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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. ^{11}Be is one of the most promising candidates, resulting in ^{10}Be following the beta decay to ^{11}B 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 ^{11}Be . 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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