From Nuclei to Stars: β Decay of Highly Charged Ions

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The famous phrase "we are all made of stardust" reflects a profound truth: nearly all visible matter in the Universe was forged in stellar interiors. Nucleosynthesis proceeds by nuclear fusion up to iron, beyond which nature relies on neutron capture and β-decay to build heavier elements. Yet our knowledge of β-decay rests almost entirely on studies of neutral atoms — a poor proxy for the interiors of stars, where atoms are stripped of most or all of their electrons.

In this presentation we will show that decay properties can change dramatically for highly charged ions (HCI). Familiar radioactive decay channels can be blocked. New ones, unavailable to neutral atoms, can open up. These effects arise from the interplay between the electron shell and the nucleus, making them relevant to nuclear structure and stellar nucleosynthesis, as well as to atomic physics in its own right.

Such measurements are carried out at the Experimental Storage Ring (ESR) at GSI, Darmstadt, presently the only facility dedicated to precision decay studies of HCIs, where freshly produced radionuclides are stored in ultra-high vacuum, preserving their high atomic charge state for extended periods.