Comparing n/p type performance

We have been studying n type segmented detectors for a couple of years, with good results. However, no proven source of crystals available. R&D with IKZ, but yield cannot be assessed at this point.

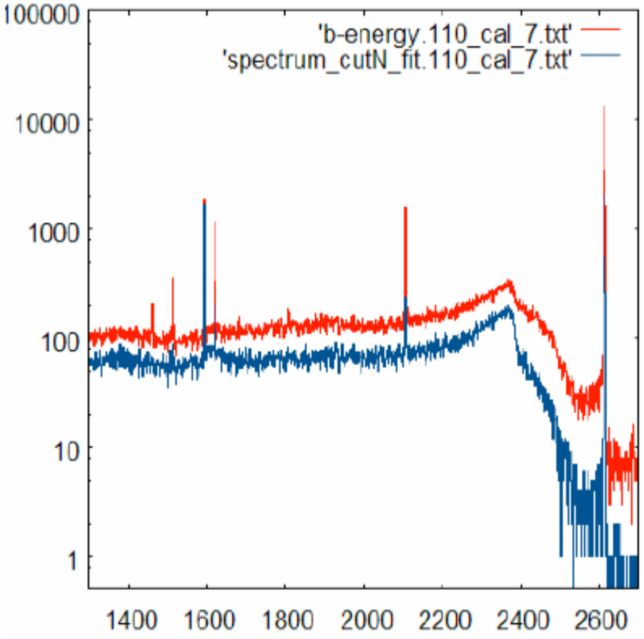
Recent result from BEGe detector show encouraging results – good MSE event rejection with standard detector. Xtal growing, yield would also need to be resolved. First discussions with Canberra have taken place.

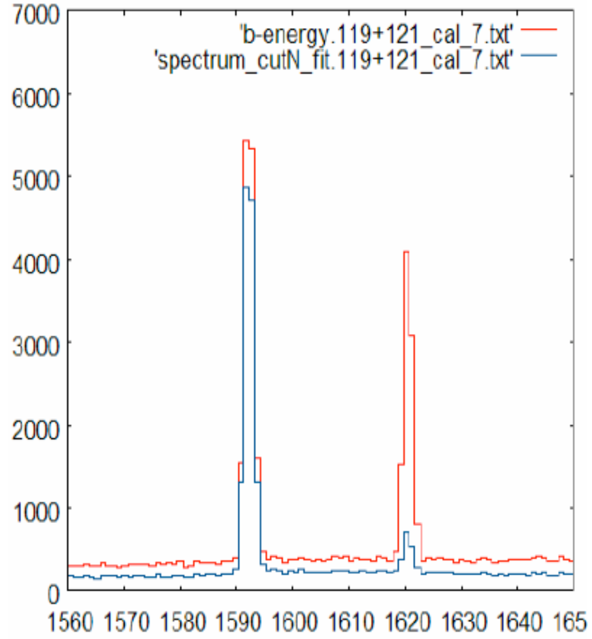
How to proceed ?

- How do we decide which path (n-type, p-type, both, …)

- What are the boundary conditions ? E.g., fixed amount of enriched Ge, finite money, time scale, manpower

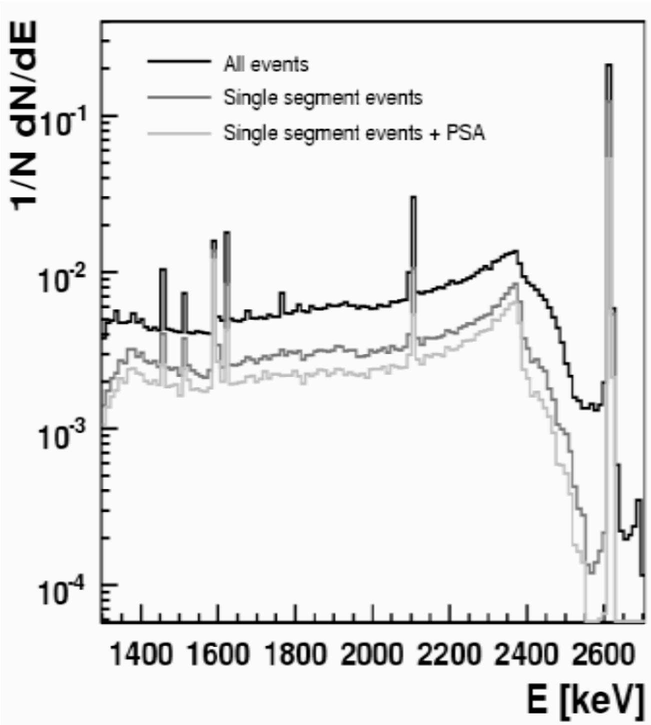
Study on Tl

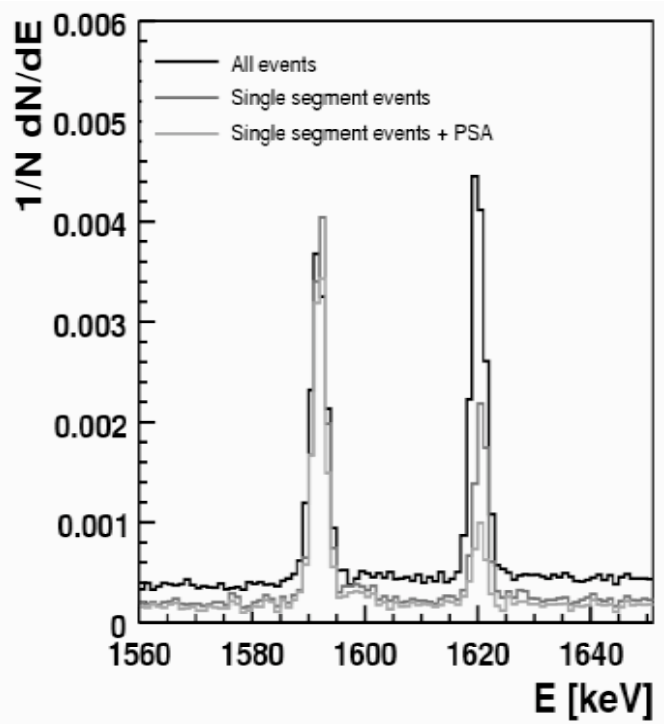




BEGe point-contact
Fractions remaining after PSA cut:

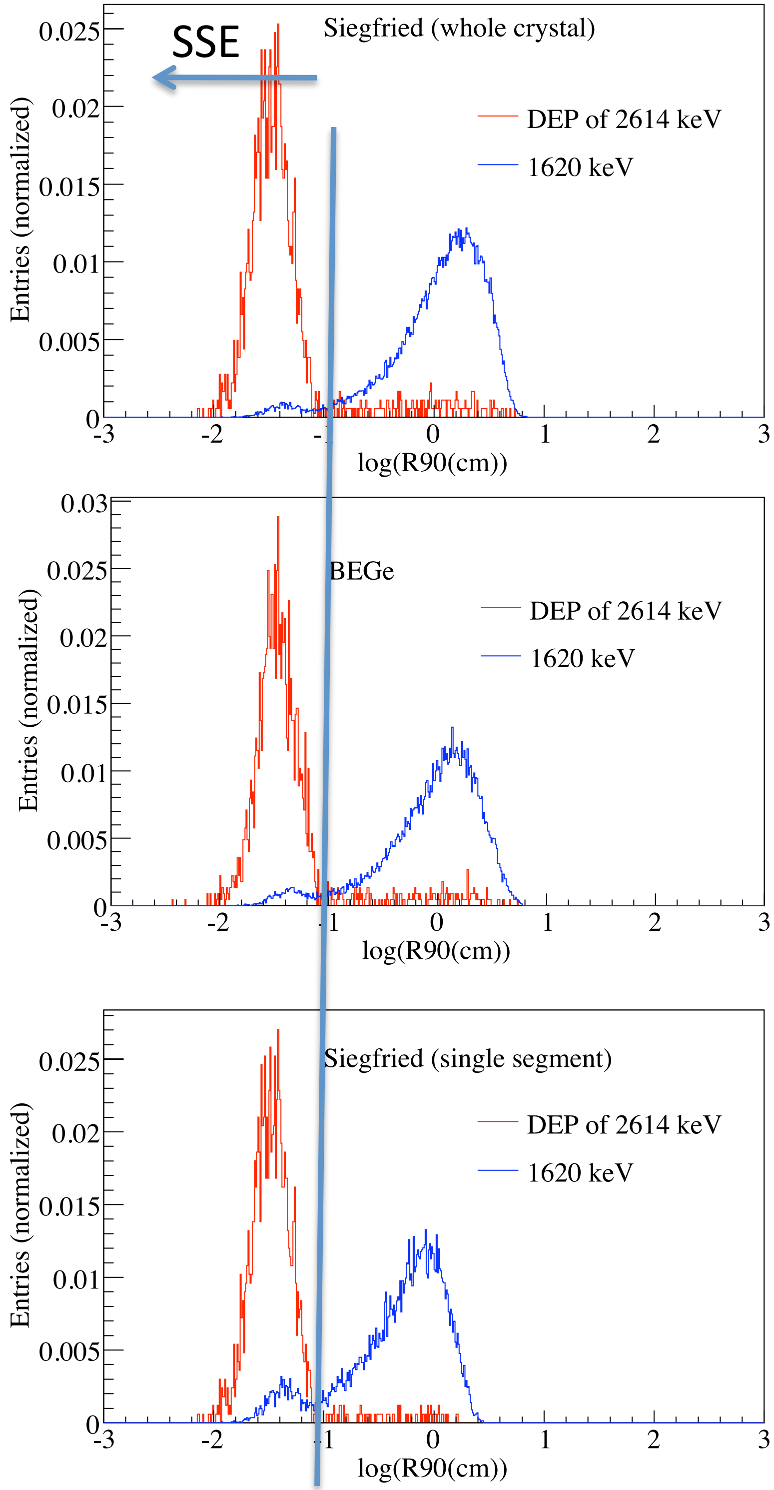
DEP 91 % ± 0.6 %
1.62 MeV 13 % ± 0.4 %
2.61 MeV 13 % ± 0.1%
ROI Qbb 49 % ± 0.4 %





18-fold segmented coax
Fractions remaining after combined single-segment and PSA cut:

DEP 82% ± 2 %
1.62 MeV 19% ± 0.4%
2.61 MeV 14.6% ± 0.3 %
ROI Qbb 48. % ± 1. %



SSE
0.92
0.04

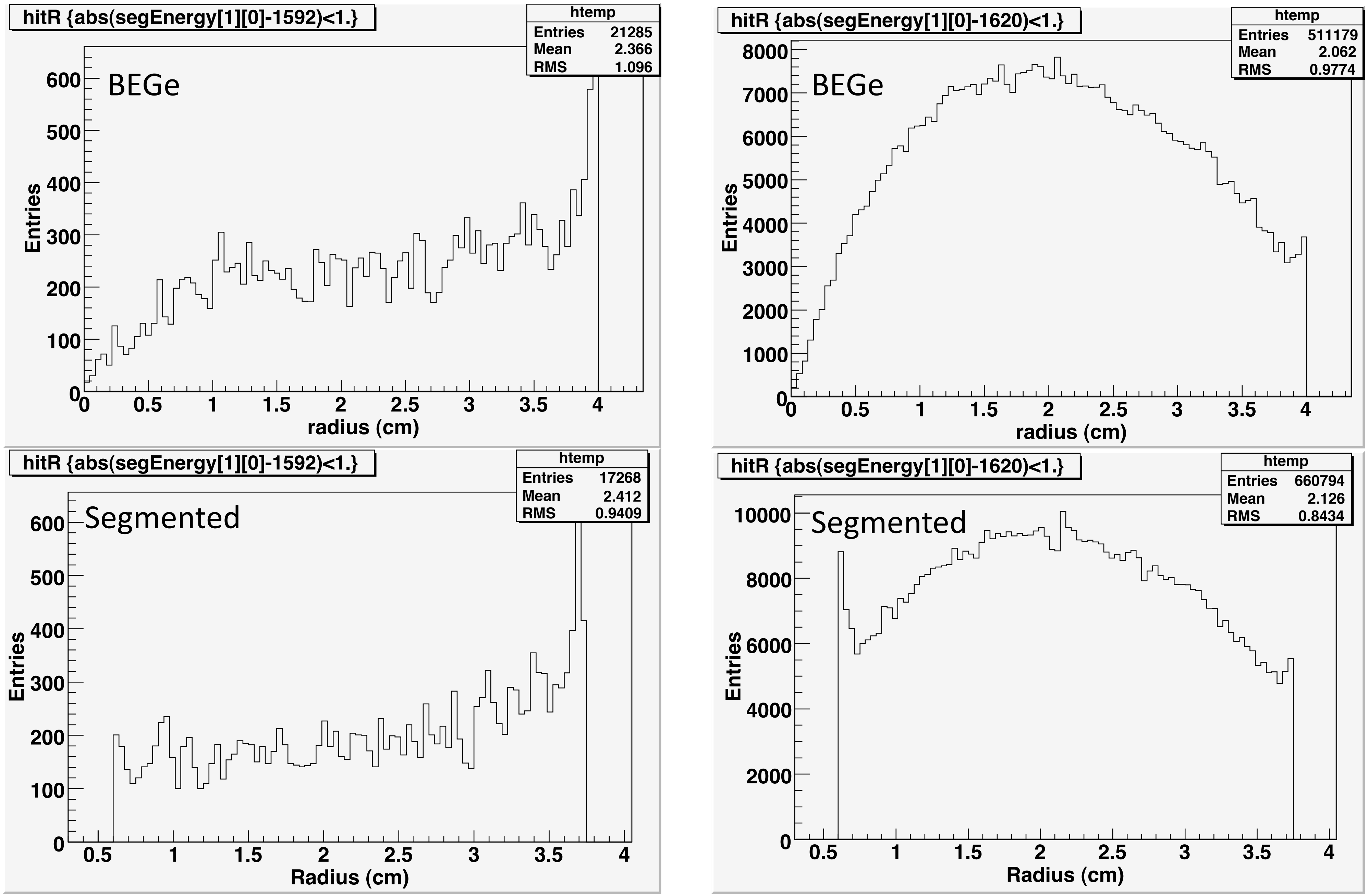
The geometry of the detector already produces a selection on the size of the energy deposits in the detector: smaller detector implies more SSE-like events in 1620 peak.

SSE
0.93
0.05

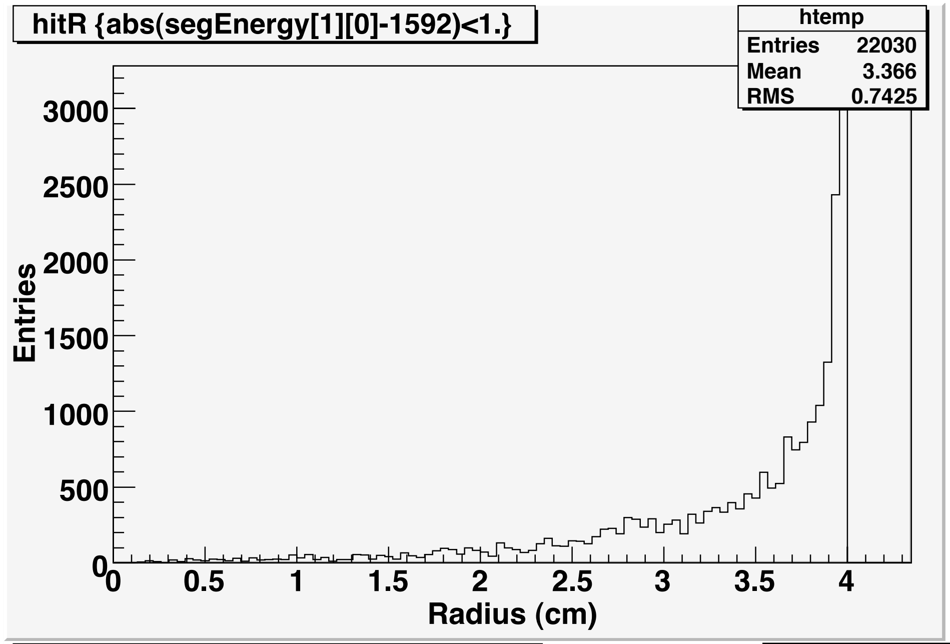
Definition: R_{90} is the radius which contains 90% of the deposited energy

SSE
0.96
0.11

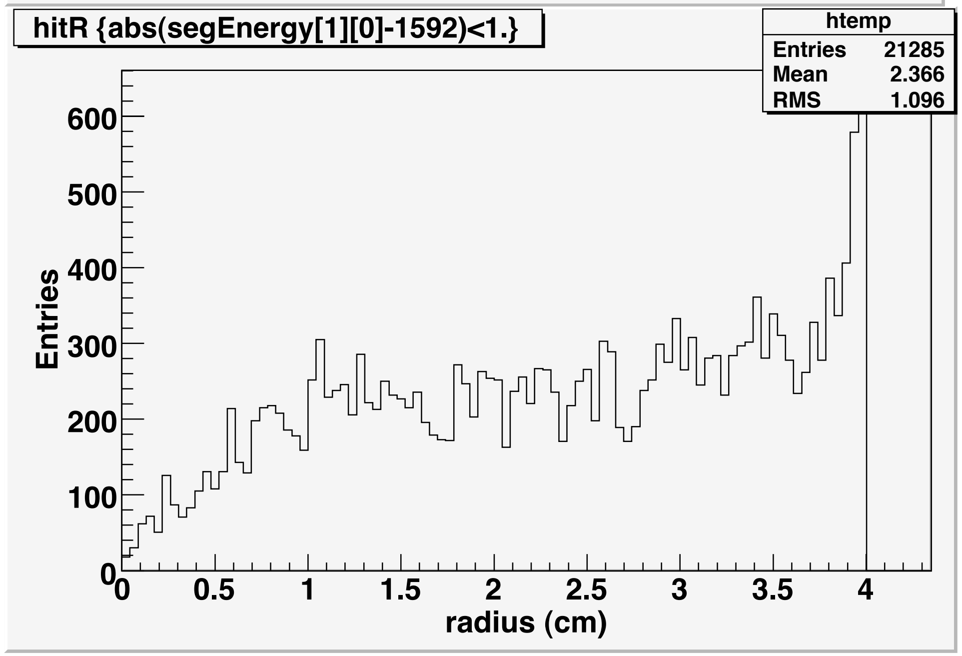
Where are the DEP and MSE events located when source placed above detector



Dependence on source position



Radius of DEP energy deposit if source at side of detector



Radius of DEP energy deposit is source above detector

• **Goal is best physics result**, which means greatest sensitivity to discovery or best limit. This is a combination of background level and exposure time. We cannot judge this simply from plots on the Bi and Tl lines, but will need to perform simulations taking into account constraints. These simulations will need to include enough of the detector modeling so we can trust the output results. Simulations need to be validated with measurements. Given that we know how to simulate the backgrounds and the response of the detectors, we need to consider:

- fixed amount of ^{enr}Ge. The **yield of the process to produce detectors** will determine the mass of ^{enr}Ge in the experiment

- limited amounts of money – if there is a **big cost difference**, this **will be important**

- **reliability considerations** – hardware complexity, analysis (understanding of E fields) complexity – produces certain amount of risk in a given technique

• It is too early to know what yields, etc. will be. **More information needed** from IKZ, Canberra

• It is unlikely that we can produce ^{enr}Ge detectors of both types since this would lead to very low yields

• on the other hand, we could certainly consider having reference detectors of different technologies to evaluate performance for a larger scale experiment (a la Majorana).

Further considerations

- do we have the resources to launch a new R&D effort (acquire Ge, purification, R&D at Canberra)

- time scales of the different efforts – when can we know yield of xtal pulling, yield of detector production

- what properties of the different detector types need to be evaluated (dead volumes, resolution, …)

- should discuss the experimental program for each detector type