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## Quantum logic inspired cooling and readout techniques for a single (anti-)proton

### Content

We present techniques tailored for sympathetic cooling and manipulation of a single (anti-)proton in a Penning trap system. Inside our trap a double-well potential is engineered for co-trapping an atomic ion, which enables for the use of quantum logic spectroscopy inspired cooling and readout schemes [1, 2]. These should allow for preparation at sub-Doppler temperatures and a readout of the (anti-) proton's spin state in less than a second. Within the BASE collaboration [3] these techniques could contribute to tests of CPT invariance with baryons through application to precision measurements of the (anti-)proton's  $g$ -factor.

The current status and recent progress made in the setup of the Penning trap apparatus, laser systems, and imaging optics for cooling, manipulation, and detection of the trapped atomic ion are presented.

[1] D. J. Heinzen *et al.*, PRA **42**, 2977 (1990)

D. J. Wineland *et al.*, J. Res. NIST **103**, 259-328 (1998)

C. Smorra *et al.*, EPJ-ST **224**, 3055 (2015)

### Summary

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