



Gamma ray detection possibilities for EXL

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Physics applications

- Information on single particle states
 - Transfer reactions (d,p) etc.
 - Charge exchange reactions (p,n)
 - Quasi-free scattering: (p,2p); (p,pn)
 - Gammas give additional information
 - Transitions between excited states
 - Angular distributions etc..
 - Beam energies 10-30 MeV/u for momentum matching for transfer



Properties of gamma rays of interest

- Energies – 100 keV – 10 MeV
- Multiplicity:
 - 1 to many depending on application but generally low e.g. $^{132}\text{Sn}(d,p)$
- Multipolarity:
 - assume dipole (M1,E1) and quadrupole (E2) most important
- Lorentz boost? (non-negligible for 30 MeV/u beams)

Design issues

- High efficiency for high energy gammas
- Resolution – few % acceptable – or germanium resolution?
- Small opening angle – Doppler broadening
- Desire to measure angular distributions?
- Dealing with Lorentz Boost?
- Polarisation?
- Absorption of pipe?
- Magnetic fields??
- Cost – large array of germanium too much?

A solution? - composite detector

- Planar germanium DSSD or a stack of planars with a large detector behind
 - Position of first interaction gives angle for Doppler correction
 - Pulse shape analysis may improve this localisation
- Back detector:
- Planar dimensions should be compatible with EUROBALL/MINIBALL clusters
- Dedicated scintillators could be used in conjunction with planars e.g. BaF

Planar HPGeDSSSD detectors

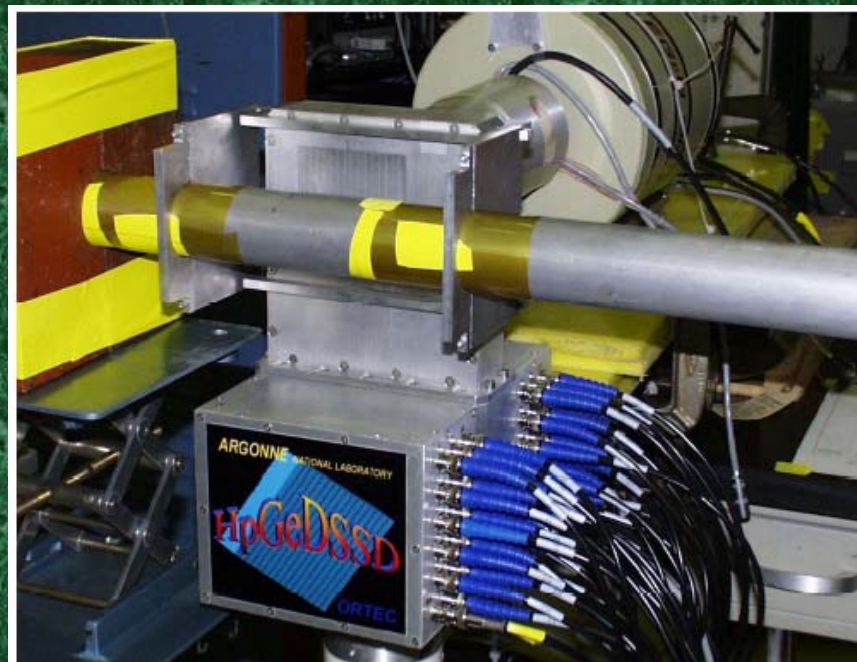
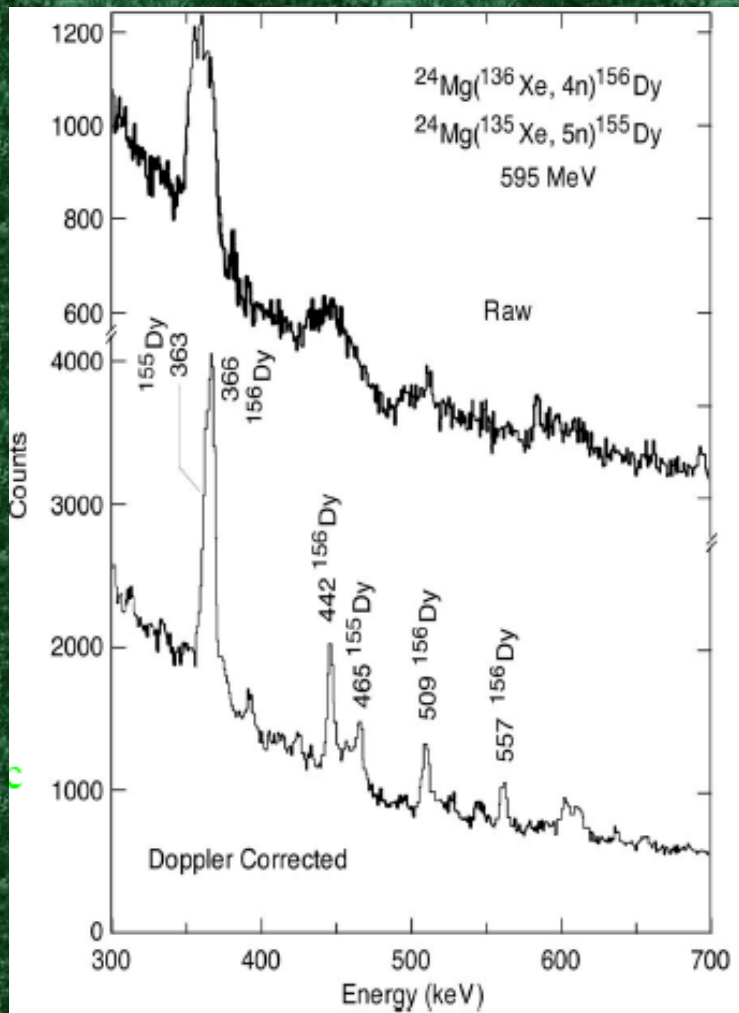


GREAT planar germanium detector for focal plane spectroscopy of gammas and betas



Argonne prototype HPGeDSSD

Pixellation to deal with high recoil velocities

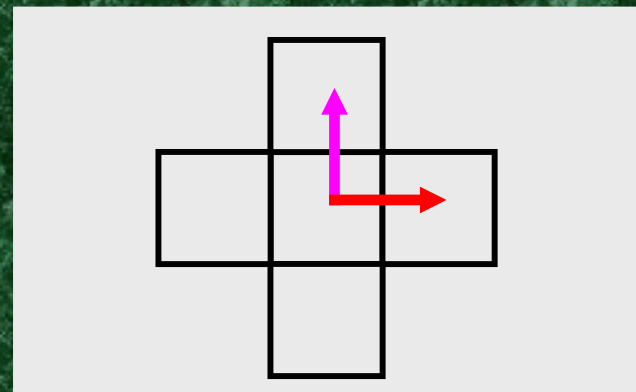


Large detector behind can operate as add-back or as veto depending on application

Compton polarimeter



In principle, such detectors form excellent Compton polarimeters, especially for low energy (200 keV) gamma rays



Conclusions

- Composite detector provides possible solution to large Doppler shift corrections with small volume of germanium
- The planar could 'mate' with both RISING detectors and/or scintillators
- Proven technology - HPGeDSSD as produced by ORTEC now beyond the prototype stage