

# Physics Colloquium Mainz

**June 25, 2024 at 16 c.t.**

Lecture room KPH,  
Johann-Joachim-Becher-Weg 45, JGU

The four fundamental interactions and their symmetries, the fundamental constants as well as the properties of elementary particles like masses and moments, determine the basic structure of the universe and are the basis for our so well tested Standard Model (SM) of physics. Performing stringent tests on these interactions and symmetries in extreme conditions at lowest energies and with highest precision by comparing, e.g., the properties of particles and their counterpart, the antiparticles, will allow us to search for physics beyond the SM. Any improvement of these tests beyond their present limits requires novel experimental techniques.

An overview is given on recent mass and  $g$ -factor measurements with extreme precision on single or few cooled ions stored in Penning traps. Among others the most stringent test of bound-state quantum electrodynamics could be performed. Here, the development of a novel technique, based upon the coupling of two ions as an ion crystal, enabled the most precise determination of a  $g$ -factor difference to date. This difference, determined for the isotopes  $^{20,22}\text{Ne}^{9+}$  with a relative precision of  $5 \times 10^{-13}$ , improved the precision for isotopic shifts of  $g$  factors by about two orders of magnitude. Our latest results on precision measurements with exotic ions in Penning traps will be presented.

**Precision Tests of Fundamental  
Interactions and Their Symmetries using  
Exotic Ions in Penning Traps**

**Prof. Dr. Klaus Blaum**

**Max-Planck-Institute for Nuclear Physics,  
Heidelberg**

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