

Mu3e News



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**Mu3e Meeting
Zurich University
July 4th, 2012**

PSI Advisory Committee Recommendation

R-12-03.0

Lol for an Experiment to search for the Decay $\mu \rightarrow eee$

A. Schöning, S. Ritt, et al., Univ. Heidelberg, PSI, Univ. Genève, Mannheim,
Univ. Zürich, ETH Zürich

This Letter is very welcomed! The next step should be the submission of a full proposal, see also comments in the committee minutes.

http://ltp.web.psi.ch/user_information/user_meeting.htm

PSI Advisory Committee Recommendation

R-12-03.0: Letter of Intent for an Experiment to search for the Decay $\mu \rightarrow eee$ (A. Schönig, S. Ritt *et al.*)

The origin of the flavor structure of elementary particles and their interactions remains one of the outstanding puzzles in particle physics. The wide range in quark and lepton masses, the sizable gap between the masses of charged fermions and neutrino masses, and the notable differences in the patterns of quark and lepton mixing have motivated a number theoretical scenarios. Many of these also predict the non-conservation of the flavor of charged leptons.

Experiments searching for the flavor violating decays $\mu^+ \rightarrow e^+ \gamma$, $\mu \rightarrow eee$ and conversion process $\mu A \rightarrow eA$ probe different combinations of possible mechanisms for charged lepton-flavor violation. The observation of a non-zero result in any one of these channels would constitute a major discovery. More broadly, the combination of results – either positive signals or limits – would provide a critical window on the origin of flavor.

A search for the $\mu \rightarrow eee$ decay with a branching ratio sensitivity of 10^{-15} or better would constitute a powerful part of a comprehensive search for charged lepton flavor violation, which includes the MEG experiment.

The Committee is enthusiastic about this experiment. The anticipated goal to improve the sensitivity of previous experiments by 3–4 order of magnitude is very exciting. With good resolutions, this measurement should be free of background. However, there are a many things to be done before a proposal for this experiment can be considered. Certainly there is more work to do on the Monte Carlo and on the tracker. The collaboration should consider all possibilities before deciding on the best technology to use. The Committee is looking forward to these next steps and a complete proposal of the experiment.

Overview

- **New Groups and Interests**
- **New Technical Developments and Status:**
 - beam line and experimental area
 - beam simulation
 - target
 - tracking
 - magnet
 - silicon pixel detector
 - TPC considerations (Bonn)
 - ToF simulation + scintillating tiles (KIP)
 - scintillating fiber detector
 - filter farm
- **Next Steps**

New Groups

- **Kirchhoff Institut Uni Heidelberg (H.C. Schultz-Coulon)**

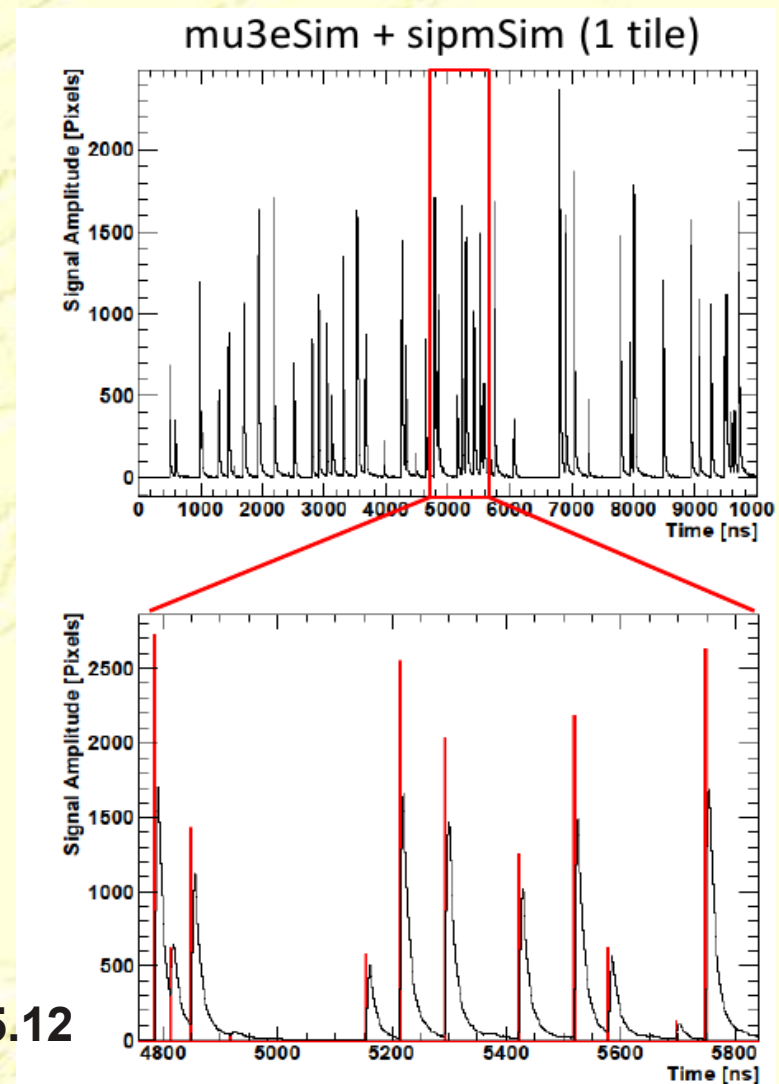
- ATLAS group (Calo Trigger)

- CALICE for ILC (SiPM for calorimetry,
characterisation + readout)

- Mu3e interest in ToF with scintillating tiles

- **PhD student Patrick Eckert**

- presentation today



P.Eckert 24.5.12

Interested Group

- **Uni Bonn (K.Desch)**
 - ATLAS group (tracking)
 - ILC (tracking, TPC)
 - Medipix detector
 - interest in Mu3e tracking (TPC?) → later



Upgraded Group

- **New Emmy Noether group (Nik Berger)**
 - five years, starting July 2012
 - group: group leader, 1 Postdoc, 4 PhD students
- **extra funding for: readout + GPU based filter farm + travel costs**

Upgraded Group

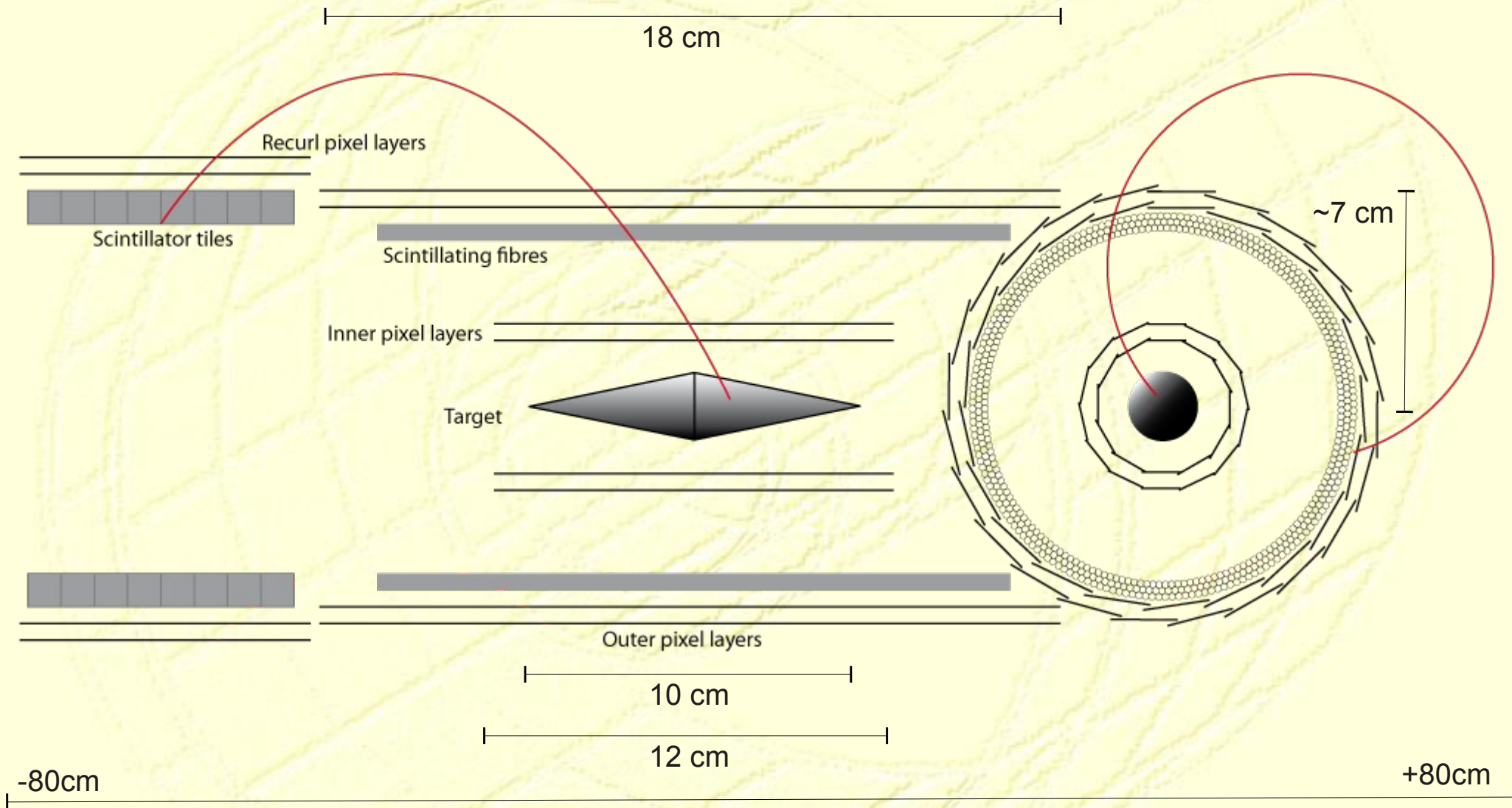
- **New Emmy Noether group (Nik Berger)**
 - five years, starting July 2012
 - group: group leader, 1 Postdoc, 4 PhD students
- **extra funding for: readout + GPU based filter farm + travel costs**

Congratulations!

New Developments

baseline design has not changed!

Experimental Design (Phase 2)

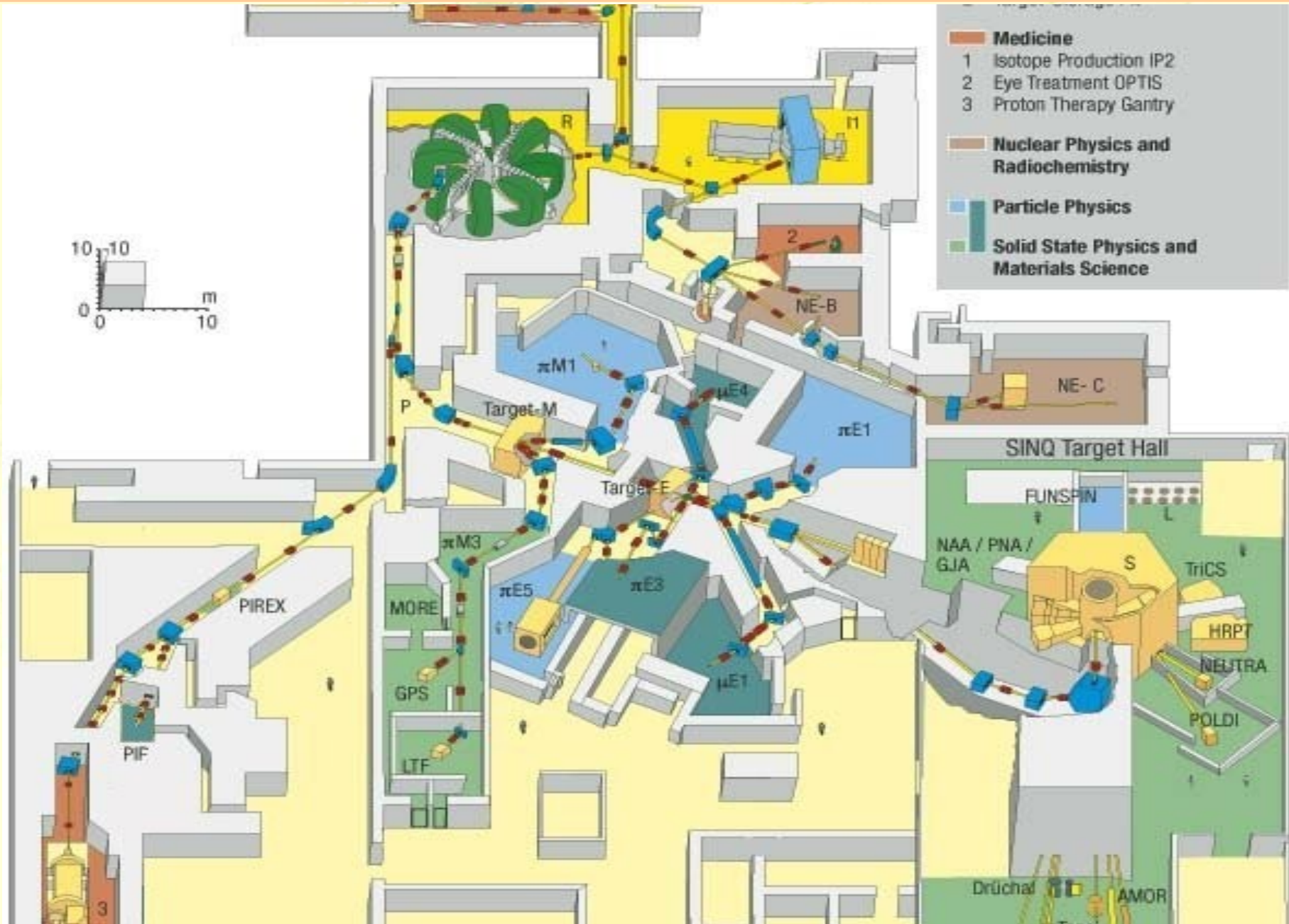


acceptance for $\mu 3e$ decay $\sim 70\%$

Muon Source and Beam Lines

- Peter is not able to join this meeting (other commitments)
- Status (email July 3rd):
 - technical aspects: no changes since last meeting in April
 - presentations of idea using the SinQ as muon source: PSI departments, concerned PSI groups, Particle Physics laboratory → **very positive feedback**
- 39 page CROSS proposal to PSI research committee, supported and endorsed by department heads of GFA & NUM
- Two years study to demonstrate feasibility is required
- Idea planned to be mentioned ETH Rat Klausur 2015+ (Joel Mesot)
- No guarantee that SinQ idea will fly

PSI Hall West



Simulation of Beam Interactions

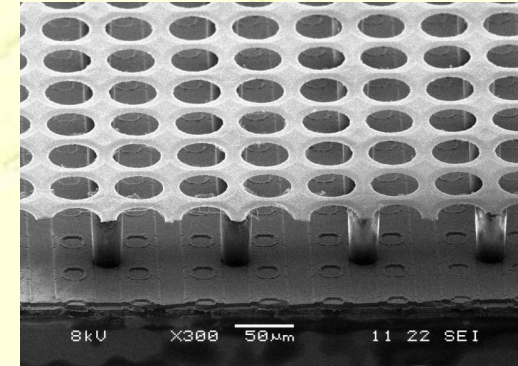
- simulation of beam interactions using Geant4 (Nik)
 - design studies required. Very first results look promising
 - full beam line simulation used for studies now

Silicon Pixel Detector

- 180 nm Prototype tested (→ Heiko Augustin, Ann Katrin Perrevoort)
 - planning beam tests in July (CERN) and September (PSI)
- another Prototype submission planned for August
 - readout electronics
 - faster timing
- “big” sensor submission planned for end of year (1x2 cm²)
- another prototype submission in fall? (→ talks Nik Berger)
- big progress on mechanical side (talk → Dirk Wiedner)
- cooling studies (talk → Marco Zimmermann)

TPC for Mu3e

- TPC was starting point (Roland Horisberger 2008)
- why not instrument the helium atmosphere?
- challenging!
 - slow drift in helium ($20 \mu\text{m}/\text{ns}$)
 - high resolution needed (Bonn proposed Medipix as detector)
 - huge data rate ($> \text{Tbyte}/\text{s}$), requiring track processing at front-end and more powerfull chip readout
 - high space charge in helium (large distortion effects in drift)
 - maximum rate 10^8 muons per second
 - did not discuss aging
- Bonn plans to have some closer look (simulation)



ToF System

- scintillating tiles
 - KIP wants to take responsibility
 - some first results and design proposals (talk → Patric Eckert)
- scintillating fibres
 - Sandro cannot join meeting
 - will prepare slides next week and communicate
 - new results from simulation (talk → Roland Gredig)

Filter Farm + Readout

- Filter Farm:
 - Nik installed GPUs for testing
 - tracking code to be developed (Moritz Kiehn, A.S.)
- Readout
 - working on interfaces for Silicon Tracker (Nik, Ivan)

Next Steps

- Plan: submit Technical Proposal by December to PSI
 - main open points (simulation, tracing + alternative technologies) are being addressed
 - good progress in many areas
 - most headache (personally) makes scintillating fibre design
- Meeting more often required (phone, EVO,...)
- Funding
 - should start to get funding now