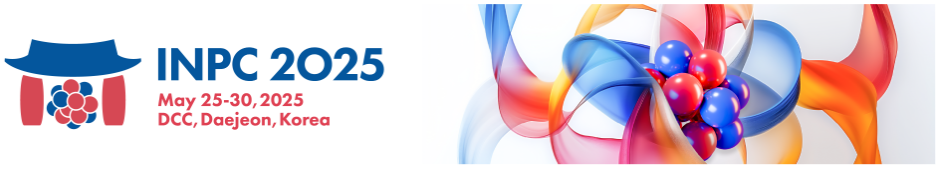

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Beta-delayed neutron emission from 8He

Friday, 30 May 2025 09:25 (15 minutes)

8He with 2 protons and 6 neutrons exhibits the most extreme neutron to proton ratio of all known nuclides. It decays by beta-decay with a lifetime of 119ms and a Q-value of 10.65MeV. The decay of 8He is challenging to measure and interpret because the decay produces final states as diverse as 8Li+gamma, 7Li+n, 7Li+n+gamma and triton+alpha+n. The decay mechanism of the decay channel with three hadrons is not known presently.

The decay of 8He represents an irreducible background for reactor antineutrino experiments because it can be produced by cosmic rays impinging on the liquid scintillator used in the neutrino detectors. The correct treatment of this decay is important for developing methods for reducing this cosmogenic background. Existing data on the decay of 8He are insufficient for an adequate treatment of this background in current and planned reactor antineutrino experiments.

We have measured the decay of 8He at the ISOLDE decay station (IDS) at CERN. The IDS is a versatile detection station based around an array of HPGe Clover detectors, which can be supplemented with different auxiliary detectors for electrons, charged hadrons or neutrons. For this experiment a compact array of double-sided silicon strip detectors (DSSDs), plastic detectors with high timing resolution for beta detection and the IDS neutron detector array (INDiE) was used.

The analysis is well advanced. With a digital trace captured for each event in the beta and INDiE detectors, different timing algorithms have been explored to maximize timing resolution for neutron time of flight and consequently energy. As part of the analysis, we have made use of the excellent energy resolution and segmentation of DSSDs to do particle identification of charged particles in coincidence with neutrons by conservation of momentum. Here we have observed neutrons in coincidence with recoiling 7Li nuclei, as well as the alpha-triton-neutron break up of highly excited states of 8Li. In all, this provides complete kinematics identification of all decay channels of 8He with high statistics as well as high spatial and energy resolution.

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