Contribution ID: **63** Type: **not specified**

Improvements and Stabilisation of the BASE Apparatus for High-Precision Measurements of the Antiproton

A number of upgrades and stabilisation techniques to the BASE apparatus [1], motivated by improving upon the recent 1.5 ppb measurement of the antiproton g-factor [2] and other fundamental properties of the antiproton, are presented.

A new modified-cyclotron mode detection system has been commissioned and installed into the BASE apparatus. The primary function of this instrument is to resistively cool the modified-cyclotron mode, necessary to resolve single spin-flip transitions with high fidelity [3] – itself an integral part of g-factor measurements. This device also allows direct observation of the modified-cyclotron frequency, which in turn permits high-resolution measurements of the magnetic field.

Pressure stabilisation is also a new addition to the BASE experimental setup and has been added to keep both the pressure inside the apparatus, and the flow out of the cryogenic liquid reservoirs, as constant a possible. This has had a significant impact on the frequency stability of sideband measurements, improving from > 5 ppb to 1.7 ppb in terms of fractional precision.

A further stabilisation improvement is the implementation of a new self-shielding solenoid, centred over the Precision Trap (PT). The intention of such a device is to suppress the effect of external magnetic field fluctuations induced by the Antiproton Decelerator (AD) on the trapped particle. A self-shielding factor of 100 has been determined for this new instrument, corresponding to a 10-fold improvement compared to the device used in a previous charge-to-mass ratio measurement [4].

With a significantly upgraded experimental apparatus and improved methods and techniques, a sub-ppb measurement of the antiproton magnetic moment is anticipated.

[1] C. Smorra et. al. BASE – The Baryon Antibaryon Symmetry Experiment, Eur. Phys. J. ST, 224, 16, 3055–3108, 2015
[2] C. Smorra et. al. A Parts-Per-Billion Measurement of the Antiproton Magnetic Moment, Nature, 550, 371–374, 2017
[3] C. Smorra et. al. Observation of Individual Spin Quantum Transitions of a Single Antiproton, Phys. Lett. B, 769, 2017
[4] S. Ulmer et. al. High-Precision Comparison of the Antiproton-to-Proton Charge-to-Mass Ratio,Nature, 524, 196–199, 2015

Summary

Primary authors: HARRINGTON, James (Max-Planck-Institut für Kernphysik, Ulmer Fundamental Symmetries Laboratory RIKEN); Mr BORCHERT, Matthias (Institut für Quantenoptik, Leibniz Universität Hannover / Ulmer Fundamental Symmetries Laboratory, RIKEN); HIGUCHI, Takashi (University of Tokyo (JP)); Mr MORGNER,

Jonathan (Institut für Quantenoptik, Leibniz Universität Hannover); SELLNER, Stefan (Ulmer Fundamental Symmetries Laboratory RIKEN,); Dr SMORRA, Christian (Ulmer Fundamental Symmetries Laboratory RIKEN,); BOHMAN, Matthew Anders (Max-Planck-Gesellschaft (DE)); MOOSER, Andreas Hannes (Ulmer Fundamental Symmetries Laboratory RIKEN,); SCHNEIDER, Georg Ludwig (Johannes-Gutenberg-Universitaet Mainz,Ulmer Fundamental Symmetries Laboratory RIKEN); SCHÖN, Natalie (Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany); WIESINGER, Markus (Max-Planck-Institut für Kernphysik, Ulmer Fundamental Symmetries Laboratory RIKEN,); Prof. BLAUM, Klaus (Max-Planck-Institut für Kernphysik); MATSUDA, Yasuyuki (University of Tokyo (JP)); Prof. OSPELKAUS, Christian (Institut für Quantenoptik, Leibniz Universität Hannover, Physikalisch-Technische-Bundesanstalt); QUINT, Wolfgang (GSI); WALZ, Jochen (Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany and Helmholtz-Institut Mainz, Mainz, Germany); YAMAZAKI, Yasunori (University of Tokyo (JP)); ULMER, Stefan (Ulmer Fundamental Symmetries Laboratory RIKEN)

Presenter: HARRINGTON, James (Max-Planck-Institut für Kernphysik, Ulmer Fundamental Symmetries Laboratory RIKEN)

Session Classification: Poster session 2

Track Classification: Poster Session 2