



Contribution ID: 45

Type: Submitted oral (In person)

## Accurate characterization of the $2^+$ isospin doublet of $^8\text{Be}$ in beta -decay

Friday 1 December 2023 11:30 (12 minutes)

In this contribution, an accurate characterization of the  $2^+$  isospin mixed doublet of  $^8\text{Be}$  is provided. The excitation spectrum of  $^8\text{Be}$  populated in the beta decay of  $^8\text{B}$  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  $^8\text{Be}$  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  $^8\text{B}$  to the  $^8\text{Be}$ '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  $^8\text{Be}$  populated through beta decay [9,10]. A mass-separated 50 keV  $^8\text{BF}_2$  beam was stopped in a 30  $\text{mg}/\text{cm}^2$  carbon foil. The  $^8\text{B}$  feed via  $EC/^{+}$  decays the excited states of  $^8\text{Be}$ . All excited states of  $^8\text{Be}$  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  $\mu\text{m}$  stacked with thick Si-PAD detectors of 1500  $\mu\text{m}$ . 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 off  $^8\text{Be}$  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.

### References

1. F.C.Gilbert, Phys. Rev. 93 (1954) 499.
2. B.J. Farmer et al., Nucl. Phys 15 (1960) 626.
3. E. Matt et al., Phys. Lett. 9 (1964) 174.
4. T. Nilsson et al., Hyperfine Int 129 (2000) 67.
5. C.P. Browne et al., Phys. Lett. 23 (1966) 371
6. P. von Brentano, Physics Reports 264 (1996) 57.
7. J. N. Bahcall and C. Peña-Garay, New Journal of Physics 6 (2004)63.
8. M.J.G. Borge et al., J. Phys. G 40 (2013) 035109
9. O. Kirsebom et al., Phys. Rev. C 83 (2011) 065802.
10. S. Viñals, PhD thesis. Complutense University of Madrid (2020)
11. M. Bhattacharya, Physical Review C 73, (2006) 055802.

**Author:** FERNANDEZ RUIZ, Daniel (Consejo Superior de Investigaciones Cientificas (CSIC) (ES))

**Co-authors:** GARCIA BORGE, Maria Jose (Consejo Superior de Investigaciones Cientificas (CSIC) (ES)); TENG-BLAD, Olof (Consejo Superior de Investigaciones Cientificas (CSIC) (ES))

**Presenter:** FERNANDEZ RUIZ, Daniel (Consejo Superior de Investigaciones Cientificas (CSIC) (ES))

**Session Classification:** Rare Decays II