

# Short Minutes of the BVR 46

## Meetings of February 9 – 11, 2015

### 1 Meetings of the Committee

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

### 2 New Proposals

The committee has received one new proposal and requests from several ongoing experiments.

#### **R-15-01.1: High rate UCN detector testing** (B. Jamieson, E. Pierre *et al.*)

The aim of this experiment is to test a detector for ultracold neutrons. The detector using  ${}^6\text{Li}$  glass is intended for a future nEDM experiment to be performed at TRIUMF, with a UCN source from RCNP Osaka. The committee is sympathetic to the request but would like to ensure that there is no adverse impact on the running nEDM experiment at PSI.

The request for beam time consists of two parts. Part 1 requires 4 days of detector tests at the beam line West-2. This has very limited impact on the nEDM experiment. Of more concern is part 2 that requires 2 days of measurements at beam line West-1. While the committee is happy to allocate the beam time, the detailed scheduling should be coordinated with the nEDM collaboration (R-05-03.1) to ensure there is no disturbance to their data taking.

### 3 Progress Reports and Beam Requests

The demand from approved ongoing experiments considerably exceeds the available beam time in  $\pi$ E1 and  $\pi$ E5. Furthermore, there are constraints on the availability of the spin rotator. Some beam time in  $\pi$ E1 requested by the AlCap collaboration (R-13-03.1) is reallocated to  $\pi$ E5. This resolves a potential conflict with other particle physics experiments and MuSR experiments at  $\pi$ E1.

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

A detailed half-day review of this experiment has taken place on Monday and the subcommittee will provide a separate report. The final MEG I result is eagerly anticipated and is expected to be published in summer 2015. There have been complications in the analysis due to unexpected deformations of the target.

There has been good progress in the upgrade of the experiment and MEG II is ready for a pre-engineering run towards the end of 2015. This run is essential to prepare for an engineering run and possibly a physics run in 2016. A partially wired mock-up drift chamber will be delivered to PSI in July. One of the concerns is the DAQ, but the collaboration has confirmed that a single full crate will be ready for the pre-engineering run and the complete system will be ready in 2016.

The 16-week beam-time request of the collaboration resulted in a conflict with other requests. While the committee reiterates that in the coming years MEG is expected to be given the highest priority in  $\pi$ E5 it also recognizes that in 2015 the beam is to be used for a pre-engineering run. Hence it was decided to award 14 weeks of beam time. Furthermore, the collaboration is asked to provide a status report to the laboratory by June 30 to enable an assessment as to whether the provided beam time can be used efficiently.

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

During 2014 the collaboration was able to take real data only during one month due to problems with the heat exchanger in a cooling plant compressor. However, at the end of 2014 all of the systems worked very well. This puts the collaboration in an excellent situation for future data taking, even if the flux provided by the UCN source is lower than the original specification.

The plan is to have a full production run in 2015, with 20 days of tuning of the source and 200 days in production mode. If everything goes according to plan, this could result in the world's best limit on the nEDM. The committee recognizes the importance of this milestone and endorses this plan. Nevertheless it requests an interim report after the first 100 days to allow the collaboration to have an opportunity to reassess the situation and optimize the run plan for the remainder of the year.

The committee is also pleased to see the publication of two physics results, concerning the neutron to  $^{199}\text{Hg}$  magnetic moment ratio and limits on axion-like particles. It anticipates a full TDR for the follow-up experiment n2EDM in the coming years.

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

The collaboration had a very successful 2014. The newly built TPC worked flawlessly and during the 11 week run  $6 \times 10^9$  events were collected. For 2015 another 12 weeks beam time in  $\pi E1$  are requested to reach the required statistics with an additional  $8 \times 10^9$  events.

The committee is impressed by the progress of the collaboration and is of the opinion that finishing an experiment should be given high priority. Therefore, the full allocation of beam time is granted. The conclusion of the experiment is expected next year, keeping open the option of a possible systematics run in 2016.

**R-10-01.1: Lamb shift in muonic helium (CREMA)** (R. Pohl, F. Kottmann *et al.*)

The committee congratulates the collaboration on the completion of this extremely successful experiment. The results of the 2013 and 2014 run were presented in the open meeting. The first resonance in  $\mu^4\text{He}$  ( $2S_{1/2} \rightarrow 2P_{3/2}$ ) was found already in 2013. The second resonance in  $\mu^4\text{He}$  ( $2S_{1/2} \rightarrow 2P_{1/2}$ ), as well as three resonances in  $\mu^3\text{He}$  were found in 2014. The full analysis of these results is ongoing.

The collaboration has not made any requests for beam time this year but the committee is looking forward to proposals for further experiments with muonic atoms in the future.

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

Following the request for a full Technical Design Report (TDR) made during the BV 45, the collaboration submitted a document to the technical subcommittee by November 1, 2014. While there has been substantial progress, notably in the detailed simulation and preliminary design of the experiment, the submitted document did not, according to the committee, represent a complete, and sufficiently detailed TDR.

The BV45 review committee had made the allocation of additional beam time contingent on the completion of a TDR. In addition, since the submitted documentation did not provide a detailed justification for the requested additional beam time in 2015, the committee decided not to directly approve the request for beam time at this point. However, at such time as the collaboration provides a detailed plan for the use of requested beam time, the laboratory management will reconsider allocation of beam time<sup>1</sup>

It is anticipated that there will be a number of detailed recommendations from the technical subcommittee to the collaboration. The goal of all concerned is to work towards a complete and optimized physics design that is fully described in a detailed TDR. This is a prerequisite for allocation of MUSE production beam time.

The committee remains convinced of the high scientific merit of the project and is pleased to see growth of the collaboration. It is of the opinion that the collaboration would benefit from further expansion, both by an increased commitment of effort from current members of the collaboration as well the inclusion of additional collaborators. In particular an enhancement of expertise in low energy muon scattering and experimental management would be beneficial.

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<sup>1</sup>Beginning of March 2015 the MUSE collaboration has submitted a detailed justification document for the test beam time in  $\pi M1$  which has subsequently been granted by PSI management.

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

A detailed half-day review of this experiment has taken place on Monday and the subcommittee will provide a separate report. The collaboration has made real progress, in particular in the simulation. The two new professorships associated with Mu3e are a very encouraging development and hopefully will contribute to the solution of funding issues.

The pixel detector has been identified as a particularly challenging part but the committee is satisfied that reasonable steps have been taken to address this challenge.

In December 2014 a proof of concept for the compact muon beam has been achieved. This should ensure that a smooth switch-over between Mu3e and MEG II at the beam line  $\pi E5$  is possible. The collaboration is requested to submit a progress report for the next BVR meeting, if they have not generated a complete TDR by that time.

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

The collaboration has made considerable progress in the experimental setup in 2014, including the use of the spin rotator to eliminate contamination from electrons. The original aim was to find the resonance due to the transition  $(n, l) = (16, 15) \rightarrow (17, 14)$  in pionic helium. While signals consistent with the formation of a  $\pi\text{He}^+$  atom were found, the resonance was not found.

Subsequent theoretical work seems to indicate that, due to its abnormally large polarizability, the state  $(17, 14)$  is unbound and, hence, the transition  $(16, 15) \rightarrow (17, 14)$  cannot be observed. However, other candidate transitions including  $(17, 16) \rightarrow (18, 15)$ ,  $(17, 16) \rightarrow (16, 15)$  and  $(16, 15) \rightarrow (16, 14)$  should still be observable. It is the primary goal of the collaboration in 2015 to look for resonances due to these three transitions, requesting 12 weeks beam time at  $\pi E5$ .

The committee is impressed by the very strong and committed group and recognizes that the search for these resonances is a foray into uncharted territory. Due to constraints from MEG at the beam line  $\pi E5$ , at this stage only 10 weeks of beam time will be granted. The allocation of any additional beam time will be decided after June 30, when the status report from MEG is available. The collaboration will also get setup time prior to their beam time, albeit without the availability of the spin rotator.

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

In 2014 the collaboration has found a surprising result in that the proton yield after muon capture in Al is a factor 3 lower than expected. If confirmed, this would have an important (positive) impact on the design of the  $\mu \rightarrow e$  conversion experiments. Apart from confirming these findings and extending the measurements to titanium, the collaboration also intends to proceed with the work packages WP2 ( $\gamma$  and X-ray emission) and WP3 (neutron emission).

Their request for 4 weeks of beam time at  $\pi E1$  starting late October is in serious conflict with the MuCool and MuSR experiments. After consultation with the collaboration it was decided to split the beam time for the work packages. For WP2 and WP3 the collaboration is allocated 2 weeks beam time at  $\pi E5$  in June, whereas WP1 will be addressed during the remaining beam time at  $\pi E1$  in November. The collaboration will be provided with support by the laboratory for the switch to the beam line  $\pi E5$ . As WP2 and WP3 are deemed to be

somewhat less urgent, there is also the possibility to address them in 2016 in case there are unexpected problems related to the switch from  $\pi E1$  to  $\pi E5$ .

#### **R-14-02.1: High-brightness ultracold muon beam** (A. Antognini *et al.*)

The bulk of the beam time allocated in 2014 has been used for a test of the longitudinal compression of the muon beam. This test has been very successful and represents a substantial improvement compared to a previous setup of 2011.

A first complete assembly for the transverse compression had been set up in the last 3 days of the beam time. Due to technical problems including gas leaks and electrical breakdown issues, it was not yet possible to observe transverse compression. The main part of the 5 weeks of beam time at  $\pi E1$  requested by the collaboration for 2015 is to be used to further investigate these technical issues and work on R&D for the transverse compression. The construction of a new longitudinal and transverse target is also foreseen.

The progress made by the collaboration is very promising. The committee is looking forward to seeing further progress in the transverse compression and allocates the requested beam time.

## **4 Miscellaneous**

The laboratory expresses its thanks to M. Pohl and M. Pendlebury who both will retire from the committee. A special thank you goes to C. Petitjean for his work as a beam coordinator for more than 40 years.

During the open session Werner Bernreuther presented a talk “TeV-scale physics probes at low energy in the LHC era”. The planned workshop on the science at a possible high intensity muon beam HiMB at PSI did not take place and will be postponed until the situation regarding the HiMB is more clear.

## **5 Next Meeting**

The next meeting (BV 47) is again planned as a 3-day meeting and will take place from Monday to Wednesday, February 8 – 10, 2016. The deadline for proposals and beam time requests is January 15, 2016.

March 9, 2015

B. Filippone, A. Signer