SYDM 1: Session 1

Time: Tuesday 11:00–13:00 Location: C/gHS

Invited Talk SYDM 1.1 Tue 11:00 C/gHS

Searching for New Physics Effects in the Muon g -Factor — •B. Lee Roberts — Boston University

Measurements of the magnetic dipole moments of the electron and muon were intertwined with the development of the *modern physics* of the 20th century. The measurements are expressed in terms of the g-value, the proportionality constant between the magnetic moment and the spin, $\vec{\mu} = g(Qe\hbar/2m)\vec{s}$. The Stern-Gerlach experiment and atomic spectroscopy told us that $g = 2$ for the electron, which was subsequently predicted by Dirac theory. Later, experiments showed that for the electron $g > 2$; and it was necessary to add an anomalous piece, $g = 2(1+a)$. For point-like particles, the anomaly $a = (g-2)/2$, arises from radiative corrections. The lowest-order correction was first obtained by Schwinger, who found that $a = \alpha/(2\pi)$, and by doing so, carried out what we now call the very first *loop* calculation in quantum electrodynamics. This remarkable result was also found to also describe the muon's magnetic moment, which indicated that in a magnetic field the muon behaved like a heavy electron. The electron anomaly has now been measured to 0.24 ppb at Harvard, and the muon anomaly to 0.54 ppm at Brookhaven Laboratory. When the Standard-Model value of the muon anomaly is calculated by including contributions from quantum electrodynamics, the strong interaction and the electroweak interaction, it appears to be more than three standard deviations smaller than the experimental value. To clarify whether this difference signifies contributions from New Physics or not, two new experiments are being prepared. The Fermilab experiment will use the relocated muon storage ring from Brookhaven. The J-PARC experiment will use an entirely different technique. I will review the goals and status of the future experiments.

Invited Talk SYDM 1.2 Tue 11:40 C/gHS

Dedicated storage ring EDM methods — •Yannis Semertzidis for the JEDI-Collaboration — CAPP/IBS at KAIST and Physics Dept., KAIST, Daejeon, South Korea.

Dedicated storage ring electric dipole moment (EDM) methods are under development with potential sensitivity level at the 1E-29 e-cm for both the proton and deuteron nuclei. Two large collaborations, the JEDI at COSY/Juelich and srEDM at BNL/USA, are working closely together to optimize the final experimental plan. Together with the neutron EDM experiments, the proton and deuteron experiments, can help to shed light on the CP-violating source should one of them discovers a non-zero EDM value.

The R&D program is well under way with work on hadronic polarimetry, spin coherent time optimization/benchmarking, electric field strength tests, and precision beam/spin dynamics. The COSY ring at Juelich is being used in several tests requiring stored polarized beams. The optimization tests are expected to be concluded within the next two to three years.

Storage ring EDMs are sensitive to new physics at the 1000 TeV level, much beyond the mass scale reach of LHC and it can provide a hint of the next interesting scale. If new physics is discovered at LHC, it will probe the CP-violating phases of this new physics at the sub-micro-radian scale, an unprecedented sensitivity level.

Group Report SYDM 1.3 Tue 12:20 C/gHS

Search for the Electric Dipole Moment of ^{225}Ra — •Peter Mueller[1], Kevin Bailey[1], Michael Bishof[1], Matthew Dietrich[2], John Greene[1], Roy Holt[1], Mukut Kalita[3], Wolfgang Korsch[3], Nathan Lemke[1], Zheng-Tian Lu[1,4], Thomas O'Connor[1], Richard Parker[4], and Jaideep Singh[5] — [1]Argonne National Laboratory — [2]Northwestern University — [3]University of Kentucky — [4]University of Chicago — [5]Michigan State University

^{225}Ra ($\tau_{1/2} = 15d$, $I = 1/2$) is a promising isotope for EDM searches in diamagnetic atoms and the corresponding quest for physics beyond the Standard Model. Due to its large nuclear octupole deformation and high Z, the EDM sensitivity of ^{225}Ra is expected to be 2-3 orders of magnitude larger than that of ^{199}Hg, which to date sets the best EDM limit in this sector. We have developed an efficient multiple-stage apparatus to laser cool and trap radium atoms and to transfer them via optical dipole traps into a magnetically-shielded science chamber, where they are spin polarized and then allowed to precess in magnetic and electric fields. We will report on the results of the first EDM measurement of ^{225}Ra as well as plans for future improvements. This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under contract number DE-AC02-06CH11357.

Group Report SYDM 1.4 Tue 12:40 C/gHS

Measurement of the $e^+e^- \to \pi^+\pi^-$ Cross Section Using Initial State Radiation at BESIII — •Benedikt Kloss and Achim Denig — Institut für Kernphysik Mainz

The cross section $\sigma(e^+e^- \to \pi^+\pi^-)$ has been measured with ever increasing accuracy at accelerators in Novosibirsk, Orsay and Frascati. More recently the two most accurate measurements have been obtained by the KLOE collaboration in Frascati and the BABAR collaboration at SLAC. Both experiments claim an accuracy of better than 1% in the energy range below 1 GeV in which the ρ resonance is largely dominating the cross section. However a discrepancy of approximately 3% on the peak of the $\rho(770)$ resonance is observed increasing towards higher energies. Unfortunately this discrepancy limits our current knowledge of $a_\mu \equiv \frac{(g-2)_\mu}{2}$, which is a famous precision observable of the Standard Model (SM) of particle physics. Another comparable experiment is needed. This measurement can be done at the BESIII experiment in Beijing, China. Using the technique of initial state radiation it might be possible to measure this hadronic cross section below 3.0 GeV with a comparable precision to BABAR and KLOE. This talk will give an overview of the current status of this analysis.