



Contribution ID: 45

Type: Submitted oral (In person)

Accurate characterization of the 2^+ isospin doublet of ^8Be in beta -decay

Friday 1 December 2023 11:30 (12 minutes)

In this contribution, an accurate characterization of the 2^+ isospin mixed doublet of ^8Be is provided. The excitation spectrum of ^8Be populated in the beta decay of ^8B is analysed via two methods; an R-matrix approach and an alternative approach based on the beta recoil. Through this complementary analysis, the isospin mixing in the doublet and the variation with excitation energy of the Fermi and Gamow-Teller components have been established.

The existence of a 2^+ isospin doublet in ^8Be formed by its 16,6 and 16,9 MeV excited levels has been known since the mid-60s [1-3]. This is the only known case of an expected full isospin mixing between two nuclear states where the 16.6 MeV ($^7\text{Li} + p$) and 16.9 MeV ($^7\text{Be} + n$) levels can be factorized into two pure isospin levels [4]. While their isospin composition has been hinted by R-Matrix fits to reaction data [5], it has never been directly confirmed. The beta decay feeding of ^8B to the ^8Be 's doublet is a good tool to probe the isospin mixing by analysing the Fermi and Gamow-Teller components. However, the difficulty is to resolve the 2^+ doublet since in the Q_{EC} window ($Q_{EC} = 17,9798(1)$ MeV) the dominant (>88%) decay mode is the feeding to a broad 2^+ state at 3 MeV [6], and the broad tail of the feeding to this level interferes in the region of the doublet.

Experiment IS633 was performed by the MAGISOL collaboration at the IDS beamline with the ambition of having enough statistics to resolve the 2^+ doublet of ^8Be populated through beta decay [9,10]. A mass-separated 50 keV $^8\text{BF}_2$ beam was stopped in a 30 mg/cm^2 carbon foil. The ^8B feed via $EC/^{+}$ decays the excited states of ^8Be . All excited states of ^8Be are unbound, they break up into two alpha particles that are detected through a system of four particle telescopes, each formed by a Double-Sided Silicon Strip Detector (DSSD) with thicknesses of 40 and 60 μm stacked with thick Si-PAD detectors of 1500 μm . The detected alpha spectra are then used to reconstruct the excitation spectrum.

IS633 represents a significant improvement in comparison to previous experimental attempts, obtaining two orders of magnitude more statistics than our previous benchmark experiment at Jyväskylä (JYFL08). Due to the high statistics, the continuum spectrum of ^8Be has been determined from 1 MeV up to 17 MeV, within this spectrum the 16,6 MeV 16,9 MeV doublet has been resolved for the first time in a beta decay study. This allows the determination of the Fermi and Gamow-teller contributions following the different methods that will be presented in this contribution.

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Session Classification: Rare Decays II