

Großes Physikalisches Kolloquium an der Universität zu Köln



Prof. Dr. Yury A. Litvinov

Institut für Kernphysik, Universität zu Köln, Köln & GSI
Helmholtzzentrum für Schwerionenforschung, Darmstadt

Intersection of nuclear-, atomic- and astro- physics: Beta decay of highly charged ions

21.10.2025
16³⁰ Uhr
HS III

The famous sentence ‘we all are made of stardust’ implies that all visible matter in the Universe, on the Earth, in our bodies, or somewhere else, has been and still is being created in the hot interior of stars. The only exceptions are the lightest elements, hydrogen, helium, lithium and beryllium, which were probably formed during the first minutes after the Big Bang or in ongoing spallation reactions in interstellar medium. The conception that our roots go back to the cauldrons of long dimmed stars is a keystone of our present perception of the Universe. Nucleosynthesis proceeds by nuclear fusion in massive stars until iron, where it stops because the fusion of still heavier nuclei consumes energy instead of providing it. Nature has, however, invented a ‘trick’ to overcome this dead-end: atomic nuclei can become heavier by capturing neutrons and can also alter their nuclear charge via beta decay (β -decay). Our knowledge of β -decay is based on numerous studies of neutral atoms. But what happens in high temperature environments of stellar interiors, where atoms lose most or even all bound electrons?



In this lecture we will see that the decay properties established in neutral atoms can dramatically change in highly charged ions. The corresponding measurements are done in the experimental storage ring ESR of GSI, where we are able to store freshly produced highly charged radionuclides in ultra high vacuum, thereby preserving their charge state for extended periods of time. An overview of the obtained results as well as remaining challenges will be presented.