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Studies of the 12C nucleus using beta-decay of 12N and 12B

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Experimental studies of the 12C nucleus are important to both nuclear theory and astrophysics. Improved knowledge of states in 12C is necessary for our understanding of the triple alpha reaction in stars. Especially the Hoyle state at just 0.38 MeV above the triple alpha threshold is vital for this process, but also a predicted 2+ state at 1.7 MeV above the triple alpha threshold in 12C has been included in the NACRE reaction rate calculations, and its existence needs to be verified experimentally.

The structure of the 12C nucleus is not fully understood. Some properties are well described by cluster models and others by mean field theory. New ab-initio calculations have been published and the results are promising giving good agreement with experimental data in the literature.

In a new experiment at KVI in Groningen, the Netherlands, 12C was populated in beta-decay of 12B and 12N. Beams of 12B and 12N ions were implanted in a 48 times 48 strip detector (DSSSD) and let decay. Because of the segmentation of the DSSSD into very small pixels the background of beta particles is significantly reduced and essentially confined to low energies. The implanted ions and emitted alpha particles are stopped in one pixel of the detector so very precise absolute branching ratios and decay spectra can be obtained. Measurements at very low energies are possible because detector deadlayer effects are avoided in the implantation method, so new information about the Hoyle state can be achieved. Results of the analysis will be presented including new energy spectra, branching ratios and comparisons to earlier work and theory.

Primary author: HYLDEGAARD, Solveig (Department of Physics and Astronomy, University of Aarhus)

Presenter: HYLDEGAARD, Solveig (Department of Physics and Astronomy, University of Aarhus)

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