Short Minutes of the BVR 49

Meetings of February 12 – 14, 2018

1 Meetings of the Committee

closed meetings:	Tuesday, February 13, from 9:00 – 12:30 Wednesday, February 14, from 9:00 – 11:30
present:	L. Baudis D. Bryman G. Colangelo B. Filippone (chair) G. Greene E. Hinds C. Hoffman P. Kammel St. Passaggio M. Ramsey-Musolf A. Signer (secretary)
beam time coordinator:	St. Ritt
ex officio:	K. Kirch Ch. Rüegg (Wed)
external consultants:	E. Garcia (Tue) H.Ch. Kästli (Wed)

2 New Proposals

The committee has received no new proposals but several beam time requests from ongoing experiments, a follow-up request for testing muonium production and several small test-beam requests. The requests for πM1 considerably exceeded the available beam time and serious cuts had to be implemented.

Test: Test of muonium production in superfluid helium (A. Soter *et al.*)

The long-term goal of these studies is the production of a muonium source with small energy and angular spread. Among other applications, such a source could provide significant advantages towards a future gravitational test of muonium, a system that is predominantly made out of antimatter (μ^+).

The collaboration has presented a very creative method for muonium production, involving nano-materials and superfluid helium (SFHe). The first test results are very promising and

we encourage the collaboration to continue their studies this year, demonstrating muonium emission from the SFHe surface. The committee supports this test run and grants the request of 3 weeks at πE1.

3 Progress Reports and Beam Requests

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

The search for $\mu \to e\gamma$ remains one of the highest priority muon experiments for particle physics, with plans to improve the sensitivity to the branching ratio by a factor of 10. In 2017 the collaboration performed a successful pre-engineering run with Michel electrons to validate the full set-up of the experiment apart from the still missing drift chamber (DC). The DC is expected to be transported to PSI in May 2018, in time for a full engineering run starting in September. Realistically, a 3 year production run is expected to start in 2020. While there is clearly some good progress on the hardware, two potentially serious issues were discussed.

In the first case the read-out electronics for the LXe detector has shown significant common-mode noise problems (up to a factor of 10 higher than allowed). This would have a major impact on the sensitivity. However, very recent attempts at addressing this problem look promising and it is hoped that a solution can be found.

A more serious issue continues to be the wire-breaking problems with the large DC. The present plan is to use the existing chamber (with only 9, instead of 10 radial layers) for in-beam running in 2018. The committee supports the plan to move, install and commission the present DC. However, since this is a single point of failure, the committee also recommends that the collaboration seriously consider their options under various potential failure scenarios.

In fact these problems have led the collaboration to consider building a new DC (with funds already reserved at INFN). For the future, the committee encourages that an external review panel be convened to consider the problematic issues with the present chamber, including corrosion and contamination problems, and how these can be mitigated. In addition this panel should comment on the design of a future new DC in the context of reducing technical risk. Of course the committee recognizes that the manpower issues associated with running the existing DC in 2018, while also building a new DC, will need to be addressed by the collaboration.

The committee grants MEG II the full beam request and encourages the collaboration to continue to commission the rest of the experiment this run cycle. Further details will be discussed in the subcommittee report.

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

PSI continues as the world-leader in the endeavour to produce a new high-sensitivity search for CP-violation in the form of a non-zero neutron EDM. The initial phase of the experiment at PSI is now completed. Due to problems with a compressor, no additional nEDM data was

taken in 2017. But even with the existing data, the world's most sensitive neutron EDM search has been performed and the committee looks forward to the publication of the result.

Demonstration that the UCN source has been able to further increase its production by 30% is noted. We are also impressed by the highly successful external technical review that was undertaken just a few weeks ago. The collaboration appreciated all of the useful questions and comments and the final report was also positive. While there was discussion that this Technical Review Committee would hold its final review in January 2019, the BVR committee encourages the collaboration and the PSI management to consider extending this useful committee for an additional year should problems arise in the project over the next year.

The committee is pleased with the creation of a baseline plan for the next phase of the experiment (n2EDM) and encourages the collaboration to focus their efforts on implementing this plan. Problems with the late delivery of the magnetically shielded room appear to be resolved, with the outer layer arriving in May for initial installation and the inner shield expected in autumn. We acknowledge the progress by the collaboration in instituting full-fledged project management including a full project plan that is under development. Further details will be discussed in the forthcoming subcommittee report.

R-12-01.2: Studying the "Proton Radius Puzzle" with μp elastic scattering (MUSE) (R. Gilman *et al.*)

The collaboration has made strong progress towards completion of the experimental hardware. The liquid hydrogen target has been successfully designed and built and has recently passed a cold test by cooling and filling with liquid neon. There is a solid design for the movable platform mount and several of the detectors have been tested in-beam in 2017. The timing detectors appear to be in good shape and the large noise problems for the GEMs and straw tubes appear under control with the availabilty of new readout cards. Further analysis of the test beam results are recommended. There is some concern with potential late arrival of some of the components, especially the straw-tube readout cards which are expected only in June.

From the science perspective a new unpublished result in atomic hydrogen suggests a larger proton radius, while another published result supports a smaller value. Independent of these results we believe a MUSE experiment with the proposed sensitivity will have a significant impact.

For the beam request, the collaboration has requested essentially all of the beam time in πM1 for 2018. While the committee acknowledges that the collaboration is anxious to begin production running, we continue to find the submitted TDR inadequate in terms of demonstration of sufficient control and understanding of experimental systematics. In particular the impact of the differences in the particle source production on the spectrometer transport and resulting momentum determination must be addressed. Our specific concerns will be presented in the subcommittee report.

Because of these issues, the committee recommends that PSI management convene a special review this year, perhaps in conjunction with NSF, to confirm that all systematic effects are understood at a level that will assure a measurement at the required sensitivity. With this

in mind the committee grants MUSE a 5 week commissioning run, where all of the hardware and calibration procedures can be tested in-beam. We then recommend that the experiment is removed while other test experiments are carried out in πM1. Following this period we grant MUSE an additional 3.5 week in πM1 at the end of the cycle to confirm hardware readiness for production running.

A full production running allocation in 2019 will be considered in BVR 50 and will be contingent on a positive recommendation from the special review committee and a successful engineering run at the end of 2018.

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

The committee is strongly supportive of this important experiment in cLFV. It appears that previous problems with a magnet vendor have been resolved and that a contract with Cryogenic Ltd has been issued. We recommend that the collaboration carefully monitor the magnet construction in conjunction with the new vendor.

It was encouraging to see a potentially realistic time schedule for the long-term construction and integration of the experiment including planning for the establishment of a local technical infrastructure.

First tests with a beta-version of the MuPix8 chips look promising and the main production of MuPix8 is expected for March 2018. It appears that the final design of the chip – MuPix10 – will be the front-end readout in the full experiment. We encourage the collaboration to monitor the chip vendor AMS, in terms of quality control, as the chips are produced. Furthermore, chip performance tests should be carried out in a configuration that is as realistic as possible, including data transfer.

Concerns were also noted about the potentially serious thermo-mechanical issues associated with the He gas cooling, including stability under high gas flow. We note that such a low profile system appears unprecedented and could prove challenging. Further details will be discussed in the subcommittee report. The beam request of 4 weeks at πE5 is approved.

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

A measurement of the charge radius of radium is essential to a future Ra atomic parity violation experiment. This experiment uses transitions in muonic radium to provide this. In the past year the collaboration successfully demonstrated a new method of stopping muons in ultra-thin targets and operated a large germanium detector array to measure muonic transitions in Au, Pb and U. The committee was very impressed with these test results and looks forward to the first charge radius measurement with ^{226}Ra during 2018. We enthusiastically approve the request of 3 weeks at πE1.

4 Miscellaneous

Laura Baudis was welcomed as a new member of the BVR committee and Gilberto Colangelo presented a talk on "theoretical aspects of the muon $g-2$", focussing on the hadronic contributions.

5 Next Meeting

The next meeting (BVR 50) is again planned as a 3-day meeting and will take place from 28 – 30 January 2019. The deadline for proposals and beam time requests is 15 January 2019.

April 24, 2018 B. Filippone, A. Signer