Method for (n,γ) cross section measurements on unstable isotopes

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The knowledge of neutron capture cross sections of unstable isotopes is important for the understanding of branching points in the reaction path of the s process during stellar helium burning [1,2], as well as for explosive nucleosynthesis in supernovae in the r and p process [3].

Branching points in the s process provide important information about the stellar interior and allow the testing of different stellar models. During supernova explosions, the reaction path is shifted far into the region of unstable nuclei. Current measurements with the time of flight (TOF) technique are limited by the available neutron fluxes which require - even under ideal circumstances - sample masses of at least several milligram. For short lived nuclei, this would imply severe background due to the activity of the target.

We propose to increase the sensitivity of the TOF method such that target masses in the microgram region can be used. This is achieved by shortening the flight path down to a few centimeters, setting up the neutron production target inside a 4π BaF_2 calorimeter [4,5]. Background suppression is realized by the proper use of backing and absorber material, combined with the extremely good time resolution of the calorimeter and energy cuts in the different energy components of the capture events.

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