



Monte Carlo Activity of the MPI Munich Group



GERDA Collaboration Meeting 02/05/2005

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Current MC Activity in Munich

- Maintenance of **CVS server** (MaGe)

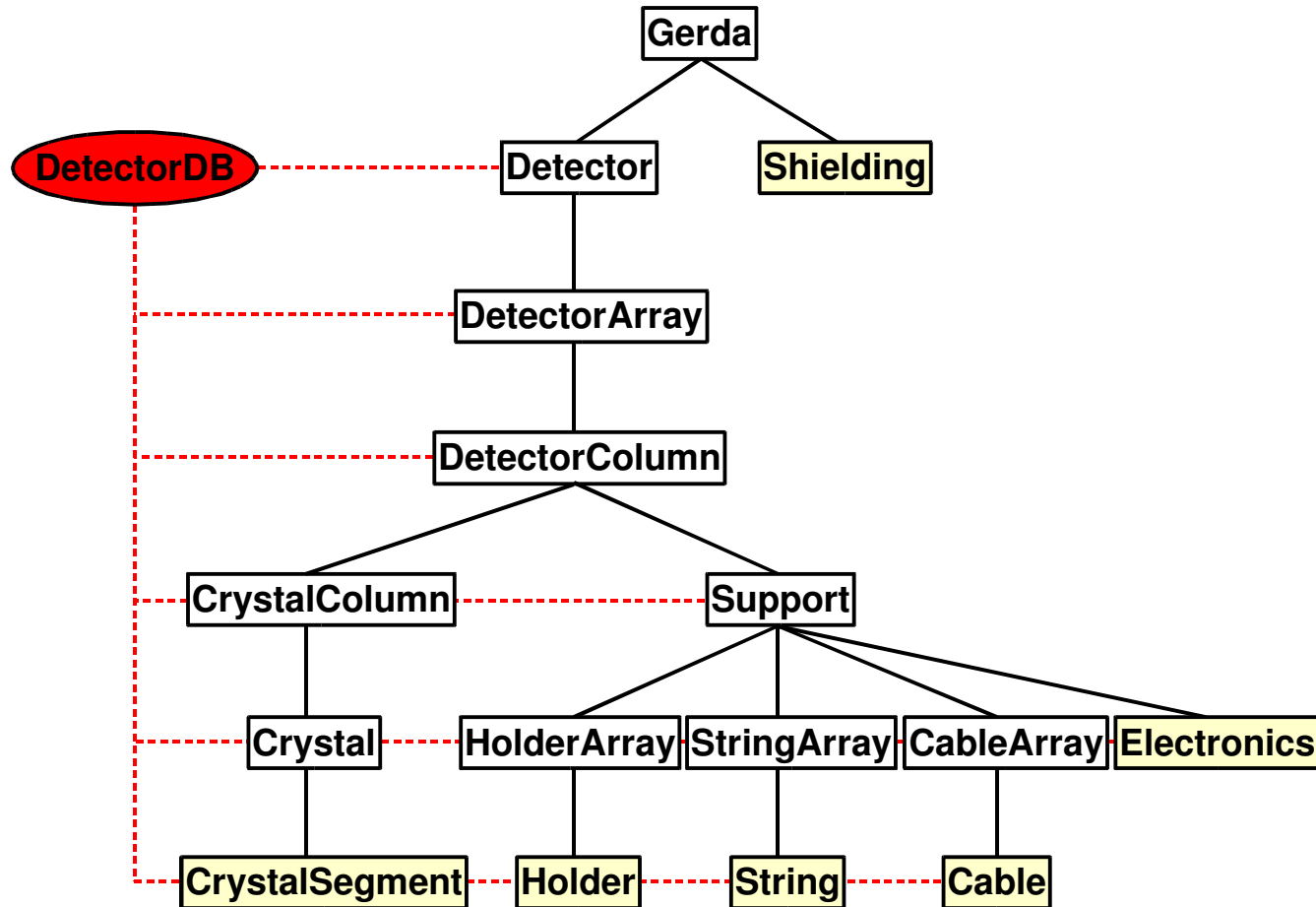
Link: http://www.gerda.mppmu.mpg.de/MC/gerda_monte_pic/setup.ps

- Update of GERDA geometry: **crystals and support structure**
- **Background and signal studies** / background suppression
- In preparation: **Pulse shape analysis** (incl. MC)
- In preparation: **Test facility** for Ge–crystals (incl. MC)

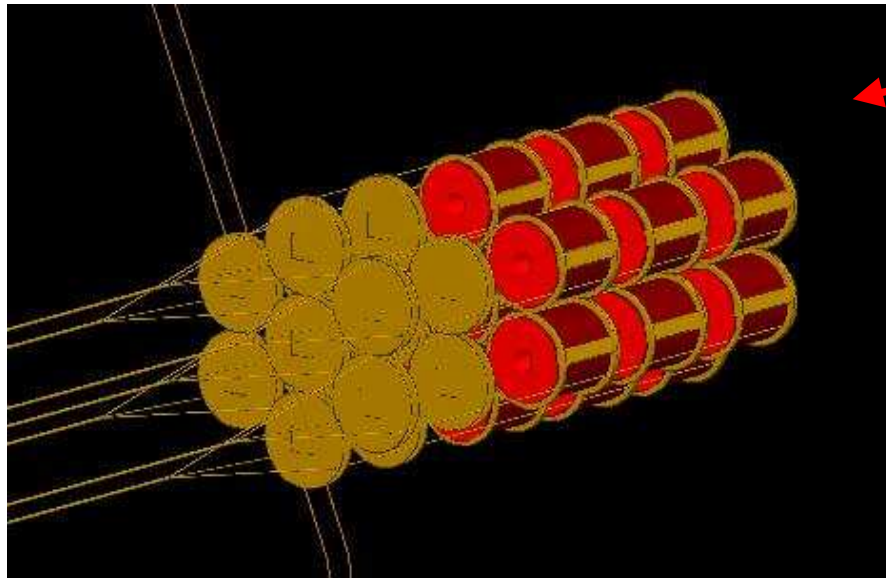


GERDA Geometry I

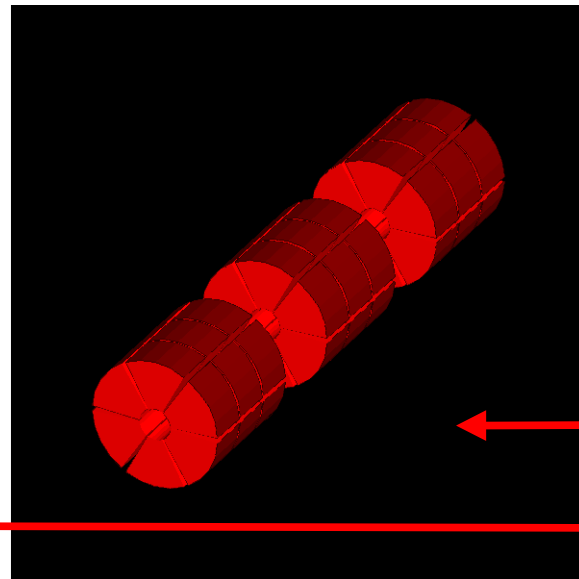
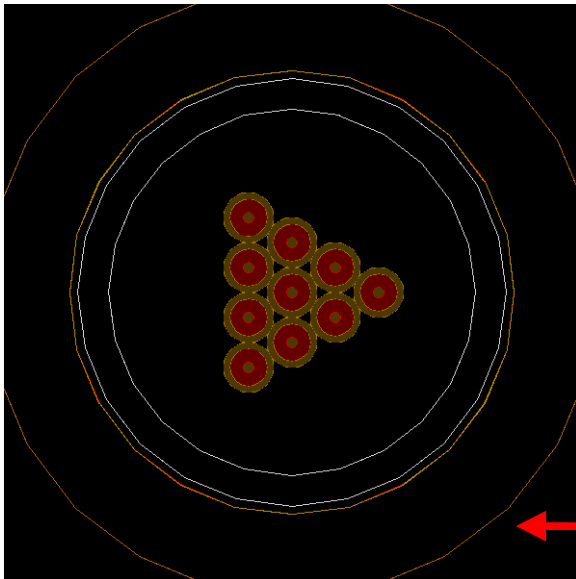
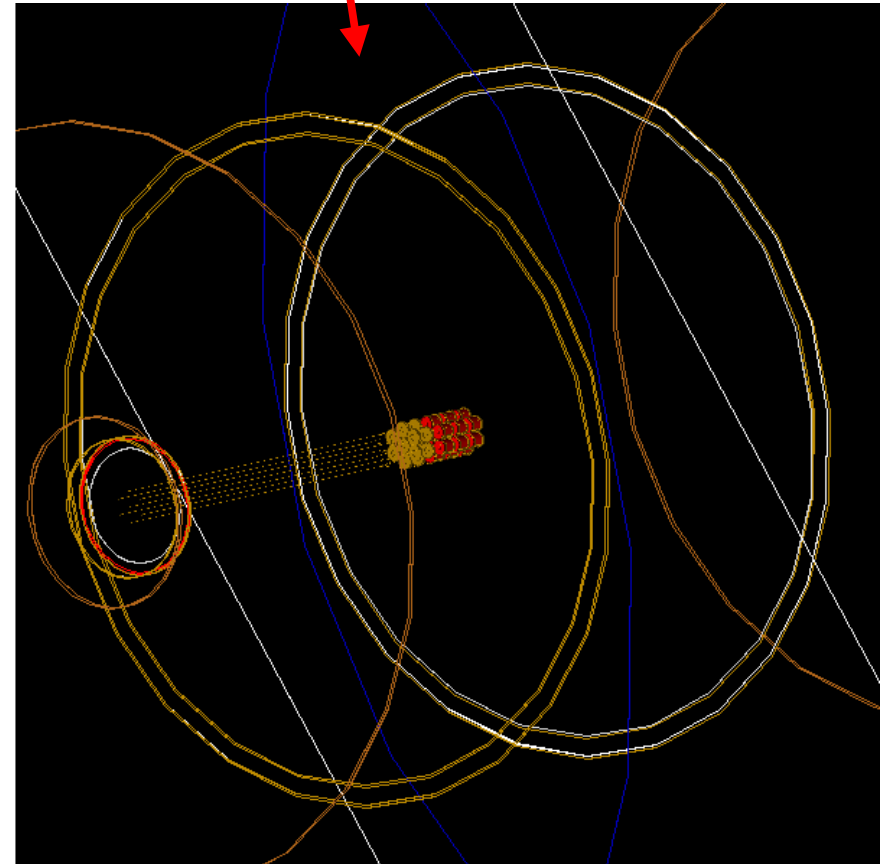
- New OO structure:



GERDA Geometry II



Standard geometry



Segmented crystal
10 columns

GERDA Geometry III

- Flexible executable: set of commands to configure geometry
- Run Geant4 with macros, e.g.

```
# ===== #
# Draws detector with standard geometry #
# ===== #

# Geometry setup

/MG/geometry/detector GerdaArray
/MG/geometry/database false

# Geometry modifications

/MG/geometry/detector/crystal/nphisegments 6
/MG/geometry/detector/crystal/nzsegments 3
/MG/geometry/detector/crystal/segmentmode 2

# Initialize run

/run/initialize

# visualization

/vis/scene/create
/vis/open OGLSX
/vis/viewer/set/viewpointThetaPhi 40 50 deg
/vis/viewer/zoom 3.0
/vis/drawVolume
```



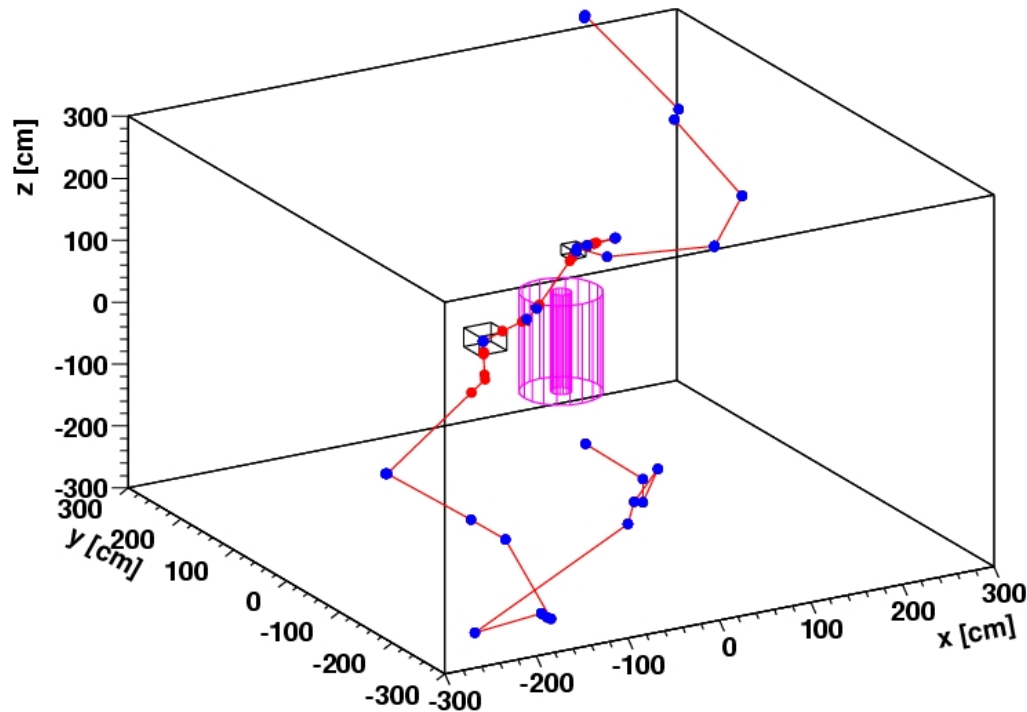
Signal and Background Studies I

- Sources studied:
 - ^{60}Co in crystal and cable
 - ^{280}Tl in crystal and cable
 - ^{68}Ge in crystal
 - ^{210}Pb in crystal
 - Signal
- More to come: implement **PNNL decay chain generator** (advantage: goes through whole decay chain whereas Geant4 / decay0 stop)



Signal and Background Studies II

- Example: ^{60}Co event display

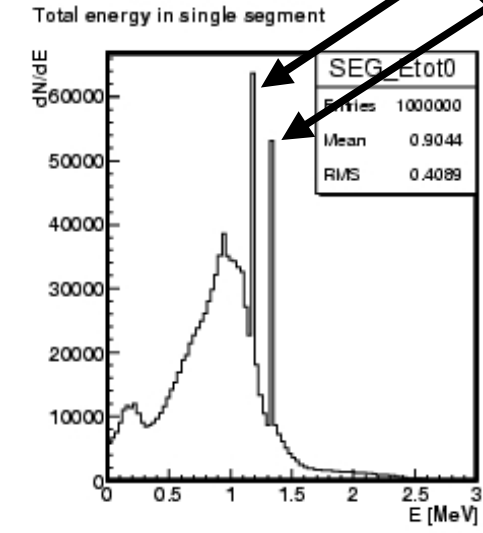
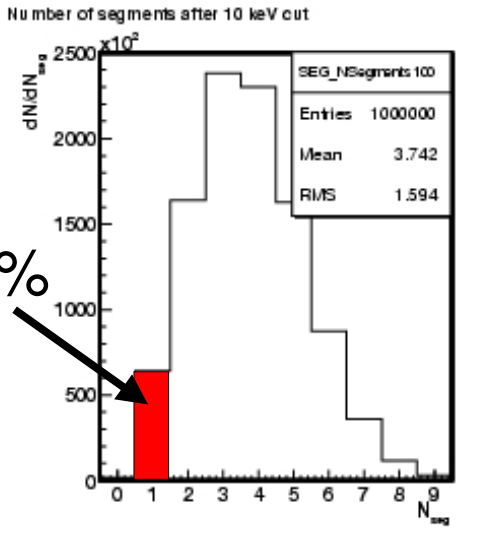
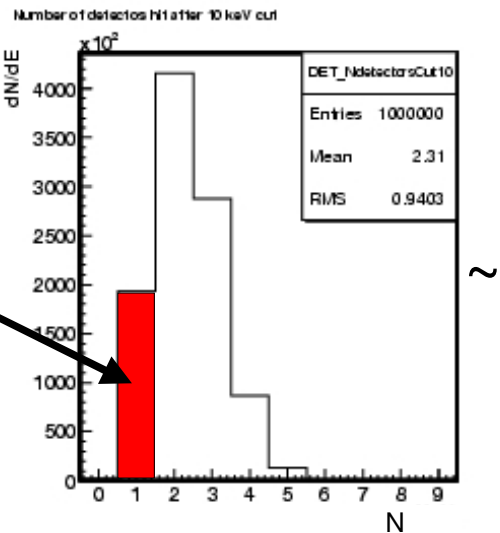
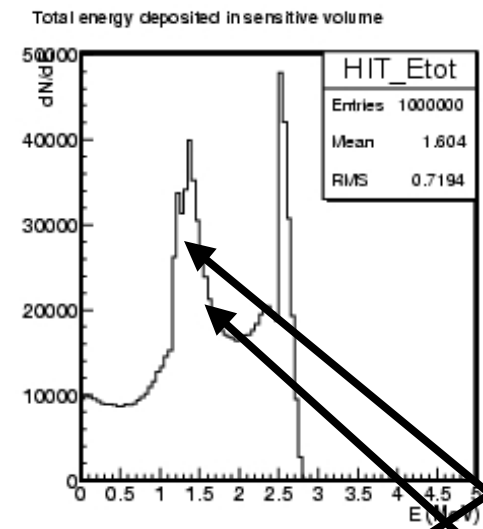
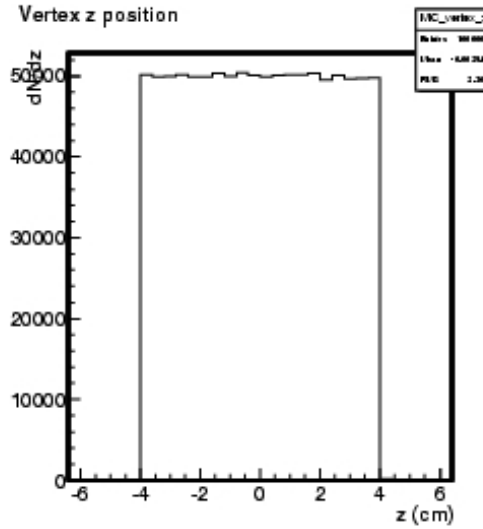
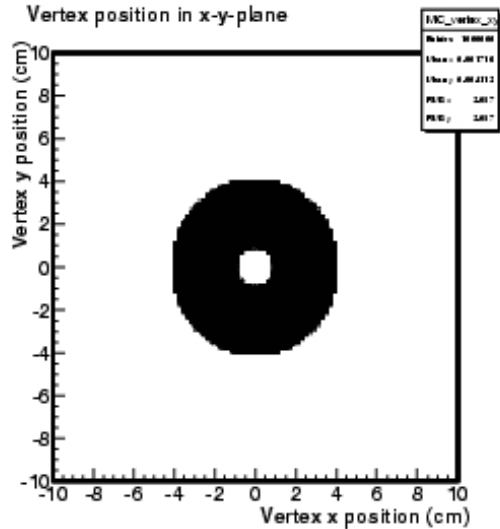


blue: electron trajectory
red: photon trajectory

- Photons carry energy to more than one crystal / segment
- Cut on number of crystals / segments with energy deposited reduces number of background events to 19% / 6%

Signal and Background Studies III

- Example: ^{60}Co control plots



~19%

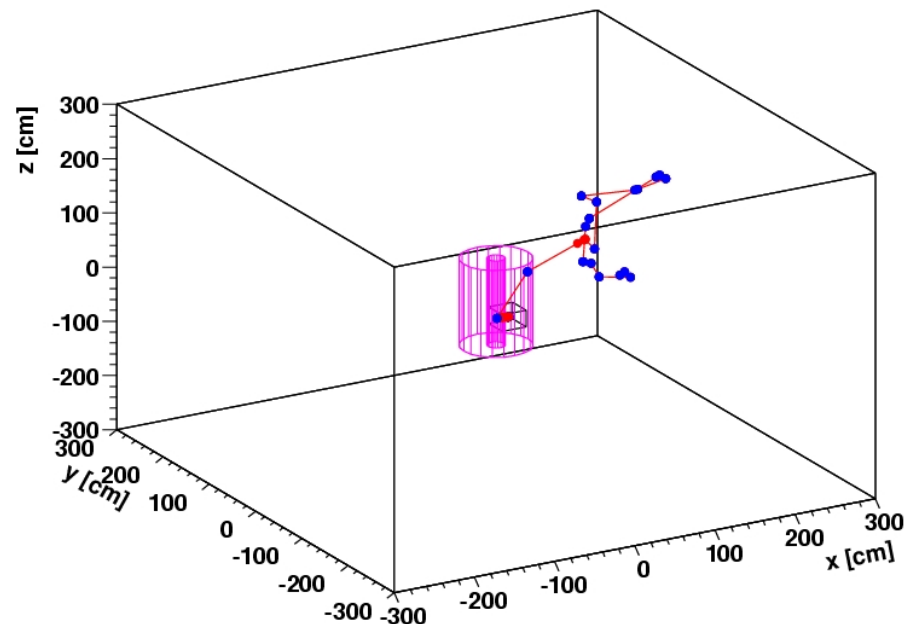
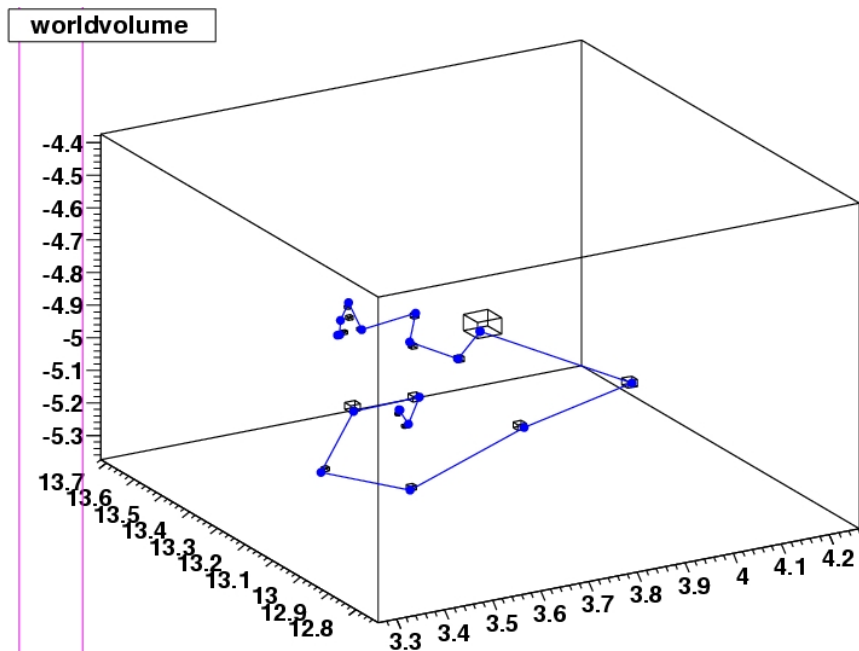
~6%

1.173 MeV
1.332 MeV



Signal and Background Studies IV

- Example: signal event display

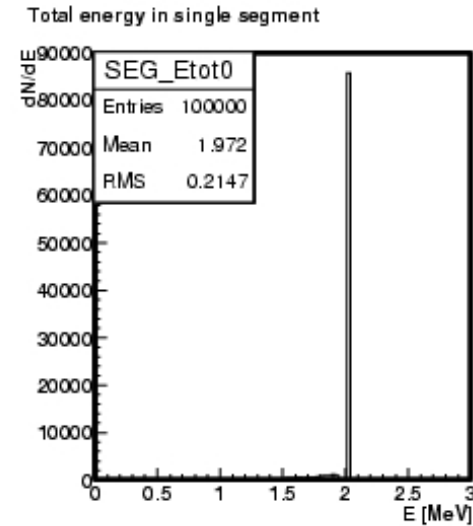
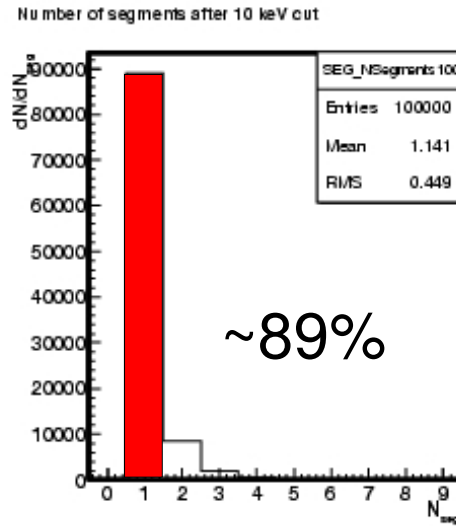
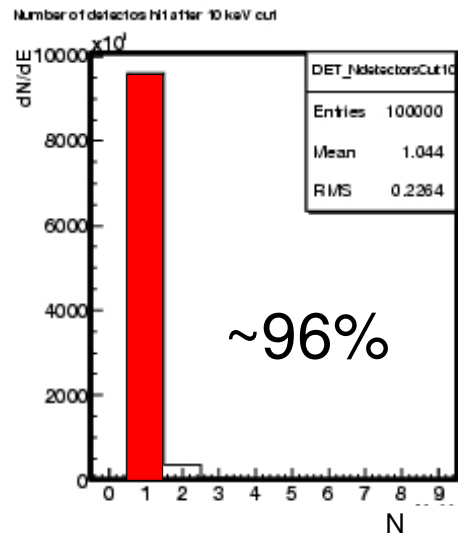
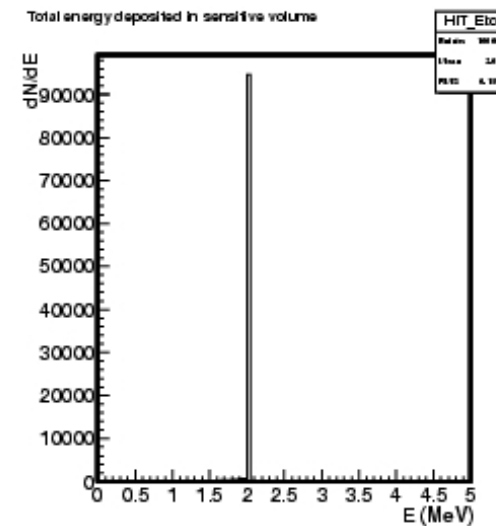
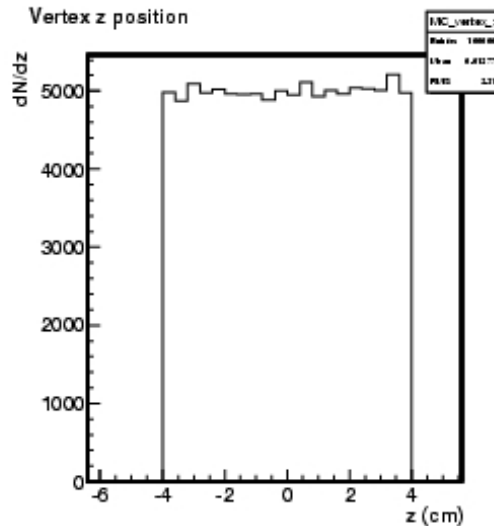
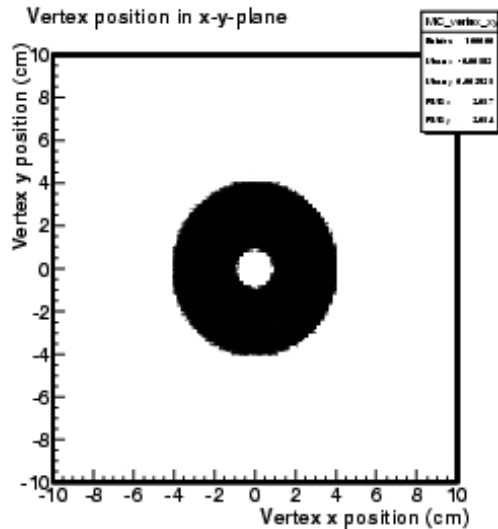


- Energy deposition locally confined $O(90\%)$
- FSR leads to non-local energy deposition $O(10\%)$

blue: electron trajectory
red: photon trajectory

Signal and Background Studies V

- Example: signal control plots



Signal and Background Studies VI

- Background suppression and efficiency:

Source	1 Crystal	1 Crystal && signal window	1 Segment	1 Segment && signal window	Number of events
Signal	0.96	0.92	0.89	0.86	100k
Co-60 (crystal)	0.19	3.00E-004	0.06	2.58E-005	1M
Co-60 (cable)	0.28	1.72E-004	0.14	9.60E-006	1M
Tl-208 (crystal)	0.18	2.40E-004	0.06	5.00E-005	1M
Tl-208 (cable)	0.24	2.20E-004	0.12	7.96E-005	1M
Ge-68 (crystal)	0.22	9.80E-004	0.05	1.21E-004	1M
Pb-210 (crystal)	1	0	9.87E-003	0	10k

- Segmentation: 6 (phi) x 3 (z)
- Includes a 10 keV threshold
- Does not include pulse shape analysis and pattern recognition



Conclusion and Summary

- Implemented new geometry in MC
- Studied background suppression / signal efficiency
- Start with pulse shape analysis soon
- Monte–Carlo website: <http://wwwgerda.mppmu.mpg.de>

