Contribution ID: **556** Type: **Oral Presentation**

[516] Exciting the Hoyle state in 12C selectively populated using the 10B(6Li,4He)12C reaction

Thursday 10 July 2025 09:40 (20 minutes)

An excited state in 12C close to the 3-alpha breakup was predicted by Fred Hoyle in 1954 and was identified in 1962 by Cook et al. as the 0+ state lying at an excitation energy of 7.65 MeV. It was the key to understanding the production of 12C and heavier elements in the Sun (stars) up to iron. In the Sun's core, fusion of two alpha-particles leads to the production of excited 8Beand then the capture of another alpha-particle a + 8Be produces excited 12Cclose to the Hoyle state. Subsequently, gamma-decay from the Hoyle state to the 4+ (4.43 MeV) state and down to the 12C ground state 0+ (0.0
MeV) results in the production of stable 12C, as opposed to 3-alpha breakup. However, the observed enhanced 12C production rate in stars is speculated to be achieved through excited states of the Hoyle state. The existence of broad excited Hoyle states at 12C(2+, 9.8 MeV) and 12C*(4+, 13.3 MeV) have been reported, previously not identified because of other nearby strongly excited states in 12C. The 10B(6Li,a)12C* reaction selectively excites 2+ states in 12C and because of the high Q-value of Q = +24.6 MeV the high energy alpha-particles are easily identified with good energy resolution.
Measurements were taken at the EN Tandem Van de Graaff accelerator of iThemba LABS (Gauteng) using 6Li beams at E_Lab = 20 MeV incident on thin 10B targets. Results will be presented for the observed high energy alpha-particles corresponding to states excited in 12C up to and above the Hoyle state. In addition, preliminary results will be shown for coincidence measurements between the outgoing high energy alpha-particle and the 12C reaction partner.

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Session Classification: Nuclear, Particle and Radiation Physics-1