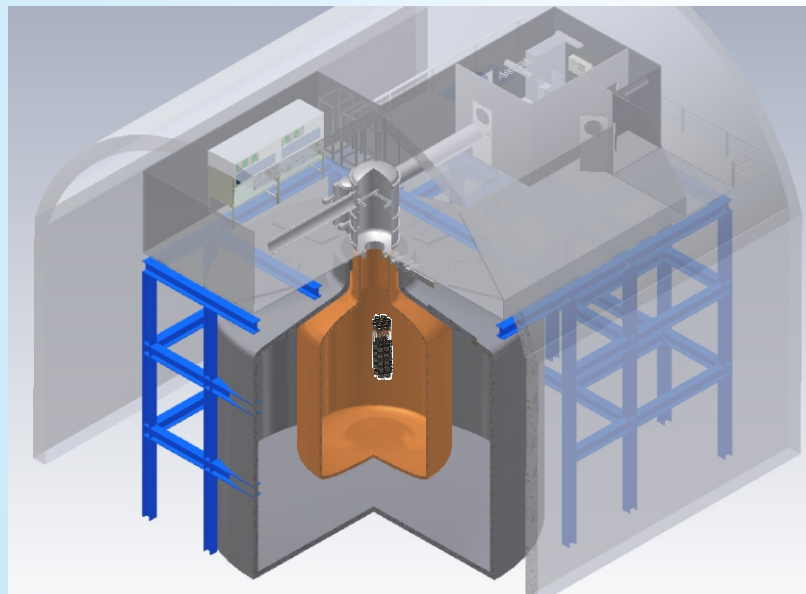


# Identification of Photon Induced Background Events with segmented Germanium Detectors



in the **GER**manium **D**etector **A**rray designed to search for neutrinoless double beta decay.

I.Abt, MPI München

# Content

**Minimum Introduction**

**Signal and Background**

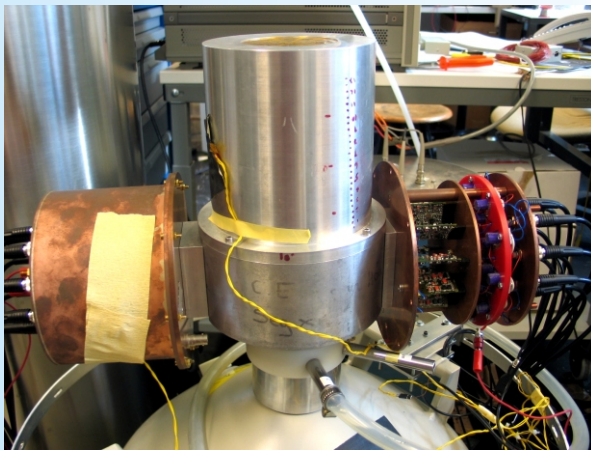
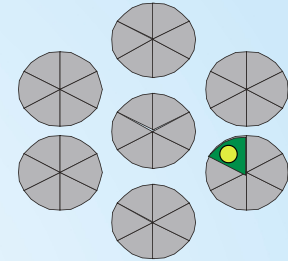
**Physics of Radiation in Germanium**

**Implication for GERDA**

**Prototype**

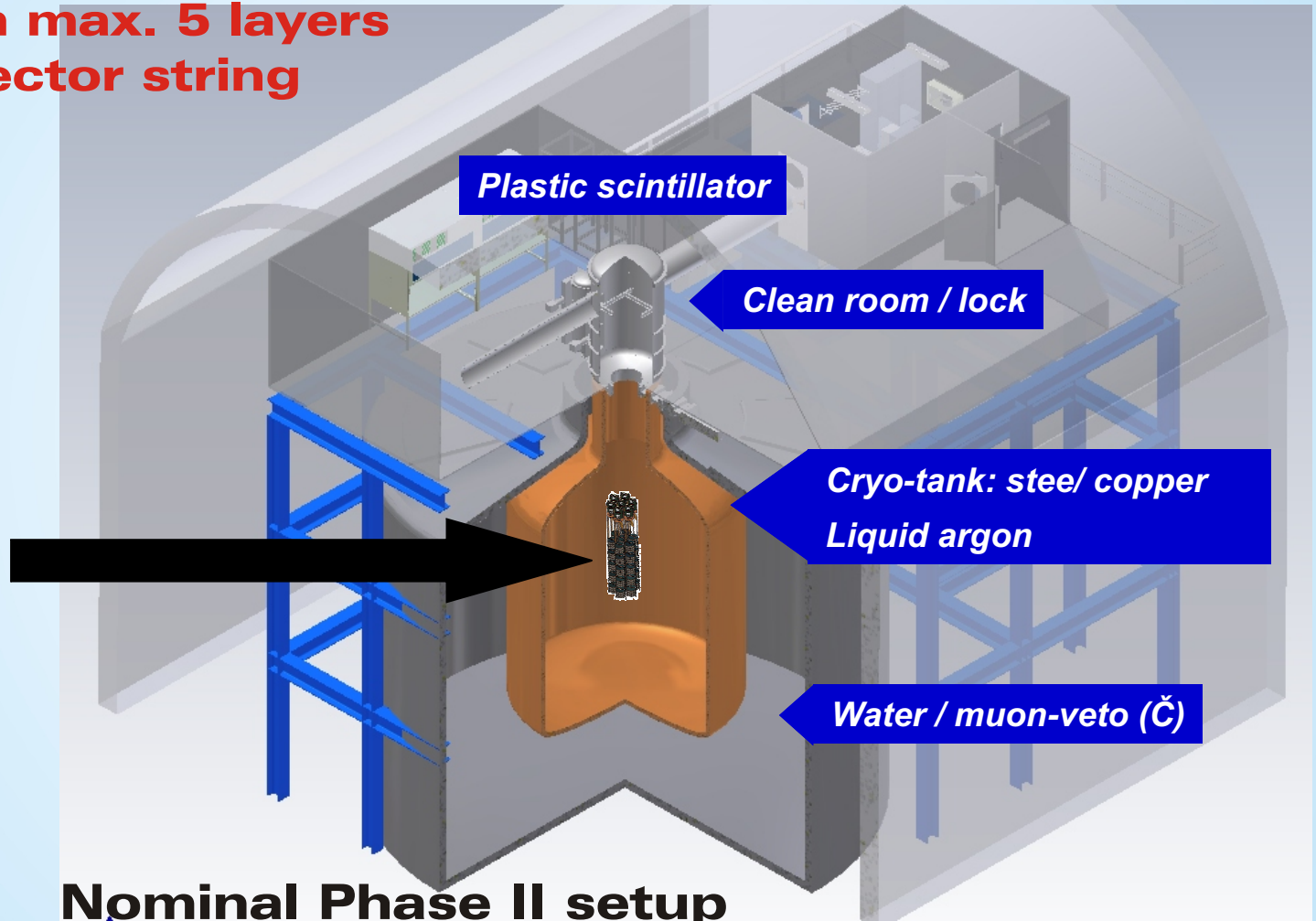
**Data from Test Setup**

**Final Remarks**



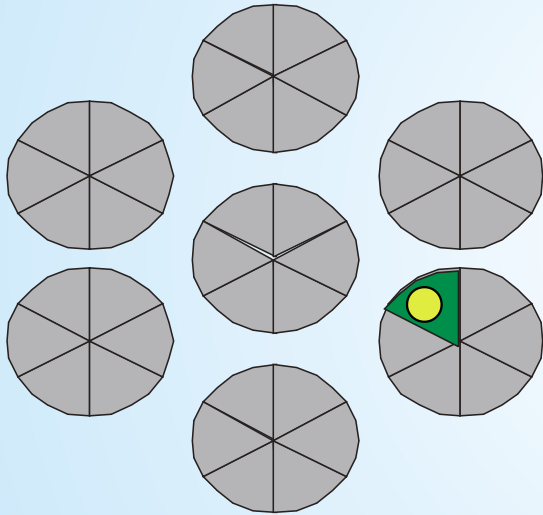
# GERDA: Technical Realization

Array with max. 5 layers  
and 7 detector string  
positions



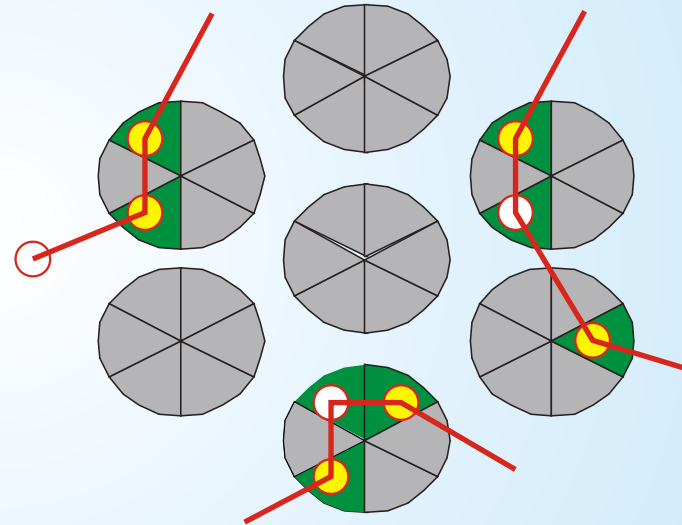
# Signal and Background

$0\nu\beta\beta$



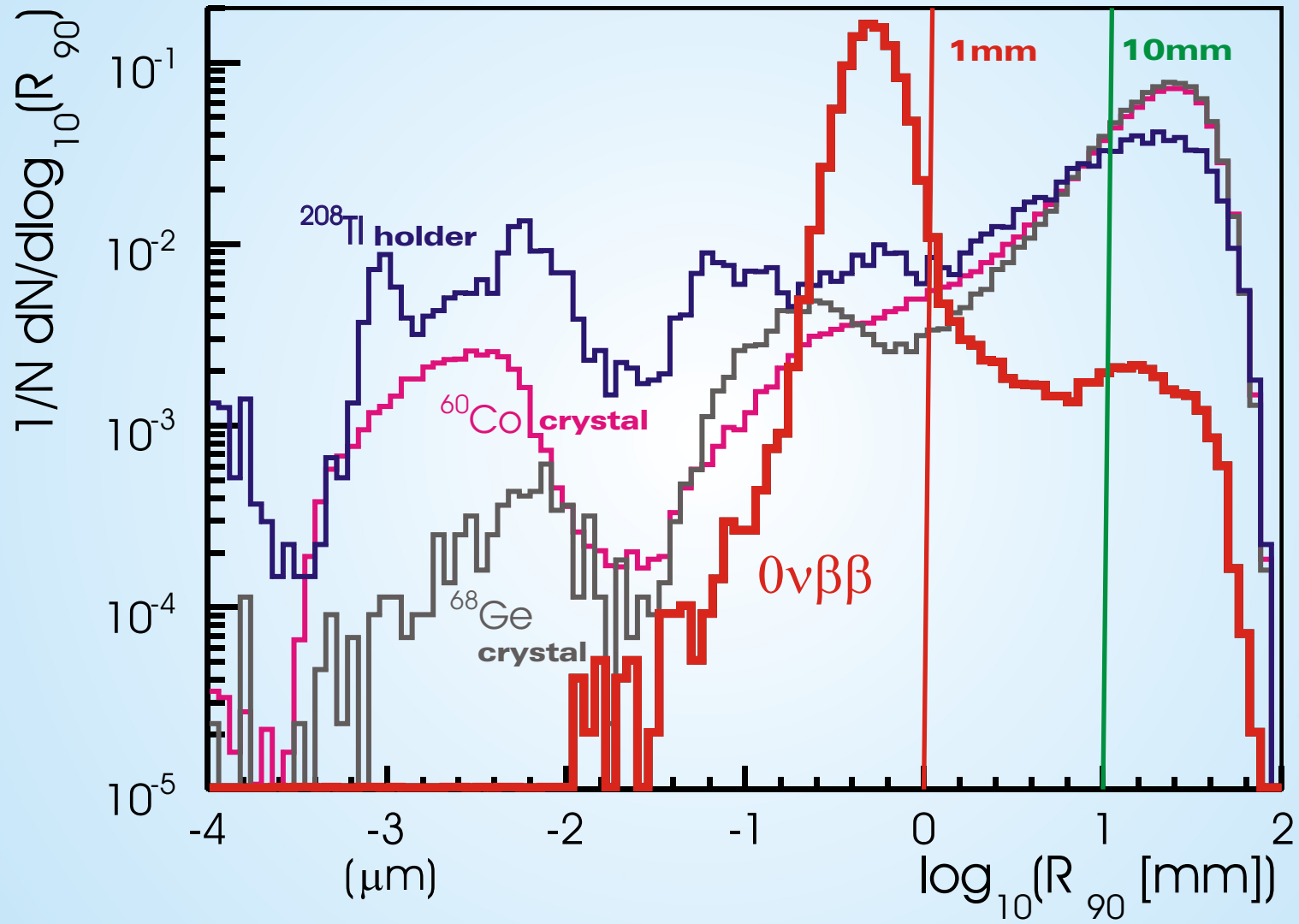
**localized deposit  
single site event**

$\gamma$  or  $2\gamma$



**several deposits  
multi site event**

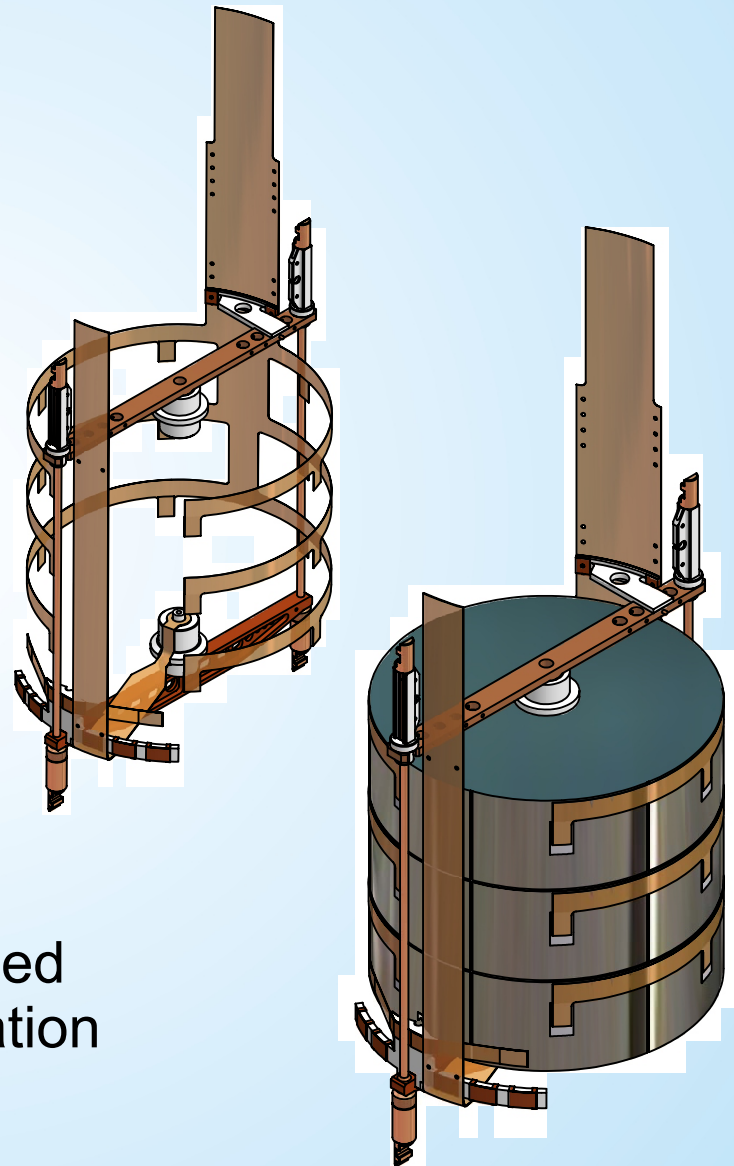
# Radiation in Germanium



# Implications for GERDA

Source	Reduction	
$^{208}\text{Tl}$ (in Ge)	13	2.6
$^{60}\text{Co}$ (in Ge)	38	3.2
$^{68}\text{Ge}$ (in Ge)	18	2.4
$^{210}\text{Pb}$ ( $\alpha$ on Ge surface)	1	
$^{208}\text{Tl}$ (in holder)	5	2
$^{60}\text{Co}$ (in holder)	157	6.7
$^{208}\text{Tl}$ (in cable)	5	3

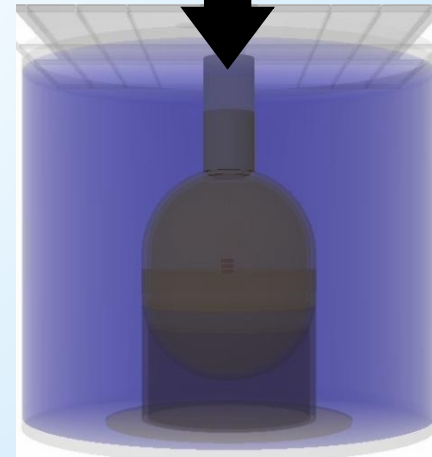
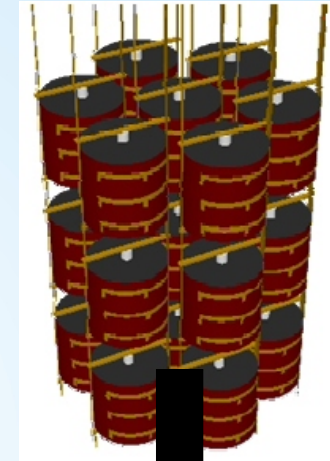
Reduction factors using **segment** or **crystal** anticoincidences determined from a GEANT4 Monte Carlo simulation





# Implications for GERDA

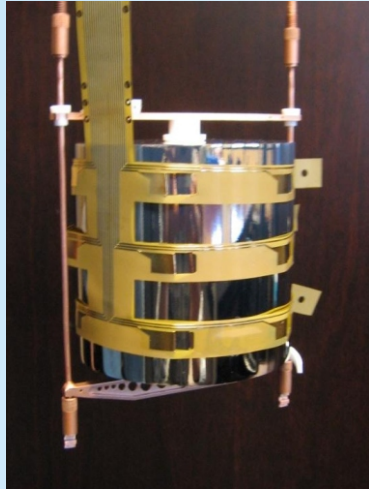
Part	Background index [ $10^{-4}$ counts/(kg·keV·y)]	
Crystal	5	●
Holder (copper)	4	●
Holder (Teflon)	8	●
Cabling	6	●
Electronics	3	
Infrastructure	4	
Muon, neutron & co.	2	
GERDA	32	



**Not bad for a first try.....**

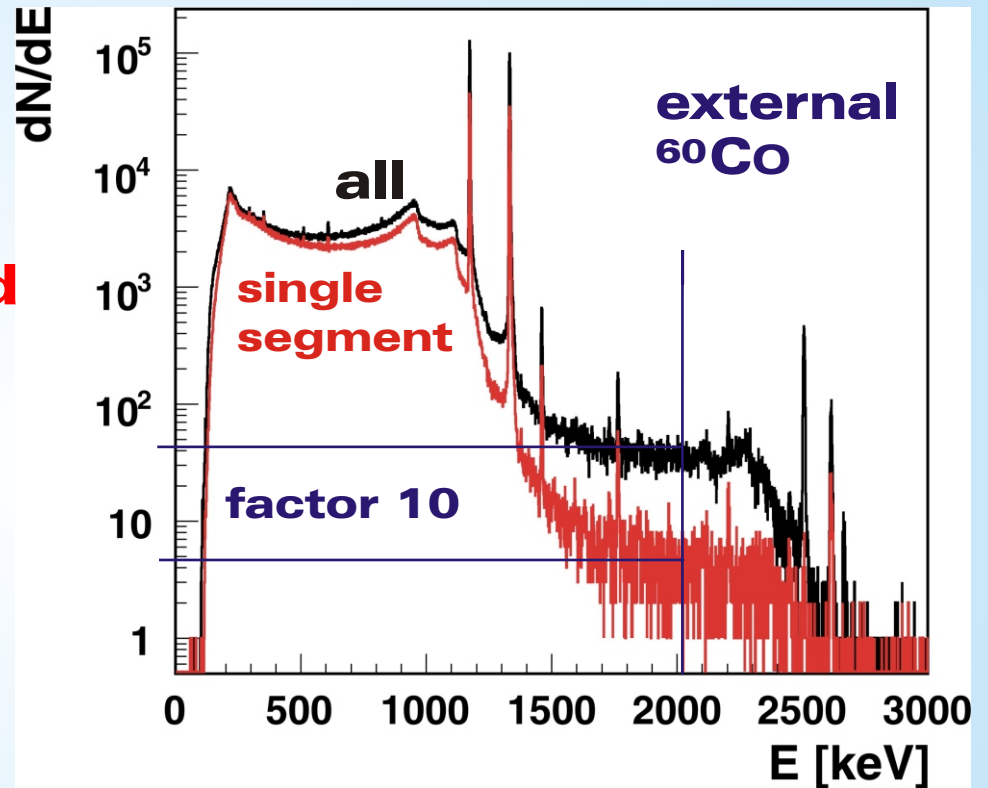
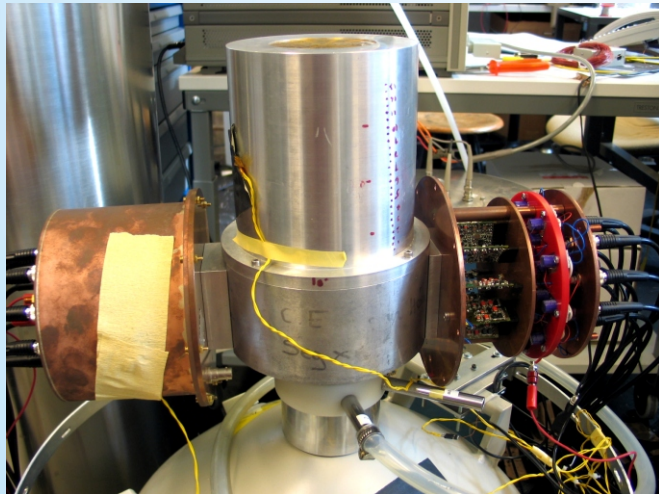
**submitted to NIM A**

# Prototype Detector



**n-type**  
**z=70 mm**  
**d=75 mm**

**segmented**  
**3 in z**  
**6 in  $\phi$**

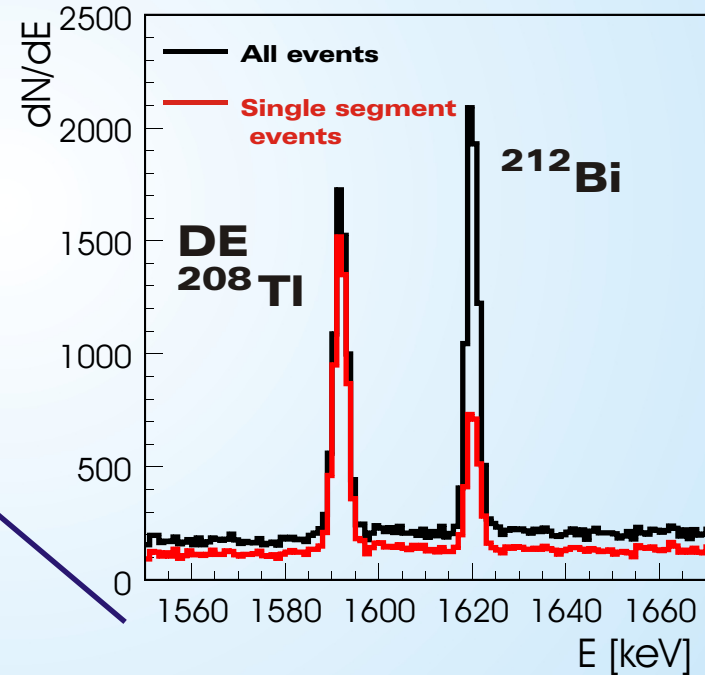
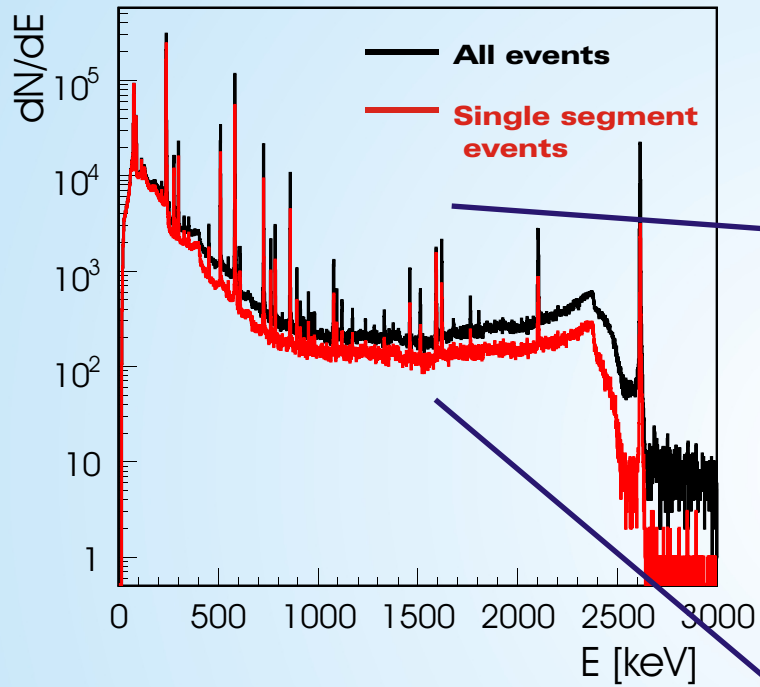


**Operation in vacuum**  
**test cryostat**



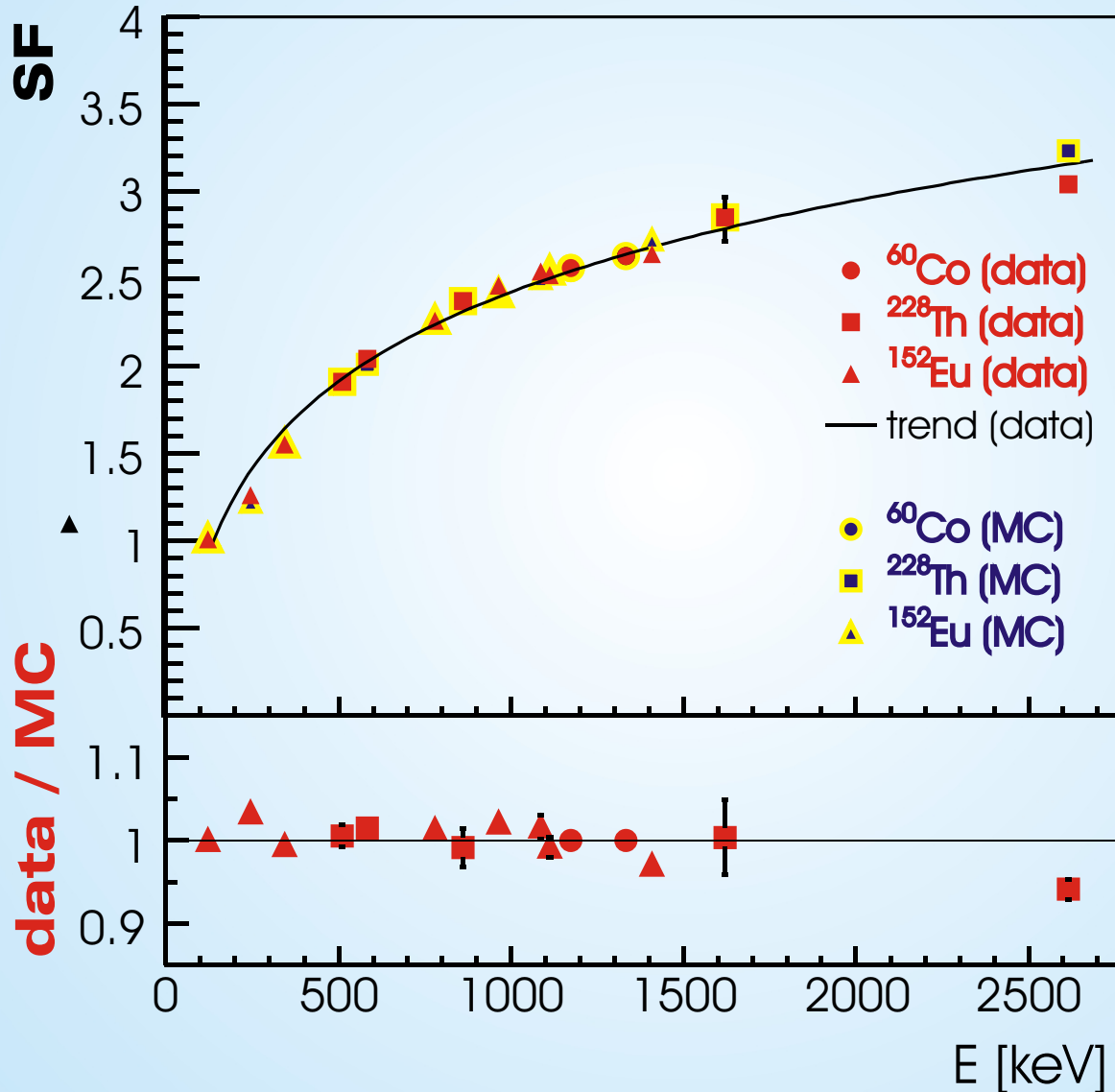
# Rejecting Photons

## $^{228}\text{Th}$



**We get rid of what  
we try to get rid of...**

# Data and Monte Carlo



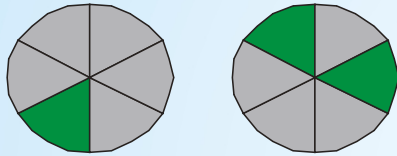
**There is nothing like data!**

**Sometimes its nice, if one doesn't see the points.**

**Data confirms Monte Carlo**

## Final remarks

**Segmented detectors can identify background events by counting.**



**By how much depends on the geometry of the complete setup. It is well worth it for GERDA.**

**Pulse shape analysis can be performed on single segments.**

**Gets you around another factor of 2.**

**Monte Carlo [GEANT] is good. It can be used to guide engineering.**

**After all the processes here are electro-magnetic.**