Counting Setup for Activation Experiments in Nuclear Astrophysics

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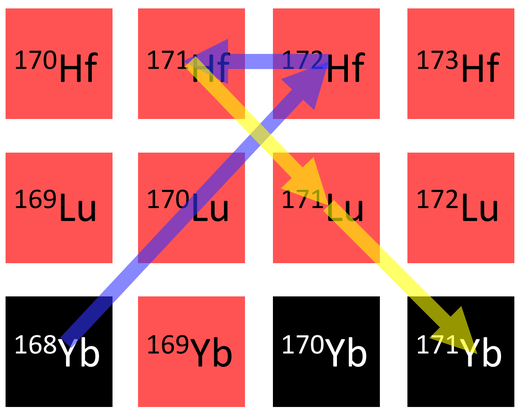
Astrophysical Motivation



Examples for relevant reactions:
^{168}Yb(α,n) and ^{141}Pr(α,n)

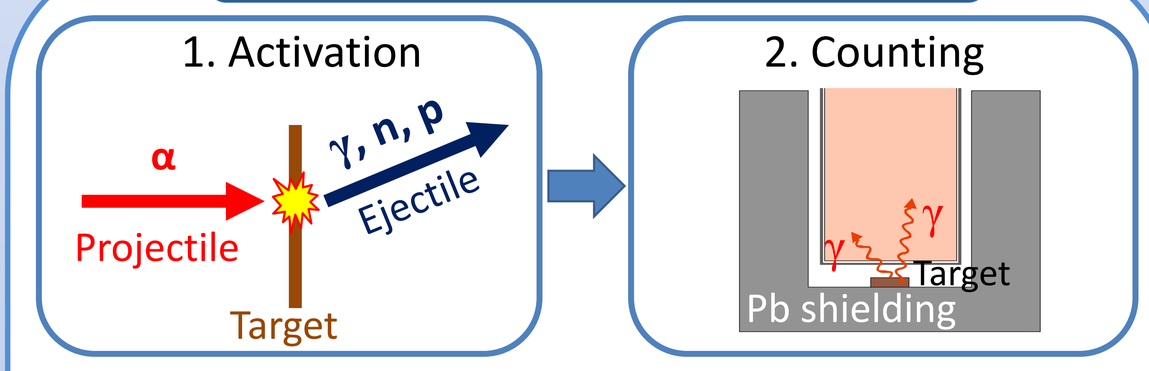
- *p* process: a process for nucleosynthesis of heavy elements
- produces about 30 – 35 heavy proton rich nuclei
- reaction network of mainly (γ,n), (γ,α) and (γ,p) reactions, contains ≈ 2000 nuclei and 20000 reactions [1]

➡ experimentally determined nuclear physics input parameters are needed to improve the accuracy of *p*-process network calculations

➡ experimental difficulties due to measurements far below the Coulomb barrier inside the Gamow window → cross sections in the µb range

➡ one possible solution: activation measurements

Activation Experiments



Advantages

- ✓ very high beam intensities
- ✓ no beam induced background
- ✓ strongly reduced background during counting

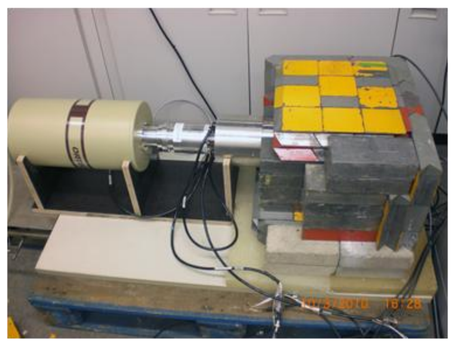
Restrictions

- ✖ stable reaction products
- ✖ appropriate half-lives
- ✖ weak γ intensities

Counting Setup

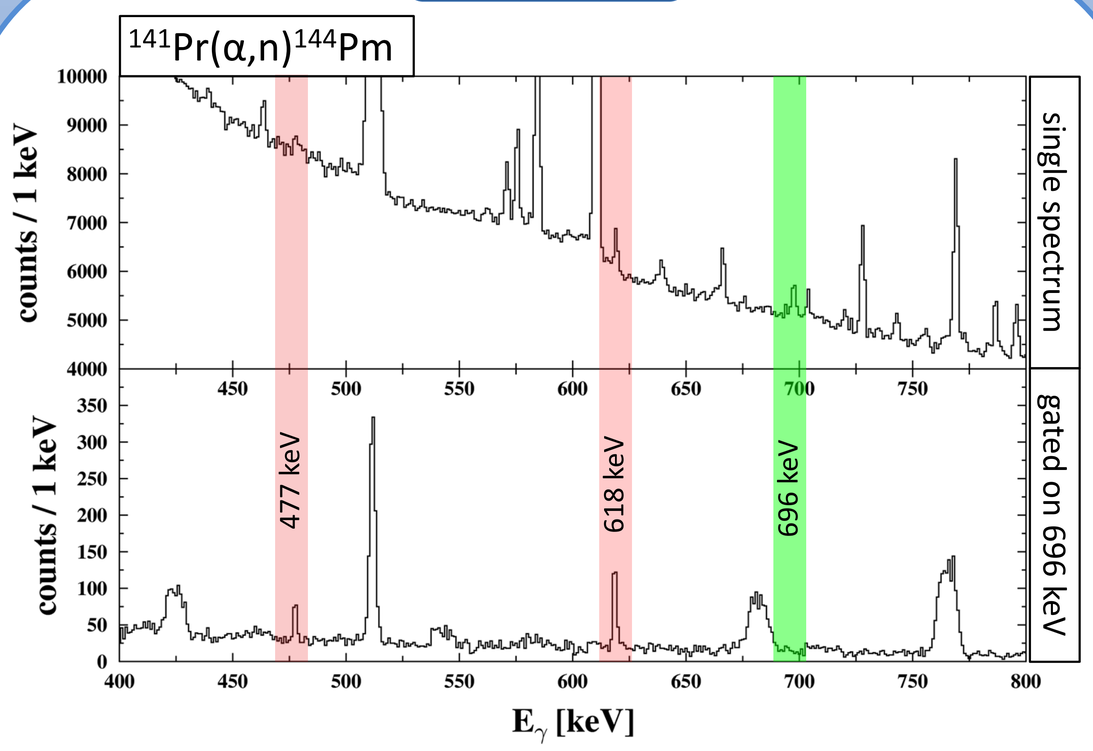
- HPGe clover detector
- four independent crystals allow γγ-coincidence measurements
- relative efficiency of 120 %
- total photopeak efficiency @ 1332 keV up to 4 %

[2]



- digital data acquisition (HK 39.11, S. Pickstone)
- passive lead and BGO shielding for background suppression

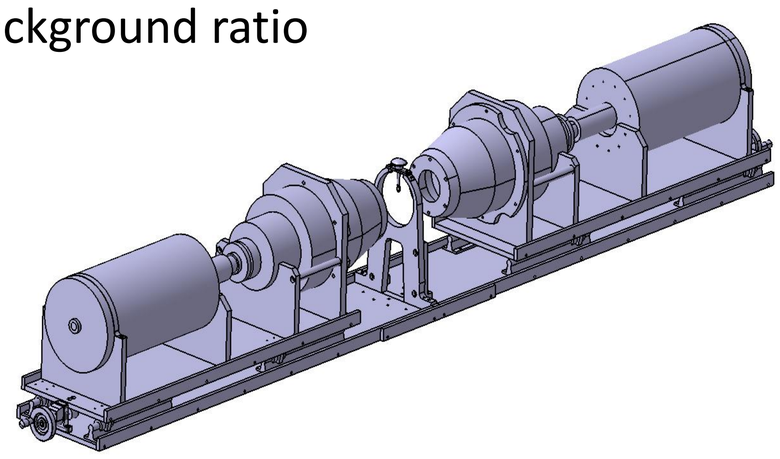
Results



- γ decay of ^{144}Nd via a cascade → γ rays emitted in coincidence
- strong background suppression by claiming γγ coincidences within one detector

Planned Improvements

- two HPGe clover detectors in face-to-face geometry
- Cu shielding for further background suppression
- addback algorithm to improve peak-to-background ratio



References:

[1] M. Arnould and S. Goriely, Physics Reports **384** (2003) 1-81

[2] G. Duchêne *et al.*, Nucl. Instr. and Meth. A **432** (1999) 90-110

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