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Beta-delayed proton emission in neutron-rich nuclei: The quest for dark decay of the neutron.

Nuclei with more neutrons than protons tend to get rid of excess neutrons to reach the valley of stable nuclei through beta-minus (β-) decays. On the other side of the valley of stability, proton-rich nuclei follow the analogous process through beta-plus (β+) decays. Beta-delayed proton emission, observed more than 40 years ago, typically occurs in very proton-rich nuclei and not on the neutron-rich side of the stable nuclei. However, the emission of protons following β- decay is energetically allowed for neutron-rich nuclei with neutrons bound by less than 782 keV. This condition may be fulfilled in so-called halo nuclei where one or several neutrons are loosely bound and orbit far from the core. 11Be is one of the most promising candidates, resulting in 10Be following the beta decay to 11B and the subsequent proton emission. A team of NSCL (National Superconducting Cyclotron Laboratory, Michigan State University, USA) and TRIUMF (Canada) researchers carried out the first direct observation of the beta-delayed proton decay of a neutron-rich nucleus by directly measuring the very low-energy protons emitted following the beta decay of 11Be. This experiment was performed with the Active Target Time Projection Chamber (AT-TPC), a gas-filled detector capable of providing high efficiency and resolution for low-energy charged particles such as the emitted protons. In this talk, I will discuss the technique and the results of such experiment, as well as different aspects of this decay, including a speculative dark matter decay.

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