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Towards quantum logic inspired techniques for tests of discrete symmetries with (anti-)protons

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We present an experimental approach based on quantum logic inspired cooling and readout techniques to contribute to CPT tests in the baryonic sector. Within the BASE collaboration [1], these techniques would allow to cool single (anti-)protons to sub-Doppler temperatures by means of coupling to a laser-cooled beryllium ion [2, 3]. For this purpose, both ions will be co-trapped in an advanced cryogenic Penning trap system using an engineered double-well potential [4]. In addition, these techniques will lead to faster g-factor measurements of the (anti-)proton, resulting in better statistics and enabling proton-antiproton comparisons within daily sidereal timescales. In this contribution, we will show the current status of the project emphasizing the latest results on Doppler cooling of ${}^9\text{Be}^+$ ions as well as the latest modifications of the cryogenic Penning trap system.

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- [2] D. J. Heinzen and D. J. Wineland, Phys. Rev. A **42**, 2977 (1990)
- [3] D. J. Wineland *et al.*, J. Res. NIST **103**, 259-328 (1998)
- [4] M. Niemann *et al.*, arXiv: 1906.09249 [physics.atom-ph] (2019)

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