October 9, 2019

NuMu2019

Dear Colleagues,

It is our pleasure to invite you to the

NuMu 2019 workshop

to be held at the Paul Scherrer Institute October 25-26, 2019.

Website: https://indico.psi.ch/event/7709/

This is a satellite workshop to the main meeting PSI2019.

The workshop will explore motivation and feasibility of a new precision muon capture experiment to determine the axial-form factor in a regime relevant for the new generation of long-baseline (LBL) neutrino oscillation experiments, which will study fundamental neutrino properties. The sensitivity reach of DUNE and T2Hyper-K depends critically on knowledge of neutrino-nucleus cross-sections[1] not yet established at the required percent level precision. An important reaction channel is charged-current quasi-elastic neutrino scattering (CCQE) which is closely related to muon capture on the proton.

$$\nu + n \Leftrightarrow \mu + p$$

Recent work showed that the theoretical predictions for this process are subject to significant uncertainties due to the axial form factor, specifically the axial radius entering its momentum expansion[2]. This dominates the theory uncertainty for muon capture and doubles the uncertainty for CCQE predictions in the kinematic range of LBL experiments[3]. In addition, it complicates the validation of theoretical models against existing ν+A scattering data.

An existing measurement of muon capture on the proton[4] determines the axial radius r_A with similar precision as the pioneering CCQE ν-scattering experiments. A 3-fold improvement in precision would reduce the cross-section uncertainty induced by r_A to a subdominant contribution.

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[1] Prog. Part. Nucl. Phys. 100 (2018) 1–68

[2] Phys.Rev. D 93, 113015 (2016)

[3] Rep. Prog. Phys. 81 (2018) 096301

[4] Phys.Rev.Lett 110 (2013) 012504

We are planning four sessions on Friday afternoon and Saturday morning.

1. **Neutrino-nucleus cross-sections at the frontier of particle physics**
   The impact of neutrino-nucleus physics on oscillation experiments will be addressed from the experimental and theoretical perspective.
2. **Muon capture and the axial form factor**
   The current status of theory and experiment on axial form factor and muon capture are presented. An experimental approach, alternative to muon capture, is discussed.
3. **Towards a 0.3% measurement of μ+p capture**
   A baseline concept for a new very high precision experiment is presented as well as experience, technologies and beamlines relevant for such a project.
4. **Round table on physics and towards forming a collaboration**
   We are inviting interested parties to discuss physics interest and expertise and contributions towards a potential new proposal.

For organizational details please refer to the main PSI2019 website https://indico.psi.ch/event/6857/.

For remote participants a video link will be established with connection information provided on the NuMu2019 website.

We are looking forward to meeting you at PSI. If you have not received the previous PSI2019 circular announcing this satellite workshop, we are aware this is a late invitation. If you are unable to make it this time, this letter intends to inform you of a first step in starting off a new idea and we welcome you to contact us if you are interested in this project.

With best greetings

Peter Kammel Federico Sanchez Nieto

Klaus Stefan Kirch Bernhard Lauss

Stefan Ritt Adrian Signer