

Short Minutes of the BVR 48

Meetings of February 6 – 8, 2017

1 Meetings of the Committee

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| closed meetings: | Tuesday, February 7, from 9:00 – 12:30 Wednesday, February 8, from 9:00 – 11:30 |
| present: | D. Bryman B. Filippone (chair) G. Greene E. Hinds C. Hoffman P. Kammel St. Passaggio A. Signer (secretary) |
| beam time coordinator: | St. Ritt |
| ex officio: | K. Clausen K. Kirch Ch. Rüegg (Wed) |
| apologies: | G. Colangelo M. Ramsey-Musolf |

2 New Proposals

The committee has received no new proposals but several beam time requests from ongoing experiments and two requests to perform tests that might lead to future proposals.

Test: Measuring the $2s$ - $1s$ transition in $Z \simeq 30$ muonic atoms (F. Wauters *et al.*)

This is a test run to assess the feasibility of a future proposal to measure parity violation in a muonic-atom transition via the first measurement of the $2s$ - $1s$ transition in a muonic atom. The concept is interesting and is correlated with MuX running. This request is granted.

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

This test will study muonium production in superfluid helium, with the aim of assessing the feasibility of a future proposal to measure the muonium gravitational interaction. The long-term goal is to gain information on the gravitational interaction of antimatter via muonium ($\mu^+ e^-$) which is predominantly antimatter. The committee supports this test run.

3 Progress Reports and Beam Requests

We note that the beamtime at π M1 is fully distributed (actually overbooked) already at the beginning of the year. Some adjustments in the detailed plan of the second half of 2017 might be required.

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

The search for $\mu \rightarrow e\gamma$ remains one of the highest priority muon experiments for particle physics. The committee congratulates the collaboration for the completion of the MEG I analysis with a very impressive overall factor of 30 improvement for the upper limit of the BR($\mu \rightarrow e\gamma$). In addition two other papers were published: a measurement of the radiative decay branching ratio and a study of muon polarization.

The future experiment, MEG II, which plans to improve the sensitivity to the BR by a further factor of 10 is strongly supported. The committee however is concerned about the situation regarding the drift chamber. It appears that the drift chamber is very delicate as demonstrated by the extreme fragility of the thin wires in the presence of humidity. There is some concern that this issue may not be behind us yet. While there is a clear path forward for potential delivery by Nov 2017, delivery speed is not the primary concern; rather it is the successful construction and transport of the completed drift chamber from Pisa to PSI.

The timing counter and the downstream radiative muon decay veto are in good shape. It also appears that the LXe detector will be ready by the end of February and will be installed in the hall by the end of March 2017. A partial DAQ system will be ready for a Michel test this summer. Further details will be discussed in the subcommittee report.

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

The high-sensitivity search for a neutron EDM remains one of the highest priorities for particle physics. PSI is presently leading the world in this endeavour.

The committee is delighted with the very productive run of about 130 days for nEDM along with the striking reliability of the experiment while in full production mode. This new data puts them in a regime where they could have the very best limit on the neutron EDM. With a large fraction of the statistics well in hand, systematics effects are under intense scrutiny. In particular, issues associated with 3rd order B -field gradients and unphysical E -field correlated changes in some of the Cs magnetometers will need to be resolved.

The experiment now has a routine to increase the UCN yield from the source with regular conditioning. Following a detailed B -field mapping campaign and an additional couple of months of data in 2017 the collaboration will reach the point of diminishing returns. Thus they plan to clear out the apparatus starting in autumn and begin to construct and install the next phase of the experiment: n2EDM. In particular, they expect delivery of the large magnetically shielded room by the end of 2017. The committee endorses the plan of the collaboration for establishing three experimental areas for n2EDM preparation.

The present goal is for full operation of the n2EDM experiment in 2020. The committee encourages the collaboration to consider setting up an external expert committee for a review of the remaining technical and scheduling issues. Results of such a review held prior to BVR49 would be an important input to this committee including the timescale for a complete TDR for n2EDM. In addition, it is important that future beamtime R&D studies be coordinated with overall facility and accelerator operations. Further details will be discussed in the subcommittee report.

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

The collaboration is to be congratulated on their successful passage through multiple NSF reviews leading to a NSF Midscale Construction Award in Sep 2016. Progress is acknowledged on detector development and there is very encouraging progress in the design and construction of the liquid hydrogen target with the addition of a new group with expertise in target development.

On the scientific side, while new preliminary results for atomic hydrogen suggest a smaller proton radius that could be consistent with the muonic measurements, the situation is far from resolved and the scientific case for MUSE remains strong.

As the collaboration moves forward, the committee welcomes every effort to facilitate an open channel of communication between PSI and NSF, perhaps with PSI participating as an observer via teleconference in the quarterly progress updates. The collaboration is also encouraged to continue forwarding future NSF reports and updates to PSI and the committee.

The committee conditionally approves the test beamtime request for 2017, subject to submission of a detailed plan on how the beamtime is used. The actual allocation will be coordinated with PSI management based on all of the requests for $\pi M1$. The committee notes that our previous request for an updated, complete TDR for BVR48 was not satisfied and we require such a document for BVR49 before considering allocation of beamtime after 2017. We also note progress on project management and collaboration organization. While advancements in simulations are noted, a full end-to-end beamline simulation based on existing beamline information is a necessary component of a complete TDR.

The collaboration request for exclusive use of the beamline $\pi M1$ in 2018/19 is denied. Thus the apparatus should be made removable. The details of this removable feature should be coordinated with PSI and will be subject to their approval. The allocation of beamtime to MUSE for 2018/19 will be decided at a later stage, depending on the committee acceptance of the complete TDR as well as progress in the construction of the experiment and tests of the detection system in the PSI beam. Further details will be discussed in the subcommittee report.

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

This innovative construction project with impressive sensitivity to charged lepton flavor violation is a major component of the future particle physics program at PSI. The committee remains extremely supportive of this experiment. However we acknowledge a significant delay in the acquisition of the magnet. The contract with Danfysik had to be cancelled in Jan 2017 and a new tendering process for the magnet is required. An optimistic scenario for the delivery of the magnet is early 2019. Fortunately the existing funding for the magnet is not compromised.

MuPix8 has seen the successful transition of production from IBM to AMS with expected delivery in Feb 2017. We are looking forward to the performance test.

An impressive preliminary version of the TDR (albeit with some missing parts) was generated. The committee has generally a very good impression and it is clear that significant progress has been made, in particular with a realistic design of the densely packed detector system. A first simulation of the most important background (Bhabha scattering) has indicated that it will not prevent the collaboration from making a measurement of $\text{BR}(\mu \rightarrow 3e) \sim 3 \times 10^{-15}$. Further details will be discussed in the subcommittee report.

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

The committee continues to strongly support this study into the production of a high-brightness muon beam. The request to test simultaneous longitudinal and transverse compression and the first extraction test of a compressed muon swarm is approved. The committee requests that the collaboration prepare a plan for the beamtime and submit this to PSI management.

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

This measurement of the charge radius of Ra is essential to a future atomic parity-violation study in this system. During the last year the collaboration successfully measured Re and Pb transitions and a well attended satellite workshop following PSI2016 took place. We approve this request for use of large area Ge detectors to investigate enhanced muonic atom production using muon transfer via $\text{H} \rightarrow \text{D} \rightarrow \text{Ra}$, along with other studies.

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

The committee congratulates the CREMA collaboration on their publication of the deuteron charge radius measurement via spectroscopy of the $2s-2p$ splitting in muonic deuterium. The result confirms the small value of the proton charge radius.

This update from the collaboration to measure the hyperfine splittings in muonic hydrogen and ^3He continues to present a strong case. The collaboration requests this feasibility study for performing the measurement in $\pi\text{E}1$ due to the heavy future commitment of $\pi\text{E}5$. The committee endorses this study.

4 Miscellaneous

At the beginning of the open meeting Willi Bertl who unfortunately passed away was remembered. Ueli Straumann and Augusto Ceccucci stepped down from committee and we would like to express our thanks for their contribution over the past years. Vincenzo Cirigliano presented a talk with the title “Probing new physics at the precision frontier”, emphasizing the impact of the PSI experimental program in the world-wide search for physics beyond the Standard Model.

5 Next Meeting

The next meeting (BVR 49) is again planned as a 3-day meeting and will take place from Monday to Wednesday, 12–14. February 2018. The deadline for proposals and beam time requests is 15. January 2018.

March 20, 2017

B. Filippone, A. Signer