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HIGH-PRECISION PENNING-TRAP MASS SPECTROMETER PENTATRAP FOR FUNDAMENTAL PHYSICS

The Penning-trap mass spectrometer Pentatrap [1] located at the Max Planck Institute for Nuclear Physics in Heidelberg recently proved its capabilities performing first mass-ratio measurements with a relative uncertainty in the 10^{-11} regime using highly charged ions of ^{187}Re [2] and different xenon isotopes [3]. Pentatrap will continue with mass measurements of dedicated nuclides which will allow, among others, to contribute to tests of special relativity, bound-state QED, neutrino-physics research, and to a search for suitable transitions in highly charged ions for a new generation of clocks. Achieving this level of precision requires using a cryogenic detection system with single ion sensitivity and phase sensitive Fourier Transform Ion Cyclotron Resonance (FT-ICR) image-current detection methods in combination with highly charged ions provided by external ion sources. A unique feature of Pentatrap is the suppression of systematic uncertainties by performing simultaneous measurements in multiple traps. The overview of the Pentatrap setup, its current performance and the latest results will be presented.

1. J.Repp et al. // Appl. Phys. B. 2012. V.107. P.983.
2. R.X.Schüssler et al. // Detection of metastable electronic states by Penning-trap mass spectrometry. (accepted by Nature, 2020).
3. A.Rischka et al. // Mass-difference measurements on heavy nuclides with an eV/c^2 accuracy in the PENTATRAP spectrometer. (accepted by Phys. Rev. Lett. 2020).

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