms an essential component in the analysis of the reactor antineutrino anomaly [P. Huber PRC 84, 024617 (2011)]. In the correct analysis of the latter, all sizeable corrections to the beta spectrum shape enter - including atomic effects. Theoretical work has been performed to analytically describe all known correction factors to the beta spectrum shape to below the per mille level, including aforementioned atomic and molecular effects [L. Hayen, to be published]. This allows for a significantly improved spectrum conversion in the reactor antineutrino anomaly, and the most precise extraction of (B)SM physics from the beta spectrum shape to date.

Primary author: Mr HAYDEN, Leendert (Instituut voor Kern- en Stralingsfysica, KU Leuven, Belgium)

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Presenter: Mr HAYDEN, Leendert (Instituut voor Kern- en Stralingsfysica, KU Leuven, Belgium)

Session Classification: Poster Session

Contribution ID: **239** Type: **Poster**

Searching for axion-like particles with the nEDM experiment at the Paul Scherrer Institute

Tuesday, October 18, 2016 5:56 PM (1 minute)

The strong CP problem may be solved by turning the theta parameter into a dynamic field. Excitations of this field are axions, which are also good cold dark matter candidates. The nEDM experiments are sensitive to interactions with a background field of ultralight axions, which would appear as oscillations in the measured neutron electric dipole moment. This analysis presents the first laboratory constraints on the axion-gluon coupling. Sensitive for periods from minutes to decades, we probe over 8 orders of magnitude in mass.

Primary authors: Mr RAWLIK, Michał (ETH Zürich); Mr AYRES, Nicholas (University of Sussex)

Co-author: NEDM, Collaboration (at PSI)

Presenters: Mr RAWLIK, Michał (ETH Zürich); Mr AYRES, Nicholas (University of Sussex)

Session Classification: Poster Session

Contribution ID: **240** Type: **Oral**

The mu+ -> e+ gamma decay search with the full dataset of the MEG experiment

Thursday, October 20, 2016 4:10 PM (20 minutes)

Lepton flavor violation (LFV) research is currently one of the most exciting branches of particle physics due to its high sensitivity to new physics. The observation of neutrino oscillations has clearly demonstrated that neutral lepton flavor is not conserved. This implies that charged LFV (cLFV) processes, such as the mu+ -> e+ gamma decay, can also occur in the Standard Model (SM), although strongly suppressed. On the other hand, Beyond SM (BSM) extensions strongly enhance the predictions for cLFV branching ratios. Therefore such decays are ideal probes for new physics.

The MEG experiment at the Paul Scherrer Institut searches for the mu+ -> e+ gamma decay and has completed the data collection at the end of the 2013. The analysis of the full data set acquired in the period 2009-2013 for a total amount of 7.5 x 10^14 stopped muons on the target will be presented. A new upper limit on the branching ratio of this decay of 4.2 x 10^-13 (90% confidence level) has been established. It is a factor 30 improvement over the previous limit set by the MEGA experiment and also the strongest bound on any forbidden decay particle.

Primary author: PAPA, Angela (Paul Scherrer Institut)

Presenter: PAPA, Angela (Paul Scherrer Institut)

Session Classification: Th - 3

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **241** Type: **Oral**

SuperSUN – a new infrastructure for experiments with ultracold neutrons at ILL

Monday, October 17, 2016 5:30 PM (15 minutes)

Conversion of cold to ultracold neutrons (UCNs) via single-phonon emission in superfluid helium has been proposed forty years ago by Golub and Pendlebury as a viable mechanism to achieve high densities of UCNs at the end of a neutron guide. Building on practical experience from two prototypes based on this mechanism, and able to provide UCNs to user experiments at room temperature, the new UCN source SuperSUN is currently being developed at the ILL. It will be located at an end position of a white, cold neutron beam and is designed as a single-user facility. The facility will primarily be suited for UCN storage experiments employing small-to-medium size storage cells but may also advance experiments that require continuous UCN extraction in a strongly restricted phase space element. Equipped with a magnetic multipole reflector around the helium converter, the UCN ensemble will be accumulated with high polarisation due to the Stern-Gerlach forces leading to spin-dependent UCN storage lifetimes. The projected spatial-mean saturation density is 1600 UCNs per ccm for energies up to 230 neV within 12 litres of ultrapure superfluid 4He held below 0.6 K. This talk will present the design concept and the status of the project.

Primary author: Prof. ZIMMER, Oliver (Institut Laue Langevin)

Presenter: Prof. ZIMMER, Oliver (Institut Laue Langevin)

Session Classification: Mo - 4

Track Classification: Advanced muon and ultracold neutron sources

Contribution ID: **242** Type: **Poster**

Design and performance of the proposed cold neutron beam facility for particle physics at the ESS

Tuesday, October 18, 2016 6:23 PM (1 minute)

Pulsed beams have tremendous advantages for precision experiments with cold neutrons. In order to minimize and measure systematic effects, they are used at continuous sources in spite of the related substantial decrease in intensity. At the pulsed neutron source ESS, such experiments will gain up to a factor of 30 in event rate, and novel concepts become feasible. Therefore, the cold neutron beam facility for particle physics ANNI was proposed as part of the ESS instrument suite. The poster will present design considerations, proposed layout and expected performance of the instrument.

Primary authors: Dr MÄRKISCH, Bastian (Physikalisches Institut, Universität Heidelberg); Dr THEROINE, Camille (ESS); Dr KONRAD, Gertrud (SMI Wien & Atominstitut, Austria); ABELE, Hartmut (Atominstitut); SOLDNER, Torsten (Institut Laue Langevin); Dr SCHMIDT, Ulrich (Physikalisches Institut der Uni Heidelberg)

Presenter: SOLDNER, Torsten (Institut Laue Langevin)

Session Classification: Poster Session

Contribution ID: **243** Type: **Poster**

A new muon beam line for fundamental physics study in J-PARC

Tuesday, October 18, 2016 6:27 PM (1 minute)

Since the first beam in 2008, Muon Facility in J-PARC has been operated, and the surface muon beam intensity
reached at the 3E+6/s, the most intense pulsed muon beam in the world, under 200-kW proton beam.
From the existing 2-cm thick graphite target, four secondary muon beam lines are able to be extracted to the
experimental areas.
Three beam lines were constructed and under operation.
They are dedicated to material science.
The last beam line is planed to be constructed.
This beamline is designed to have a large acceptance, momentum tunablity, and ability to install a kicker and a Wien
filter, and will provide an intense beam for fundamental study in the field of elementary particle physics.
Such a study needs to occupy the experimental area for a long time in comparison with material-science programs.
The fourth beam line is constructed to answer such demands.
The details of the beamline design and the construction schedule will be presented.

Primary author: Dr KAWAMURA, Naritoshi (KEK)

Presenter: Dr KAWAMURA, Naritoshi (KEK)

Session Classification: Poster Session

Contribution ID: **244** Type: **Poster**

Status of the PSI UCN source

Tuesday, October 18, 2016 6:24 PM (1 minute)

Ultra-cold Neutrons (UCN) are a very prominent tool in fundamental physics since they can be stored due to their low kinetic energy below 300 neV. The UCN source at PSI has been in operation since 2011. Fast neutrons, produced by guiding PSI's high intensity 590 MeV proton beam on a lead spallation target, are frst thermalized in D2O and then moderated into the cold regime using solid D2 (sD2) held at 5 K. Afterwards, the neutrons lose almost their entire kinetic energy through phonon excitation of the sD2 lattice and become UCN that can be guided to various experiments.
This report presents the current status and performance of the source, as well as new findings concerning the optimization of the UCN output.
Support from SNF # 200020 163413 is acknowledged.

Primary author: HILD, Nicolas

Co-author: -, on behalf of the UCN Team at PSI (PSI)

Presenters: HILD, Nicolas; -, on behalf of the UCN Team at PSI (PSI)

Session Classification: Poster Session

Contribution ID: **245** Type: **Oral**

The search for an electric dipole moment of the neutron at PSI

Monday, October 17, 2016 12:40 PM (20 minutes)

For more than fifty years physicists have tried to measure the electric dipole moment of the neutron (nEDM). The limit on the nEDM has become smaller and smaller, but at present its value remains consistent with zero. However, the Standard Model of particle physics predicts a small non-zero value, as do the various extensions of the Standard Model. The predictions span several orders of magnitude, making the measurement of the nEDM an excellent probe for beyond Standard Model physics. Additionally, the T- and P-violation that a non-zero nEDM would imply, could shed some light on the origin of the baryon asymmetry that is observed in our universe.
Presently, our international collaboration is running the world's most sensitive nEDM experiment at the ultra cold neutron source of the Paul Scherrer Institute (PSI). In this talk I will give a general overview of the experimental technique, discuss recent improvements insensitivity and elaborate on advances in our understanding of systematic effects.

Primary author: Ms WURSTEN, Elise (KU Leuven)

Presenter: Ms WURSTEN, Elise (KU Leuven)

Session Classification: Mo - 2

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **246** Type: **Poster**

Neutron moderators for the European Spallation Source

Tuesday, October 18, 2016 6:26 PM (1 minute)

The design of the neutron moderators for the European Spallation Source, intended to be installed at the start of operations of the facility in 2019 has now been finalized and the moderators are being fabricated.
Among the driving principles in the design have been flexibility for instruments to have access to cold and thermal neutrons with highest possible source brightness.
Different design and configuration options were evaluated. The final configuration accepted for construction foresees two moderators with identical para-hydrogen (so-called "butterfly") shape, but different heights, placed above and below the spallation target. Both moderators are able to serve the full 2 x 120° beam extraction sectors of instrument suite. The top, 3-cm tall moderator, has both high thermal and high cold brightness, more than by a factor of 2.5 compared to the previous design of the Technical Design Report. The bottom, 6-cm tall moderator, has lower brightness and emits 1.3 times higher total intensity integrated over the 2 times larger emission surfaces.

Primary author: KLINKBY, Esben (DTU / ESS)

Co-authors: TAKIBAEV, A. (European Spallation Source ERIC, Tunavägen 24, 223 63 Lund, Sweden); MEZEI, F. (European Spallation Source ERIC, Tunavägen 24, 223 63 Lund, Sweden); BATKOV, K. (European Spallation Source ERIC, Tunavägen 24, 223 63 Lund, Sweden); ZANINI, L. (European Spallation Source ERIC, Tunavägen 24, 223 63 Lund, Sweden); SCHOENFELDT, T. (European Spallation Source ERIC, Tunavägen 24, 223 63 Lund, Sweden)

Presenter: KLINKBY, Esben (DTU / ESS)

Session Classification: Poster Session

Contribution ID: **247** Type: **Poster**

Data Acquisition with GPUs for the Muon g-2 Experiment at Fermilab

Tuesday, October 18, 2016 6:25 PM (1 minute)

A new measurement of the anomalous magnetic moment of the muon, $a_\mu \equiv (g-2)/2$, will be performed at the Fermi National Accelerator Laboratory. The most recent measurement, performed at Brookhaven National Laboratory from 1999 to 2001, shows a 3.3-3.6 standard deviation discrepancy with the standard model value of g-2. The new measurement will accumulate 21 times those statistics, measuring g-2 to 140 ppb and improving the uncertainty by a factor of 4 over that of the previous measurement.

The data acquisition system for this experiment must have the ability to create deadtime-free records from 700 μs muon spills at a raw data rate 18.6 GB per second. Data will be collected using 1296 channels of μTCA-based 800 MSPS, 12 bit waveform digitizers and processed in a layered array of networked commodity processors with 24 GPUs working in parallel to perform a fast recording of the muon decays during the spill. The system will be controlled using the MIDAS data acquisition software package. The described data acquisition system is currently being commissioned, and will be fully operational before the start of the experiment in 2017.

Primary author: Dr GOHN, Wesley (University of Kentucky)

Presenter: Dr GOHN, Wesley (University of Kentucky)

Session Classification: Poster Session

Contribution ID: **252** Type: **not specified**

Status of HIPA Facility at PSI

Monday, October 17, 2016 9:10 AM (20 minutes)

Presenter: GRILLENBERGER, Joachim Kurt (Paul Scherrer Institut)

Session Classification: Mo - 1

Contribution ID: **253** Type: **not specified**

Welcome

Monday, October 17, 2016 9:00 AM (10 minutes)

Presenter: KIRCH, Klaus Stefan (Paul Scherrer Institut)

Session Classification: Mo - 1

Contribution ID: **254** Type: **not specified**

Information on Fundamental Physics @ the ESS

Monday, October 17, 2016 6:30 PM (30 minutes)

Primary authors: Dr KONRAD, Gertrud (SMI Wien & Atominstitut, Austria); SOLDNER, Torsten (Institut Laue Langevin)

Presenters: KONRAD, G.; SOLDNER, T.

Session Classification: Mo - 4

Contribution ID: **255** Type: **not specified**

The COMET program

Thursday, October 20, 2016 2:30 PM (30 minutes)

Presenter: Dr MIHARA, Satoshi (KEK)

Session Classification: Th - 3

Contribution ID: **256** Type: **not specified**

Outlook

Thursday, October 20, 2016 4:30 PM (10 minutes)

Presenter: Prof. FILIPPONE, Brad (caltech)

Session Classification: Th - 3

Contribution ID: **257** Type: **Poster**

Monte Carlo Programs for Muon Decays at NLO

Tuesday, October 18, 2016 6:07 PM (1 minute)

Using the amplitude provided by GoSam, a tool for the automated generation of tree level and one-loop amplitudes, fully differential NLO corrections were obtained for the three decay channels of the muon: The conventional or Michel decay $\mu \to \nu\bar{\nu}e$, the radiative decay $\mu \to \nu\bar{\nu}e\gamma$ and the rare decay $\mu \to \nu\bar{\nu}eee$. Especially the latter two are important Standard Model backgrounds to searches for Lepton Flavour Violation at the PSI experiments MEG and Mu3e as they become indistinguishable when the neutrinos carry little energy. With our NLO program we are able to compute custom tailored observables for the experiments, especially in this region of the phase space.

Primary author: Mr ULRICH, Yannick (PSI / UZH)

Co-authors: SIGNER, Adrian (PSI); LUISONI, Gionata (CERN); PRUNA, Giovanni Marco (PSI)

Presenter: Mr ULRICH, Yannick (PSI / UZH)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **258** Type: **Poster**

A Scintillation Stopping Target for the MEG II Experiment

Tuesday, October 18, 2016 6:33 PM (1 minute)

The detection of events excluded by the Standard Model would be an unambiguous sign of new physics. The MEG Experiment has reached the most stringent upper limit of 4.2 10-13 , in its search for the lepton flavor violating decay mu->e+gamma. The increased beam rate in the MEG-II upgrade experiment requires an improved stopping target. We are investigating the use of a scintillation target, viewed by a CCD camera, also usable as a beam monitoring system providing direct information about the beam centre, beam profile and the total intensity. The results of the first tests will be presented.

Primary author: Mr BERG, Felix Anton (PSI)

Presenter: Mr BERG, Felix Anton (PSI)

Session Classification: Poster Session

Track Classification: Advanced detector technologies

Contribution ID: **259** Type: **not specified**

Final words

Thursday, October 20, 2016 4:40 PM (2 minutes)

Presenter: KIRCH, Klaus Stefan (Paul Scherrer Institut)

Session Classification: Th - 3

Contribution ID: **260** Type: **Oral**

PULSTAR UCN source: studying solid deuterium growth and evolution

Wednesday, October 19, 2016 5:30 PM (20 minutes)

Solid deuterium is one of the two practical choices for making UCN convertors at modern UCN sources. The quality of the solid deuterium (SD2) crystal is crucial for obtaining a high UCN yield. The growth of deuterium was intensively studied for small targets in fusion and neutrino mass experiments, also in a somewhat larger size in preparation for the operation of the PSI UCN source. At PULSTAR we are able to study deuterium growth in a full-sized cryostat. A summary of the results of recent runs will be presented.

Primary author: Dr KOROBKINA, Ekaterina (NC State University)

Presenter: Dr KOROBKINA, Ekaterina (NC State University)

Session Classification: We - 4

Track Classification: Advanced muon and ultracold neutron sources

Contribution ID: **261** Type: **Poster**

Study of Discrete Symmetry Breaking Effects in Neutron-induced Compound States

Tuesday, October 18, 2016 6:35 PM (1 minute)

The neutron absorption in eV region is dominated by capture process via well-resolved compound states. The breaking of the spatial inversion symmetry is known to be largely enhanced in p-wave compound resonances according to the interference in the entrance channel between neighboring resonances with different angular momentum of incident neutrons. The entrance-channel interference naturally implies the interference between components with different channel spins. Such interference is theoretically predicted to cause an enhancement in the observation of T-odd spin correlation terms which may contained in mesonnucleon interactions. Assuming the CPT-theorem, the enhanced sensitivity to Tviolation introduces a new type of CP-violation search beyond the standard model, which may be competitive with other experimental searches such as the neutron electric-dipole-moment measurement. We discuss the study of the interference mechanism to quantify the experimental sensitivity to T-violation and discuss possible experiments with the pulsed neutron beam from intense spallation neutron sources.

Primary authors: NOPTREX, Collaboration (—); Prof. SHIMIZU, Hirohiko (Nagoya University)

Presenter: Prof. SHIMIZU, Hirohiko (Nagoya University)

Session Classification: Poster Session

Track Classification: Fundamental physics and precision experiments with muons, pions, neutrons, antiprotons, and other particles

Contribution ID: **263** Type: **Poster**

Neutron decay measurements with PERKEO III

Tuesday, October 18, 2016 6:37 PM (1 minute)

Neutron beta decay is an excellent system to study the charged weak interaction experimentally. The decay is precisely described by theory and unaffected by nuclear structure effects. Observables are numerous correlation coefficients which e.g. relate the spin of the neutron and the momenta of the particles, spectra and the neutron lifetime. Most importantly, precision measurements in neutron beta decay are used to investigate the structure of the weak interaction beyond the V-A of the standard model and to derive the element Vud of the CKM matrix.

The instrument PERKEO III was used to investigate angular correlations of the emission directions of all three decay products with respect to the neutron spin using a pulsed cold neutron beam. The measurement of the beta asymmetry A is the most precise way to determine ratio of coupling constants $\lambda = gA / gV$. Combining this result with the proton asymmetry C or the neutrino asymmetry B allows to derive limits on non-standard couplings. For the determination of B and C, a combined detector system, allowing the
simultaneous detection of electrons and protons, was used.

This poster will the present the detection concept and the current status of the measurements performed at the PF1B cold neutron beam line at the Institut Laue-Langevin in Grenoble.

Primary author: Mr ROICK, Christoph (TU Muenchen)

Co-authors: PETHOUKHOV, A. (Institut Laue-Langevin, Grenoble); Prof. MÄRKISCH, Bastian (Technische Universität München); WERDER, D. (Physikalisches Institut, Universität Heidelberg); DUBE-BRS, Dirk (Physikalisches Institut, Universität Heidelberg); KONRAD, G. (Atominstitut, Technische Universität Wien & Stefan Meyer Institut, Wien); MEST, H. (Physikalisches Institut, Universität Heidelberg); SAUL, H. (Atominstitut, Technische Universität Wien & Technische Universität München); ABELE, Hartmut (Atominstitut, Technische Universität Wien); RAFFELT, L. (Technische Universität München & Physikalisches Institut, Universität Heidelberg); KLOPF, M. (Atominstitut, Technische Universität Wien); LENNERT, P. (Physikalisches Institut, Universität Heidelberg); SOLDNER, T. (Institut Laue-Langevin, Grenoble); SCHMIDT, U. (Physikalisches Institut, Universität Heidelberg); MACH, W. (Atominstitut, Technische Universität Wien); WANG, X. (Atominstitut, Technische Universität Wien)

Presenter: Mr ROICK, Christoph (TU Muenchen)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **264** Type: **Poster**

Data blinding for the nEDM experiment

Tuesday, October 18, 2016 6:36 PM (1 minute)

Psychological bias towards (or away from) a prior measurement or a theory prediction is an intrinsic threat to any data analysis. While various methods can be used to avoid the bias (e.g. actively not looking at the result), only data blinding is a traceable and thus trustworthy method to circumvent the bias and to convince the external audience that there is not even an accidental psychological bias.

Data blinding is nowadays standard in particle physics, but it turns out that it is particularly difficult for the neutron electric dipole moment experiment as several cross measurements (various magnetometers) create a self-consistent network where it is hard to inject a fake signal.

In this poster we will describe those difficulties and how they were defeated at the Paul Scherrer Institute. This includes the mathematical models, as well as the cryptographic tools that ensure a trustworthy blinding.

Primary author: Dr KREMPEL, Jochen (ETH Zürich)

Co-author: ON BEHALF OF, the nEDM Collaboration at PSI

Presenter: Dr KREMPEL, Jochen (ETH Zürich)

Session Classification: Poster Session

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **265** Type: **Poster**

Cs magnetometers in the nEDM experiment at PSI

Tuesday, October 18, 2016 6:34 PM (1 minute)

Precise magnetic field control and monitoring is one of the biggest challenges of all experiments searching for a neutron electric dipole moment (nEDM). In this contribution we describe the way in which the magnetic field is measured by a laser-driven array of Cs magnetometers incorporated in the world's most sensitive nEDM experiment at PSI.

Primary author: Dr KASPRZAK, Malgorzata (Kath. Univ. Leuven)

Co-author: ON BEHALF OF, nEDM Collaboration

Presenter: Dr KASPRZAK, Malgorzata (Kath. Univ. Leuven)

Session Classification: Poster Session

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **266** Type: **Poster**

Preparation for the Time Reversal Invariance experiment at COSY (TRIC)

Tuesday, October 18, 2016 6:50 PM (1 minute)

The Universe around us consist mainly of matter although it is assumed that in the Big Bang an equal amount of antimatter has been produced. The Standard Model prediction for the proportion for the number of the baryons and antibaryons differs from the Astrophysical observations by eight orders of magnitude. To explain this phenomenon, which is usually called the Baryon Asymmetry of the Universe (BAU), a strong CP or T-violation must be found. A possible discovery of a T-symmetry violation in a system of baryons would be a strong indication for the existence of the physics beyond the Standard Model.
Using a polarized proton beam of the Cooler-Synchrotron COSY-Jülich and tensor polarized deuterium target, located at the internal PAX target place, we have access to the unique genuine T-odd P-even null observable Ay,xz. It will be determined in the transmission experiment where the total cross section of the double polarized pd scattering will be determined from the difference in beam current slopes for two beam-target spin configurations. Hence, in addition, to the polarized beam and target, a dedicated high precision beam current measurement system is under the preparation for the TRIC experiment.
During an experiment in June 2016 a polarized proton beam of COSY, a deuterium target at PAX, and a high precision beam current measurement system were commissioned. In addition, during this beam time the first measurement of the AY,Y observables in pd scattering at 135 MeV has be obtained using the TRIC method. In this contribution an overview of activities towards realization of the TRIC experiment as well as preliminary results from the test beam time will be presented.

Primary author: Dr VALDAU, Yury (Pax collaboration)

Presenter: Dr VALDAU, Yury (Pax collaboration)

Session Classification: Poster Session

Track Classification: Low energy precision tests of the Standard Model

Contribution ID: **267** Type: **Poster**

muCool: Development of a novel high-brightness low-energy muon beamline

Tuesday, October 18, 2016 6:57 PM (0 minutes)

We are developing a novel mu+ beamline that reduces the phase space of the input beam by a factor of 10E10 with 10E-3
efficiency. The phase space compression is achieved by stopping mu+ in cryogenic helium gas and applying strong electric and magnetic
fields and gas density gradients. The beamline consists of several consecutive stages, which can be tested individually in the first
step. The transverse and longitudinal compression stages were recently successfully demonstrated. The measurements show that we can achieve
the muon beam compression with a high efficiency. The GEANT4 simulation of the full beamline is currently under development and preliminary
results are in very good agreement with the measured data.

This work is supported by SNF grant 200020_159754.

Primary author: BELOSEVICH, Ivana (Inst. for Particle Physics, ETH Zurich)

Co-author: MUCOOL COLLABORATION, on behalf of

Presenter: BELOSEVICH, Ivana (Inst. for Particle Physics, ETH Zurich)

Session Classification: Poster Session

Track Classification: Advanced muon and ultracold neutron sources

Contribution ID: **268** Type: **Poster**

Electric field studies for nEDM experiments

Tuesday, October 18, 2016 6:58 PM (1 minute)

The sensitivity of a nEDM experiment is linearly proportional to the applied electric field strength. It is therefore important to find ways to maximise the electric field strength in nEDM Ramsey chamber. In the current room temperature PSI experiment the applied electric field is partly limited by depolarisation of the mercury co-magnetometer when the electric field is reversed. We are studying this depolarisation in a small mercury magnetometer setup. At the University of Sussex we are also investigating the maximum electric field possible for a cryogenic Ramsey chamber. This involves performing high voltage breakdown measurements in liquid helium to understand the mechanisms involved.

Primary author: THORNE, Jacob (Univ. of Sussex)

Presenter: THORNE, Jacob (Univ. of Sussex)

Session Classification: Poster Session

Track Classification: Searches for permanent electric dipole moments

Contribution ID: **269** Type: **Poster**

Cartan's Torsion as Origin for Cosmological Constant and Dark Energy Density

Tuesday, October 18, 2016 6:51 PM (1 minute)

We analyse the Einstein–Cartan gravity in its standard form $calR = R + calK^2$, where $calR$ and R are the Ricci scalar
curvatures in the Einstein–Cartan and Einstein gravity, respectively,
and $calK^2$ is the quadratic contribution of torsion in terms of
the contorsion tensor $calK$. We treat torsion as an external (or
a background) field and show that the contribution of torsion to the
Einstein equations can be interpreted in terms of the torsion
energy–momentum tensor, local conservation of which in a curved
spacetime with an arbitrary metric or an arbitrary gravitational field
demands a proportionality of the torsion energy–momentum tensor to a
metric tensor, a covariant derivative of which vanishes because of the
metricity condition. This allows to claim that torsion can serve as
origin for vacuum energy density, given by cosmological constant or
dark energy density in the Universe. This is a model–independent
result may explain a small value of cosmological constant, which is a
long–standing problem of cosmology. We show that the obtained result
is valid also in the Poincar\'{e} gauge gravitational theory by Kibble
(T. W. B. Kibble, J. Math. Phys. {\bf 2}, 212 (1961)), where the
Einstein–Hilbert action can be represented in the same form $calR = R + calK^2$.

Primary author: Prof. IVANOV, A.N. (TU Wien)

Co-author: WELLENZOHN, M. (TU Wien)

Presenter: Prof. IVANOV, A.N. (TU Wien)

Session Classification: Poster Session

Track Classification: Searches for symmetry violations and new forces