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Precision Mass Measurements of Neutron-rich Isomers for the r-process

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Approximately half of the nuclei heavier than iron are produced by the rapid neutron capture process (r process). [1] The r process can be simulated with nuclear reaction network codes for which nuclear input data is essential. Particularly neutron capture reaction rates and
β-decay Q values are important, both of which are dependent on nuclear masses. However, many neutron-rich nuclei have measured masses with rather large uncertainties, and the isomeric states might be even lesser known. [2] Improving the accuracy of the measured masses for these nuclei also leads to more precise reaction rates which in turn lead to reduced uncertainties in the r-process simulations. The improved masses also affect the beta decay Q values which are important for the heating rate of the r process.

JYFLTRAP, a double Penning trap mass spectrometer [3], at the IGISOL facility has been utilised to accurately measure the masses of several neutron-rich isotopes. Combined with the phase-imaging ion cyclotron resonance (PI-ICR) technique [4], several low-lying isomeric states have been successfully resolved [5,6]. While currently not widely used in astrophysical simulations, isomeric states can have substantial effect on the r-process outcome. [7] In my presentation, example cases of measured isomeric states are presented with updated reaction rates and their effects on the r-process abundances and heating rate.

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