

# Short Minutes of the BVR 47

## Meetings of February 8 – 10, 2016

### 1 Meetings of the Committee

|                        |   |
|------------------------|---|
| closed meetings:       | Tuesday, February 9, from 9:00 – 12:30<br>Wednesday, February 10, from 9:00 – 11:30   |
| present:               | D. Bryman<br>B. Filippone (chair)<br>G. Greene<br>C. Hoffman<br>P. Kammel<br>St. Passaggio<br>M. Ramsey-Musolf<br>A. Signer (secretary)<br>U. Straumann |
| beam time coordinator: | St. Ritt  |
| ex officio:            | K. Clausen<br>K. Kirch  |
| apologies:             | E. Hinds<br>A. Ceccucci<br>G. Colangelo   |

### 2 New Proposals

The committee has received three new proposals and requests from several ongoing experiments.

#### **R-16-01.1: Measurement of the charge radius of radium (MuX) (A. Knecht *et al.*)**

The collaboration proposes to measure the charge radius of Ra (and potentially other radioactive nuclei). Apart from the interest in charge radii as such, a precise Ra result is necessary for a possible future high precision measurement of the nuclear weak charge (which can be related to the weak mixing angle) using atomic parity violation measurements with  $\text{Ra}^+$ . This could lead to a factor of 5 improvement compared to previous determinations using Cs.

The committee is pleased to see this first discussion of the experiment. The requested beam time for tests in 2016 at  $\pi\text{E1}$  can easily be accommodated and is approved. Before the priority for running at  $\pi\text{E5}$  can be assessed, it will be important for the collaboration to provide further details in the future, including progress towards the milestones specified in the proposal as well as the optimization of the stopping fraction in the final target.

**R-16-02.1: Hyperfine splittings in muonic hydrogen and  $^3\text{He}$  (CREMA)** (A. Antognini *et al.*)

The CREMA collaboration has presented an impressive proposal for a measurement of the hyperfine structure of muonic hydrogen and  $^3\text{He}$  to 1 ppm. This would allow a determination of the two-photon exchange contribution with a relative accuracy of  $10^{-4}$ . Such a measurement would provide important input to improve our knowledge of the Zemach radius and polarizability contributions for these nuclei.

There are potentially competing experiments at RIKEN-RAL and J-PARC, having the advantage of working with a pulsed beam. Due to the continuous beam at PSI the CREMA collaboration faces additional difficulties for the laser system. However, the collaboration has proved in the past that they are well capable of designing and constructing ground-breaking laser systems.

The full beam request of one week at  $\pi\text{E5}$  in December is granted. However, future requests will likely be part of a highly competitive program in  $\pi\text{E5}$  and the collaboration should plan accordingly. In particular, detailed Monte Carlo studies including optimization of the signal-to-noise ratio as well as the peak search strategies are required.

**R-16-03.1: Characterization of new materials for polarized UCN transport** (E. Pierre *et al.*)

The requested beam time of 1 week at UCN-West-1 would allow the TRIUMF UCN group to test neutron depolarization in UCN guides covered with a thin coating of nickel phosphorus. It is possible to accommodate this experiment without adverse effect on the currently ongoing nEDM measurement. Hence the committee is happy to approve the request and provide the beam time as a service.

### 3 Progress Reports and Beam Requests

Fortunately there are no serious conflicts for beam time in 2016. However, it is very likely that in future years there will be very strong competition, in particular for  $\pi\text{E5}$  as well as  $\pi\text{M1}$ . The situation could become even more difficult due to a possibly longer shutdown in 2018 and 2019.

**R-99.05.2: Search for  $\mu^+ \rightarrow e^+ \gamma$  (MEG II)** (T. Mori, A. Baldini *et al.*)

Following the unblinding of the data in December, the final result for  $\text{BR}(\mu^+ \rightarrow e^+ \gamma)$  from MEG I is anticipated to be presented in March 2016.

The collaboration has made considerable progress towards MEG II with mechanical and timing counter tests in 2015. Recent studies have shown that the radiative decay counter should allow for a 20–30% reduction of the background.

During the pre-engineering run in 2015 there were problems with the DAQ system. Furthermore, the delivery of the drift chamber will most probably be delayed. However, it is expected that by the end of 2016 both a DAQ system and the drift chamber will be available.

The full beam request is approved and a more detailed report will be provided by the subcommittee.

**R-05-03.1: Measurement of the neutron EDM** (K. Kirch, G. Ban *et al.*)

The collaboration is making a huge effort to understand every detail of the UCN source. In 2015 the UCN flux was the highest so far and the nEDM measurement has now reached a sensitivity that is world leading. The collaboration has also produced an elegant result with the spin-echo measurement of neutron depolarization associated with the gravitational separation of neutron velocities.

Their full beam-time request is granted and they are encouraged to proceed with a 200 day production run in 2016.

The plans presented for the next generation experiment n2EDM are progressing well towards construction. Even in the unlikely case of no further improvements of the source, the upgrade from nEDM to n2EDM will lead to an improvement in sensitivity by a factor 5, resulting in a sensitivity of  $\sim 10^{-27}$  e cm. The collaboration is currently world leading and with the n2EDM upgrade they will remain so for the foreseeable future.

The status of the worldwide effort for UCN sources and EDM experiments had been discussed in the committee. Experience shows that the design performance of future sources needs to be taken with utmost care. In the past all UCN sources have fallen well short of their design goals. In fact, the committee is convinced that there is no credible competition to the PSI experiment in the coming 5–7 years. Furthermore, there is no concept of an improved source that could not be incorporated into the n2EDM experiment at PSI. Hence it urges the collaboration and PSI management to make full use of their pole position and continue with the program.

**R-08-01.1: Muon capture on the deuteron (MuSun)** (P. Kammel, C. Petitjean, A. Vasilyev *et al.*)

The committee is pleased to hear that the main production data taking from MuSun is completed. The collaboration's request for 6 weeks of extra beam time at  $\pi$ E1 for systematic studies is approved.

**R-12-01.2: Studying the “Proton Radius Puzzle” with  $\mu p$  elastic scattering (MUSE)** (R. Gilman *et al.*)

The committee concurs with the recommendations of the recent NSF MUSE review and looks forward to a finalized TDR. In particular it is important that the collaboration identify their optimum sensitivity to the charge radius difference between  $ep$  and  $\mu p$  measurements, with as little model dependence as possible.

While there is continued progress on the simulations of the experiment, generally speaking progress is slow and the situation regarding the design of the target is far from satisfactory.

Prior to the next BVR meeting, the collaboration should complete and submit an appropriate TDR and provide a plan for the timely implementation of the experiment. Since the availability of the  $\pi$ M1 region is not guaranteed in the long term the collaboration may not be able to afford any further delays.

The subcommittee will provide additional details.

**R-12-03.1: Search for the decay  $\mu^+ \rightarrow e^+ e^- e^+$  (Mu3e)** (A. Schoening, St. Ritt *et al.* )

The funding situation of Mu3e has improved substantially and the collaboration has made important steps towards construction of the experiment. In particular, the magnet (funded by the DFG) has been ordered and will be delivered by the end of 2016.

The committee is impressed with the progress towards real hardware for the experiment. The full beam-time request of 6 weeks at  $\pi E5$  is approved.

The main issue currently is related to the so-called pixel-chips and is beyond the control of the collaboration. The  $(3 \times 3)$  mm<sup>2</sup> version, Mupix 7, has been tested completely, and fulfilled or came close to all specifications. However, there is a serious delay of about one year with the scale-up to Mupix 8, due to the transfer of the production from IBM to a new foundry (AMS). The expectation is that the new design can only be submitted in mid 2016.

The committee asks the collaboration for a report on the overall status of the experiment (including the latest coherent design concept) by summer 2016. The subcommittee will then interact with the collaboration in order to provide comments on the structure and content of the TDR. We anticipate the submission of a full TDR in time for the next BVR meeting.

The subcommittee will provide additional details.

**R-13-01.1: Laser spectroscopy of pionic helium atoms (PiHe)** (M. Hori *et al.*)

During their run in 2015, the collaboration managed to see a resonance and established the existence of metastable pionic helium. Before precision measurements can be made, the laser system needs improvements. Hence, no beam-time request was made for 2016, but it is very likely that the collaboration will come back with beam-time requests in the future.

**R-13-03.1: Study of muon capture for  $\mu \rightarrow e$  conversion experiments (AlCap)** (P. Kammel, Y. Kuno *et al.*)

The collaboration is currently analysing the data and will present their results next year. For 2016, no beam-time request has been made.

**R-14-01.1: Pion induced change of material parameters in silicon** (T. Rohe *et al.*)

The collaboration proposes to continue studying the impact of high pion fluxes on the hardware for the future LHC upgrade.  $\pi E1$  is the only beam in the world that can deliver the necessary pion flux. The full request of 6 weeks is granted.

**R-14-02.1: High-brightness ultra-cold muon beam: muCool** (A. Antognini *et al.*)

The collaboration presented their progress in the open meeting. The problems regarding transverse compression that were encountered in the pre-engineering run of 2014 (gas leak and electrical breakdown) could be solved during a very successful beam time in 2015.

Apart from the demonstration of transverse compression, the longitudinal compression could be combined with a drift to extract the beam.

The committee appreciates the significance of the developments and agrees with the plan of the collaboration to perform additional studies in 2016 before returning with a beam-time request for 2017.

## 4 Miscellaneous

At the beginning of the open meeting Mike Pendlebury and Reinhart Frosch, who unfortunately both passed away in 2015, were remembered. Riccardo Barbieri presented a talk with the title “Particle physics after the discovery of the Higgs boson”, giving an overview of the current situation in particle physics.

## 5 Next Meeting

The next meeting (BV 48) is again planned as a 3-day meeting and will take place from Monday to Wednesday, 6–8. February 2017. The deadline for proposals and beam time requests is 15. January 2017.

March 10, 2016

B. Filippone, A. Signer