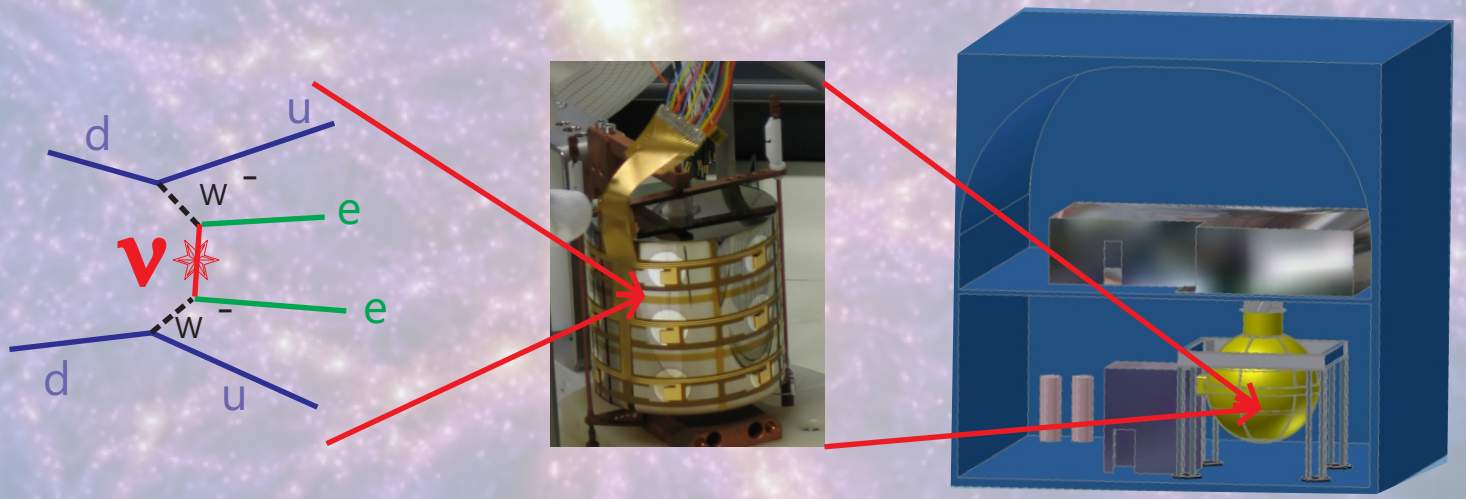
Germanium Detector Development
GeDet



Project Review 2014

I.Abt, L.Garbini, Ch. Gooch, H. Liao, B. Majorovits,M.Palermo
D. Palioselitis, O.Schulz, J.Tang, L.Vanhöfede, H.Seitz
guests: H. Ma, X. Liu, C. Carissimo
bachelors: M. Duda, M. Schuster, K.Schneider

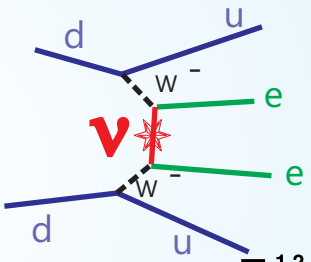
Germanium, what for?

Neutrinos and **Dark Matter**

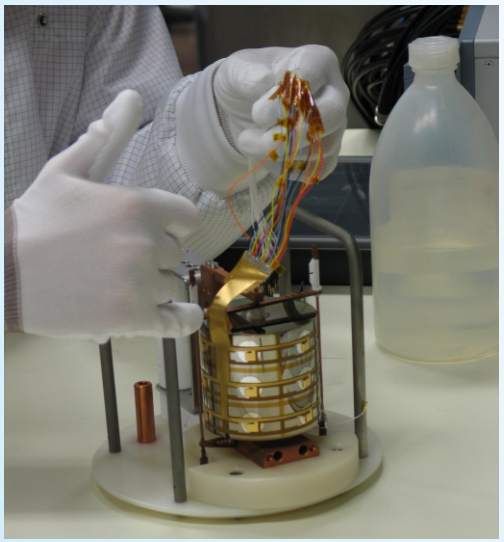
1-ton

future projects ?

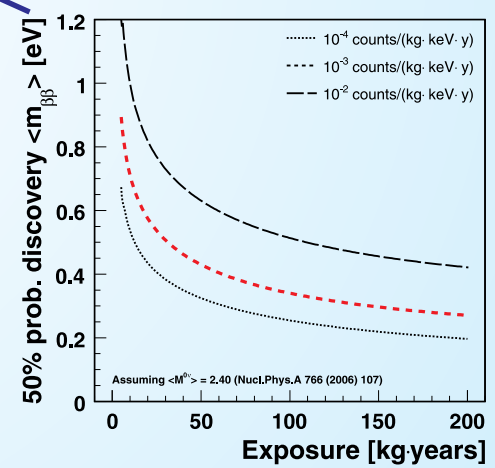
not with Ge
at MPI (yet?)



Majorana mass



- **Goals**
- **Background Studies**
- **Detector Technology**
- **Future**

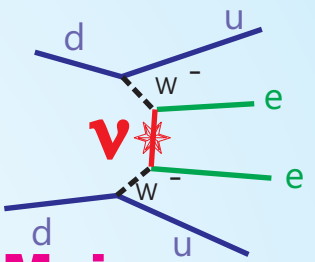


Expectations and Goals

Neutrinoless Double Beta Decay

should be studied down to 10 meV

to exclude inverted hierarchy



Majorana Nature

→ **1t for 5 years with**

1 background event in 5 years

background at 10-5 /kg /keV /y**

Dark Matter

should be studied until neutrinos are seen

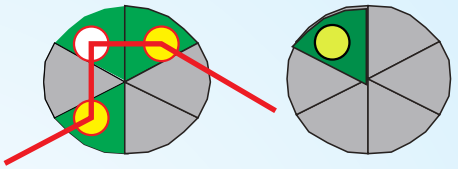
→ **1t for 5 years with**

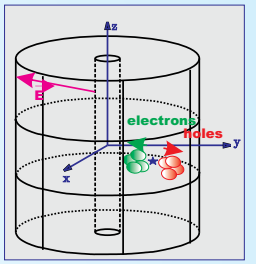
a few background events

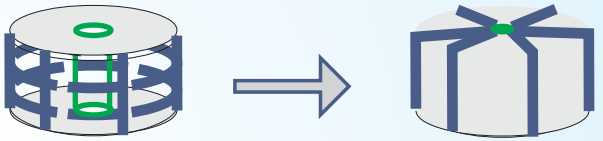
at very low threshold

Background and Technology

Photons Segmentation can gain a factor 10 in background suppression







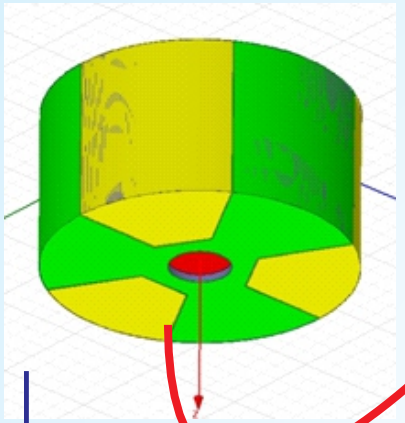
low threshold => point contact

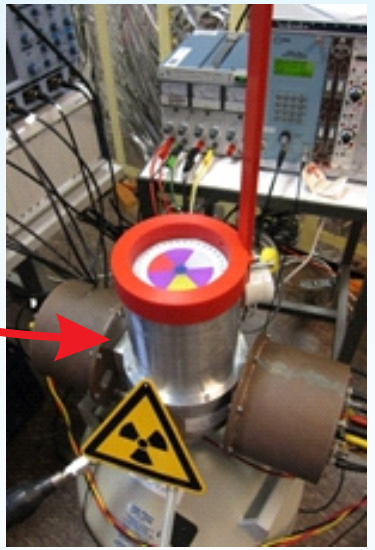
Alphas typical surface contamination

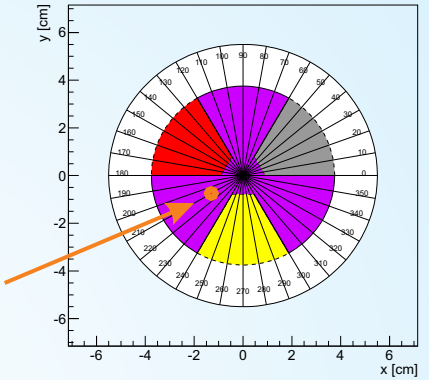
Neutrons from muons

how to measure, how to shield

Segmented Point Contact Detector

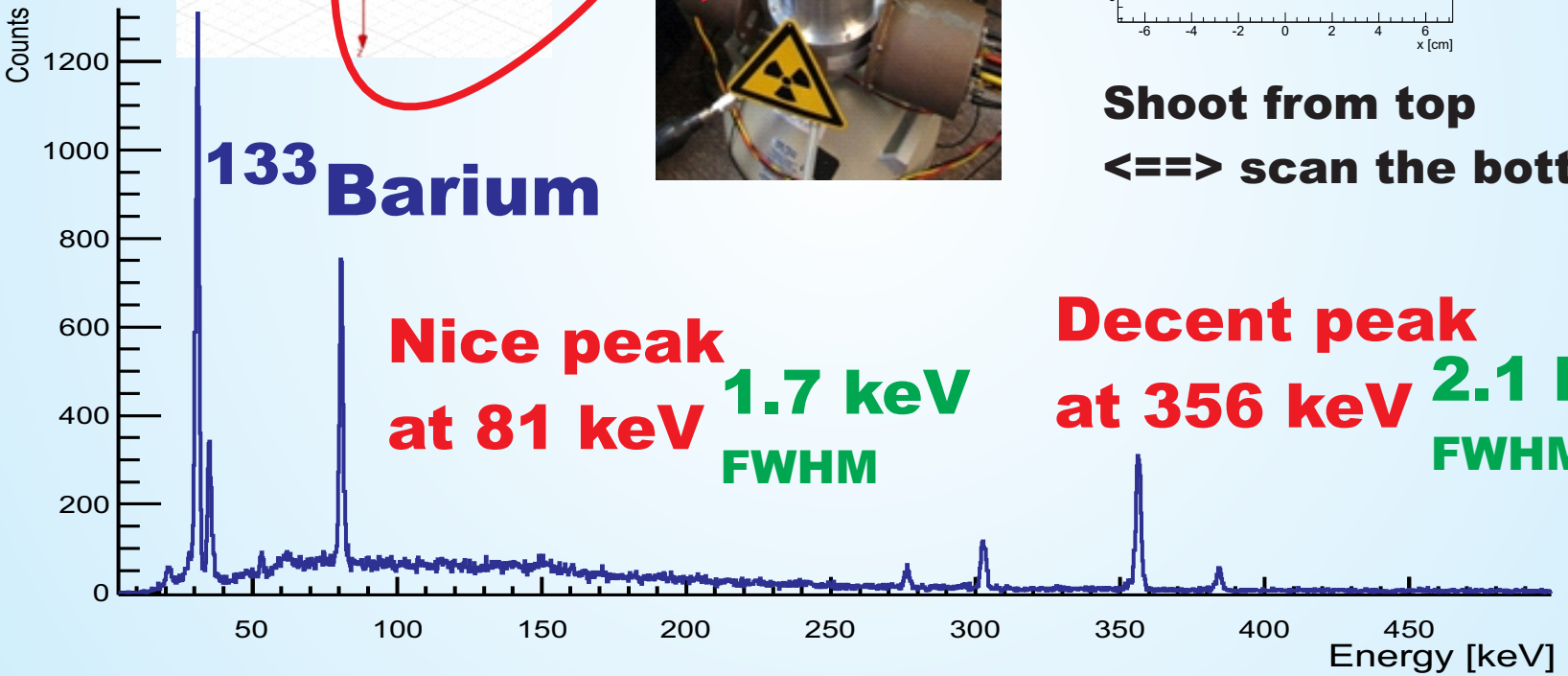






Shoot from top
<==> scan the bottom

^{133}Barium

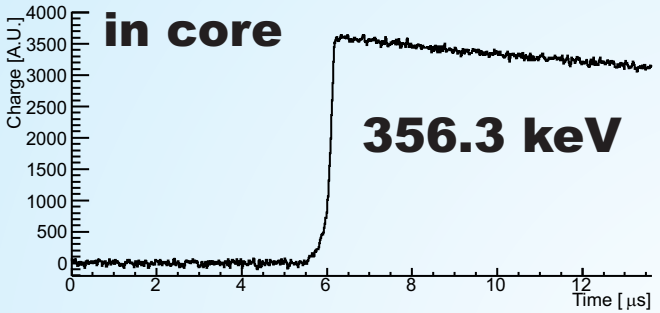


Nice peak at 81 keV **1.7 keV FWHM**

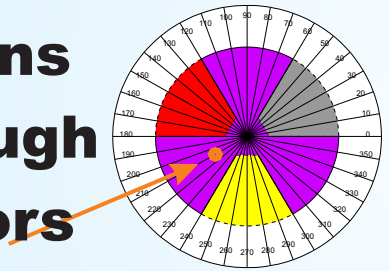
Decent peak at 356 keV **2.1 keV FWHM**

Segmented Point Contact Detector

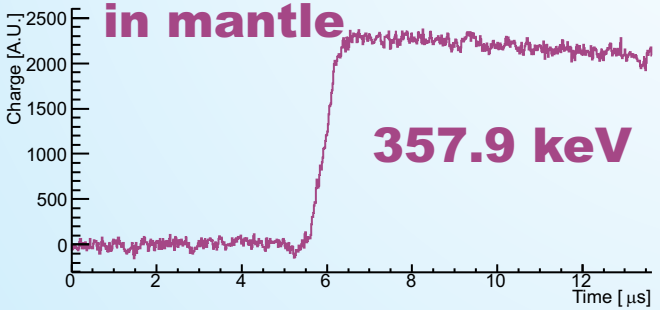
Electrons are collected in core



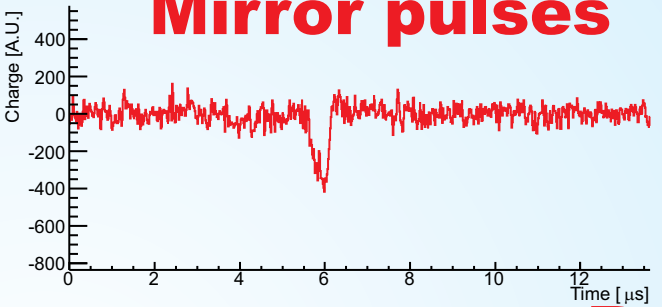
Electrons run through detectors



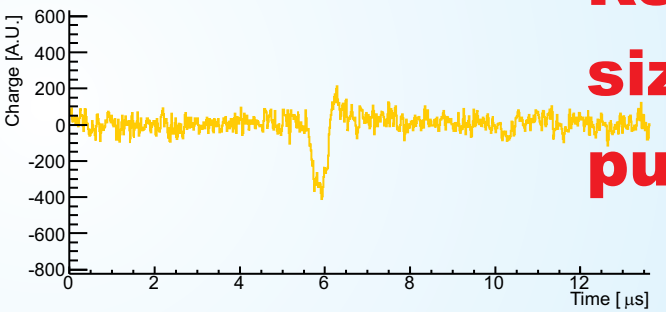
Holes are collected in mantle



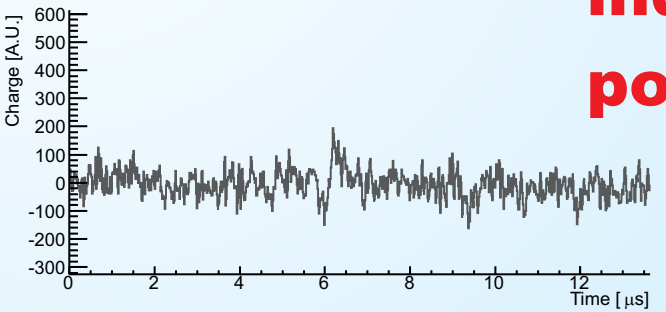
Mirror pulses



Relative size of pulses

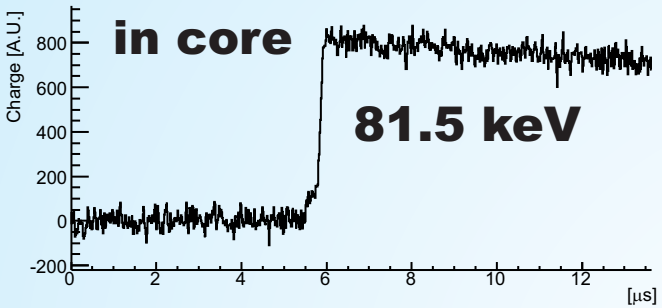


indicate position

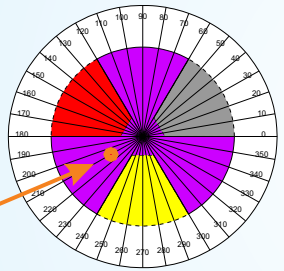


Segmented Point Contact Detector

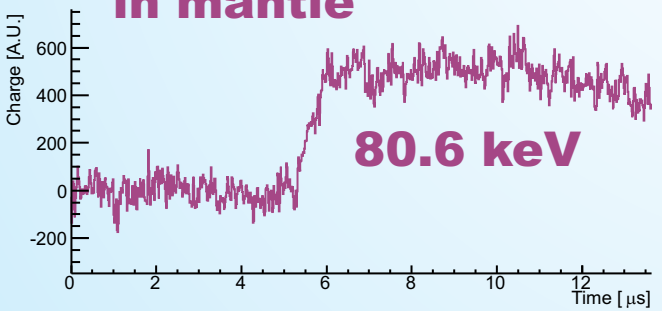
Electrons are collected in core



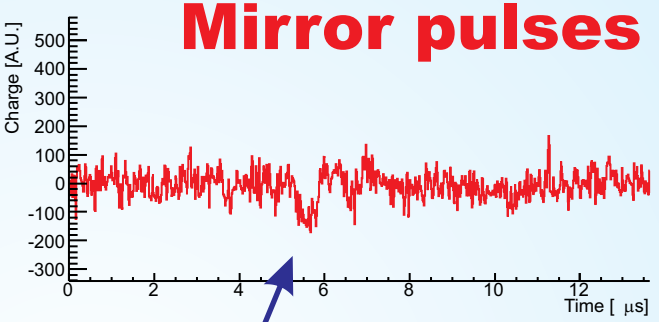
Electrons run through detectors



Holes are collected in mantle

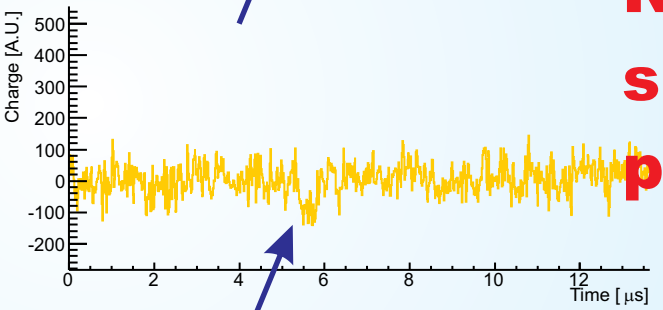


Mirror pulses

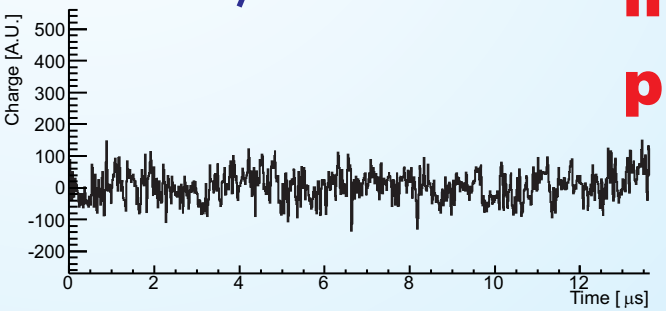


small at low energy

Relative size of pulses

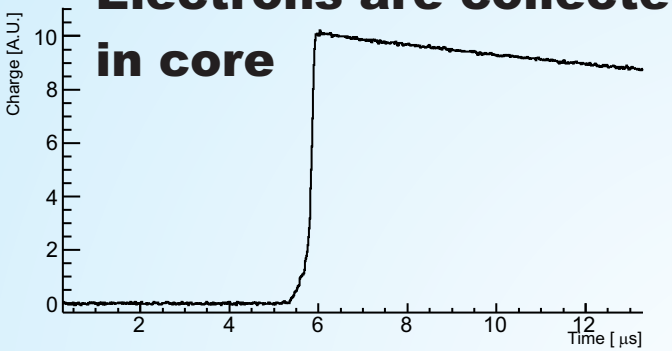


indicate position

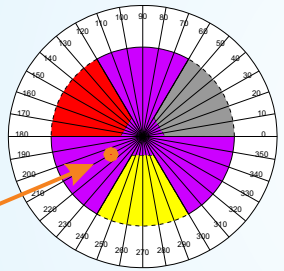


Segmented Point Contact Detector

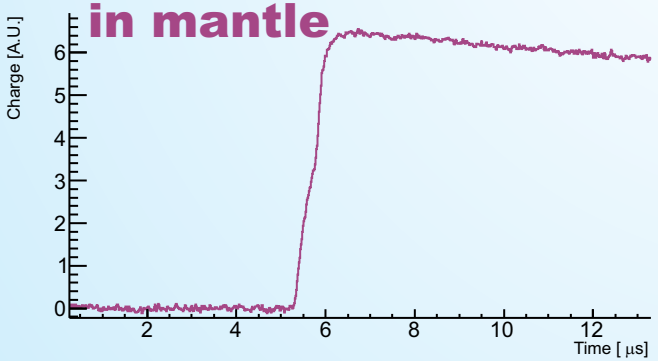
Electrons are collected in core



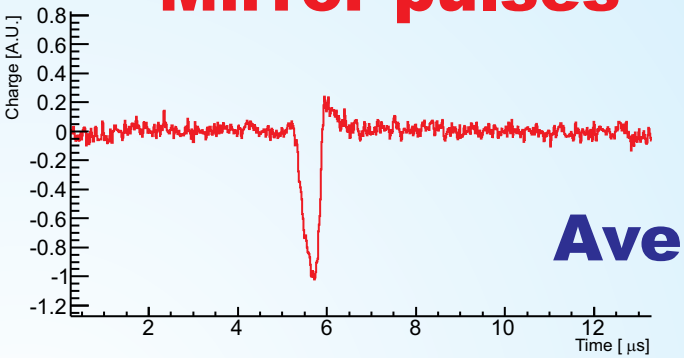
Electrons run through detectors



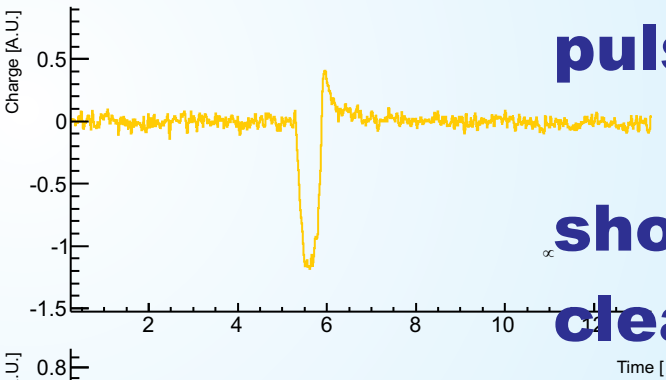
Holes are collected in mantle

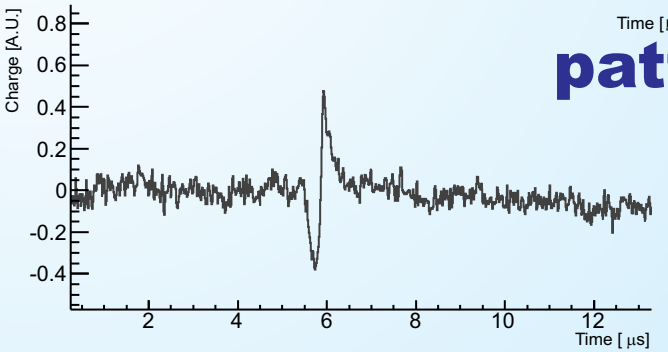


Mirror pulses



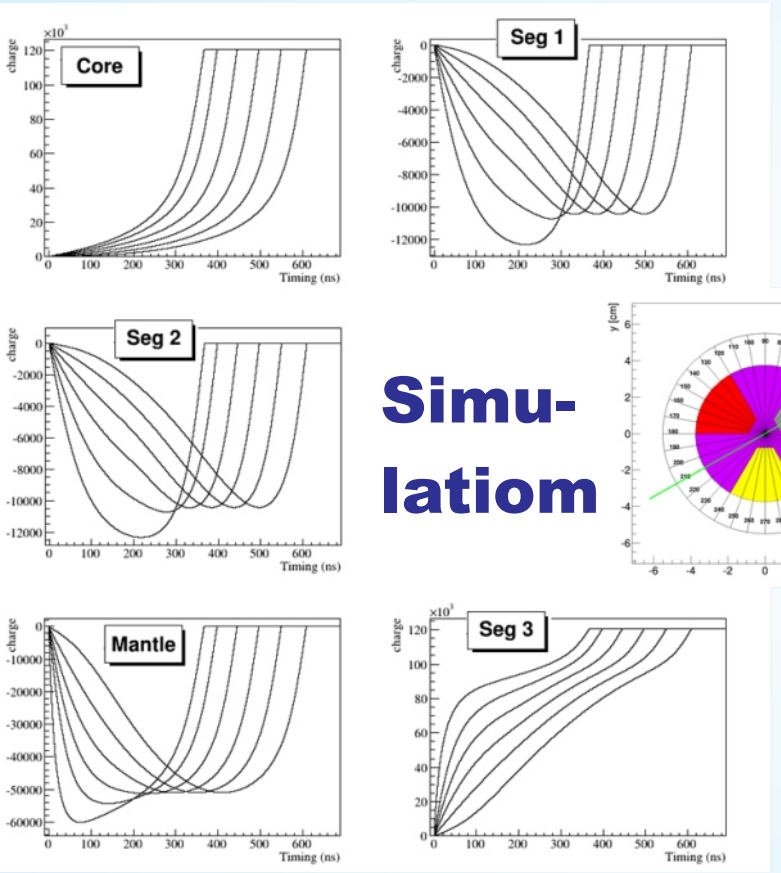
Averaged pulses show clear pattern





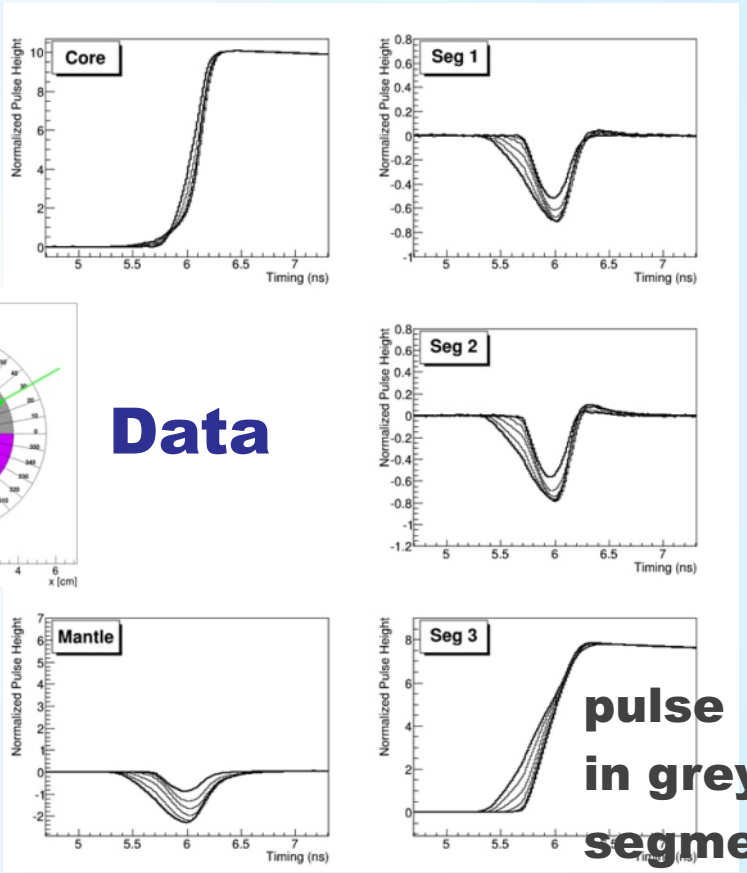
Segmented Point Contact Detector

Average pulses at fixed position and scan



Simu-latiom

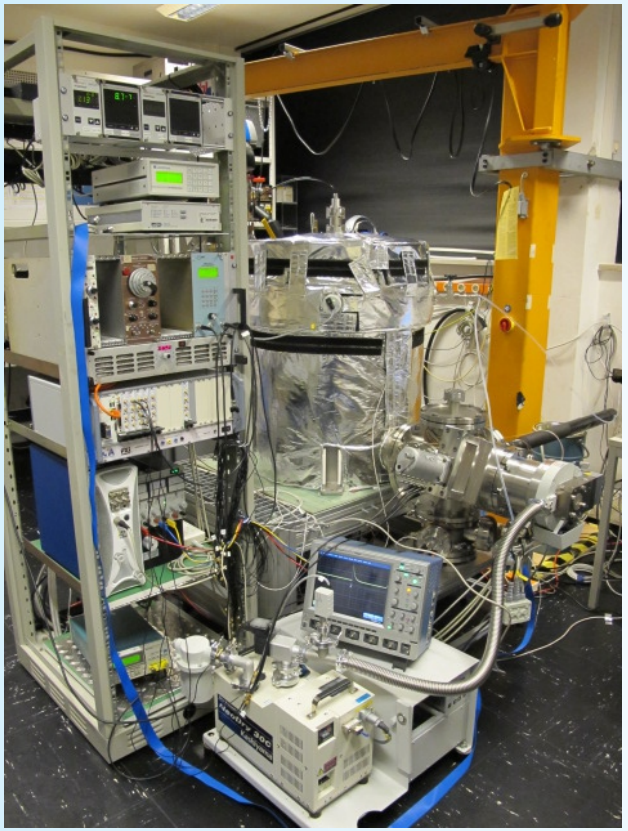
Data

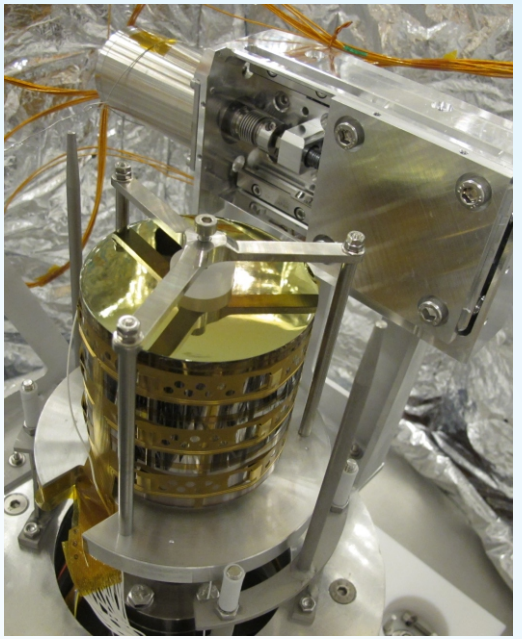


pulse in grey segment

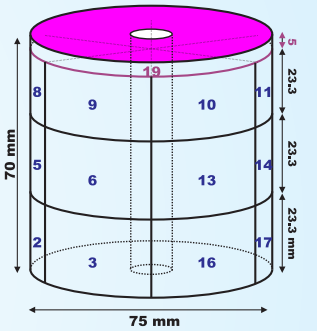
Compare observed and simulated variations

Alphas and GALATEA

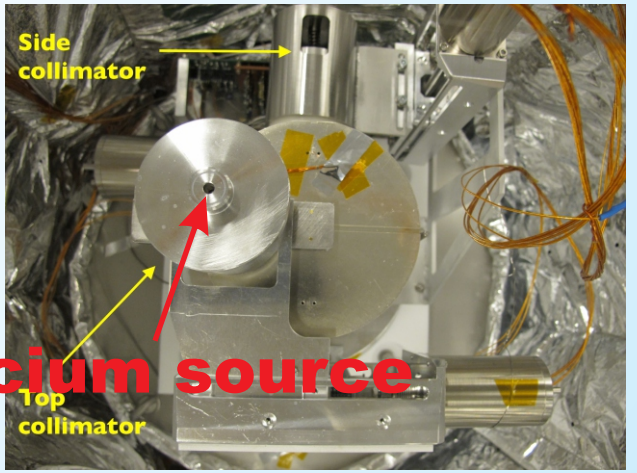




Special 18+1 segmented detector

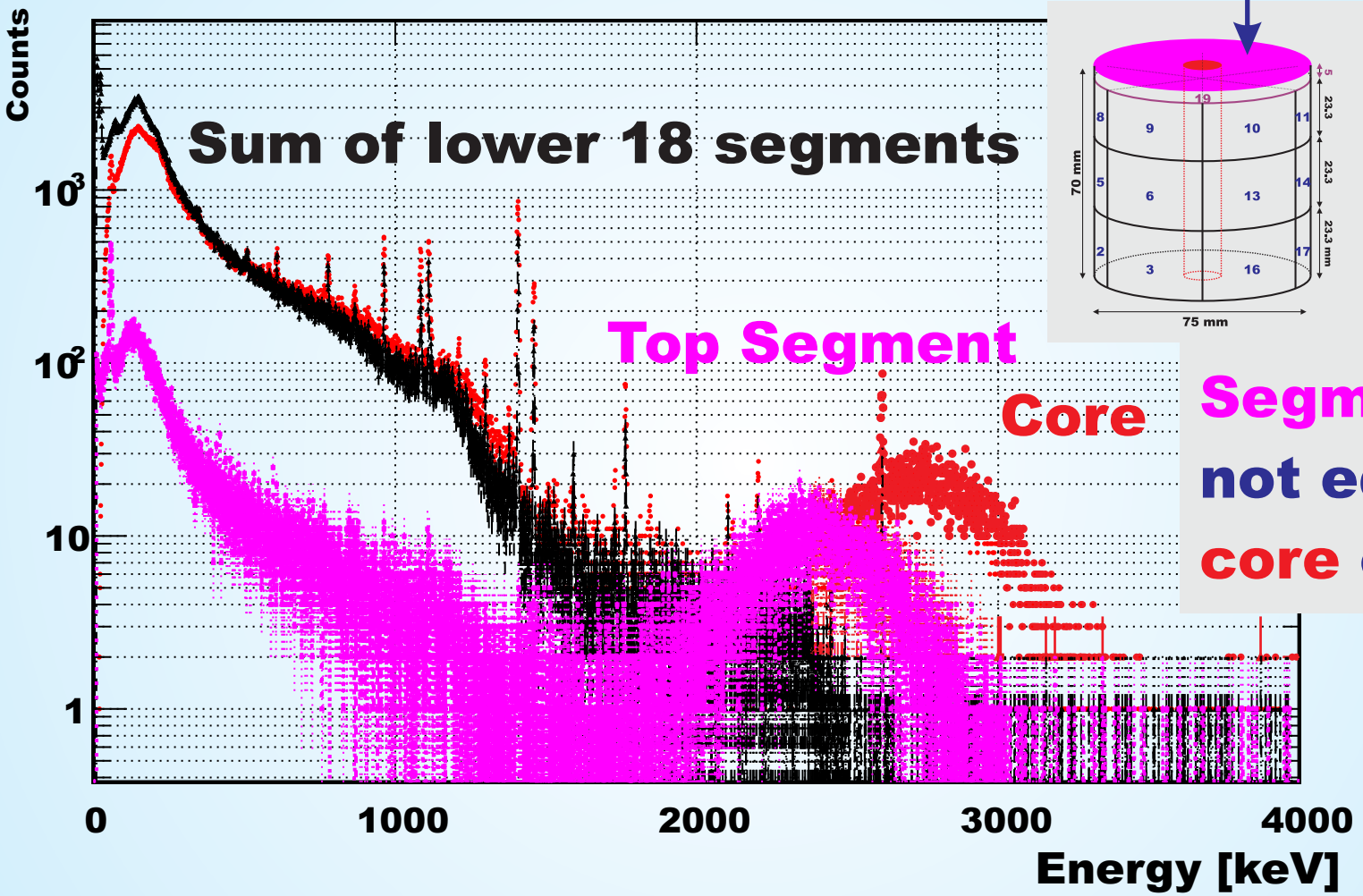


No material between source and detector



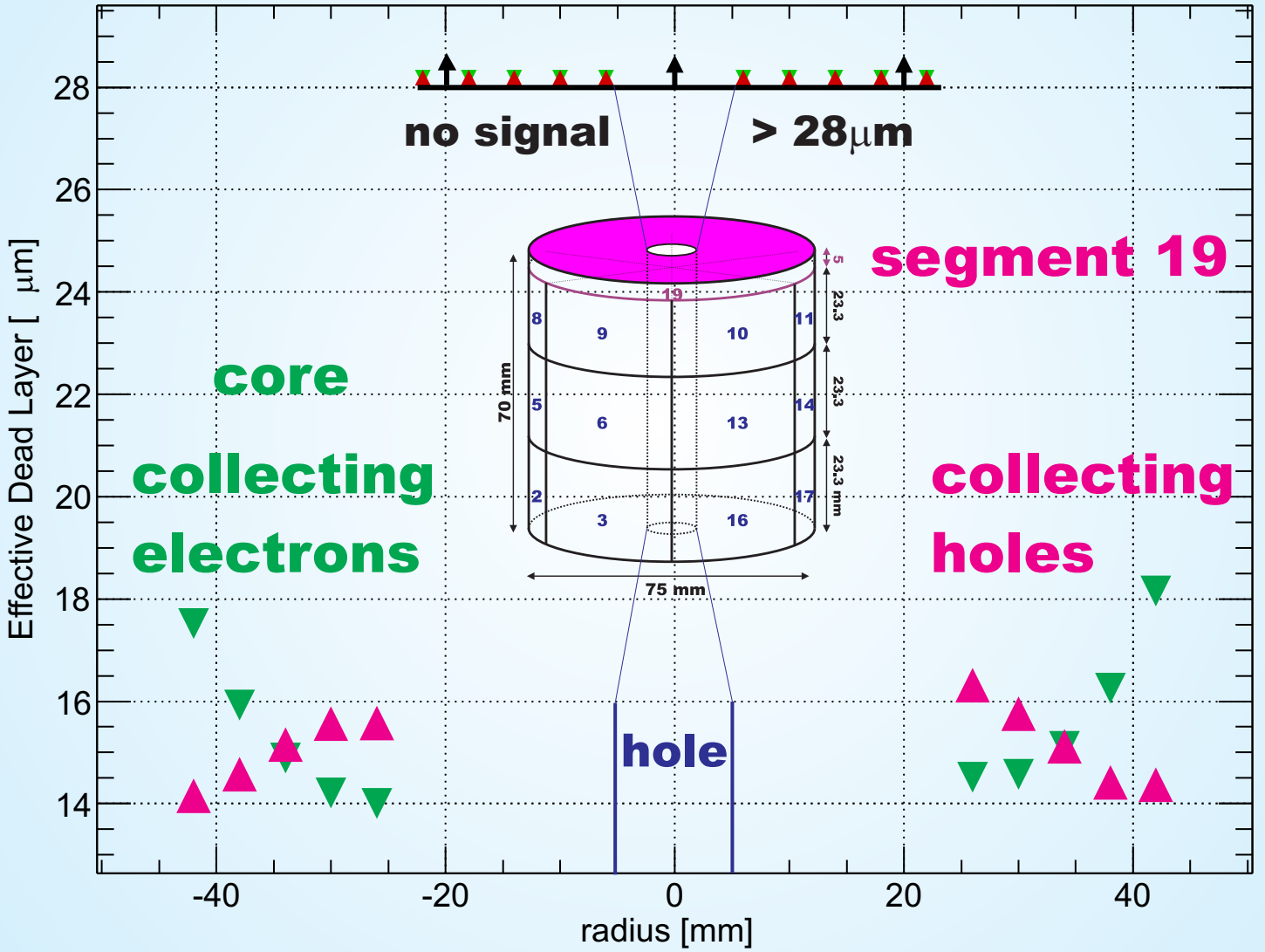
Characterize alpha events on passivated surface with Americium source

Alphas



5 MeV alphas from Americium

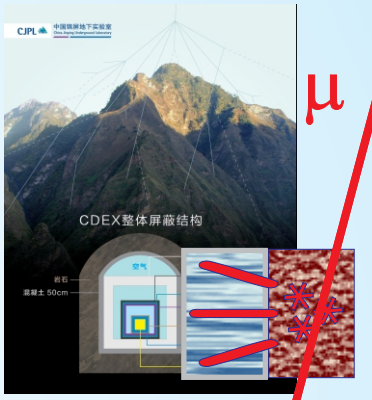
Dead Layers

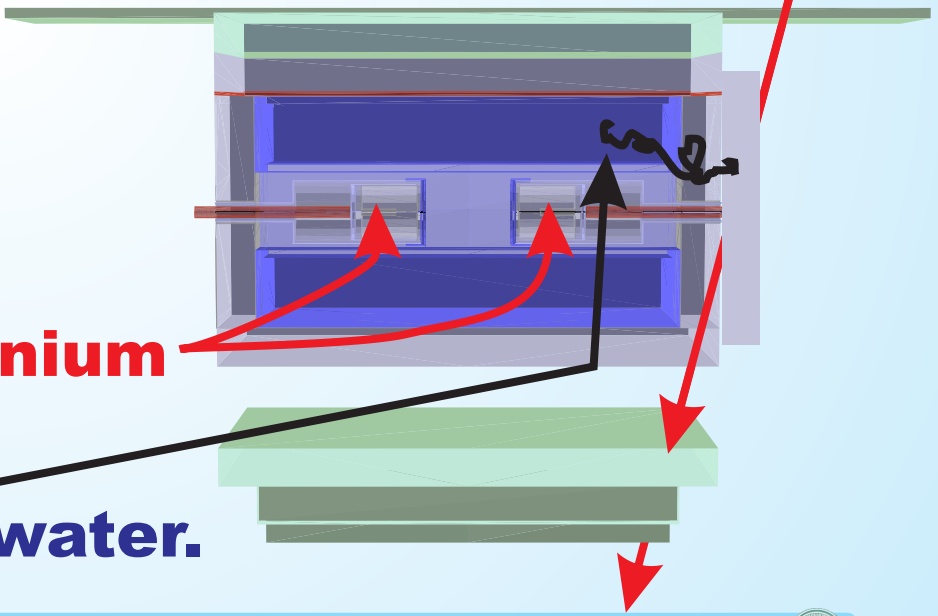

no signal
> 28μm
segment 19
core
collecting
electrons
collecting
holes
hole
70 mm
75 mm
23.3 mm
Effective Dead Layer [μm]
radius [mm]

Muon Induced Neutrons

Irreducible and nasty background, especially when meta-stable states are created.

Worth measuring

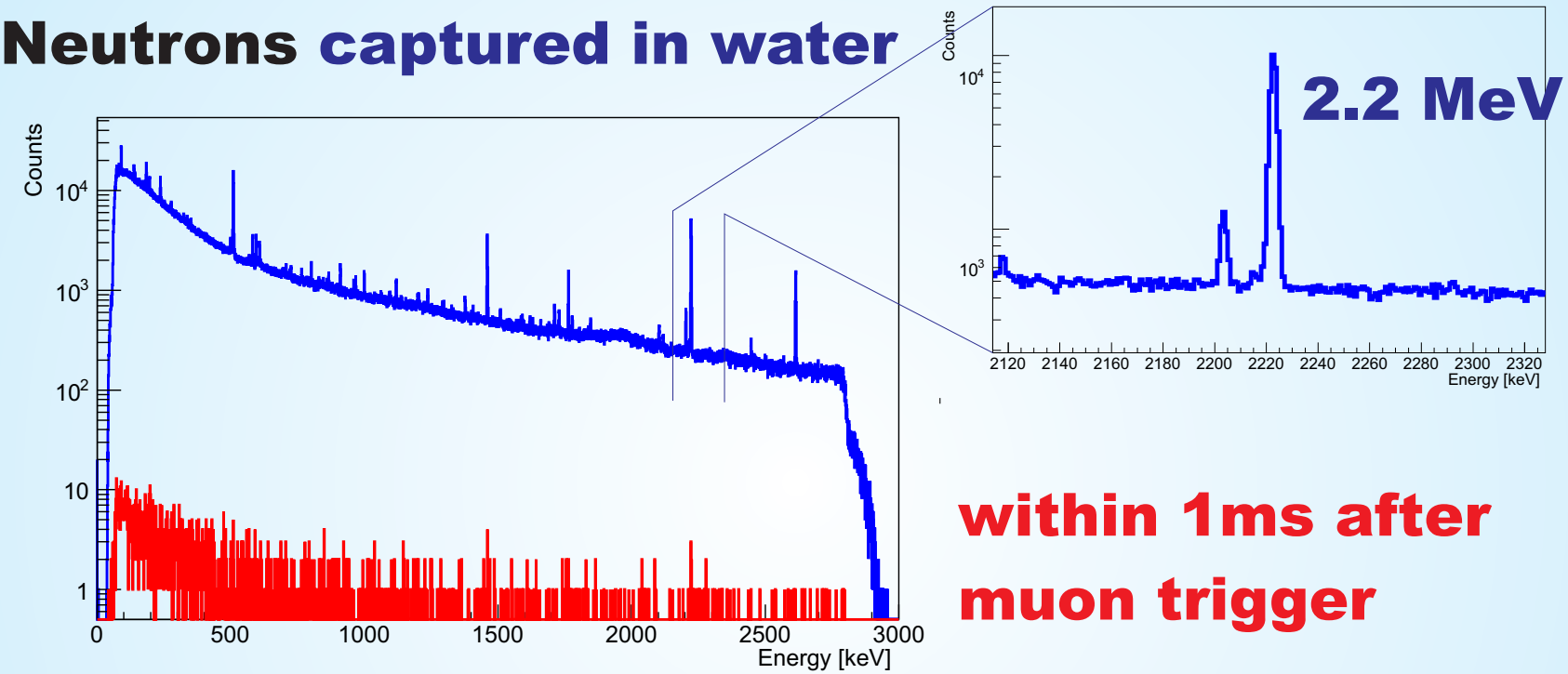




Use two standard germanium detector to see signal from neutron capture in water.

Muon Induced Neutrons

Neutrons captured in water



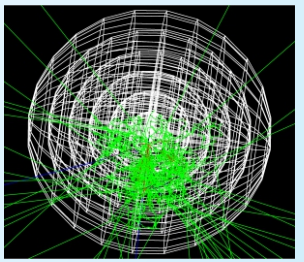
within 1ms after muon trigger

Measurements above ground: background is too large.

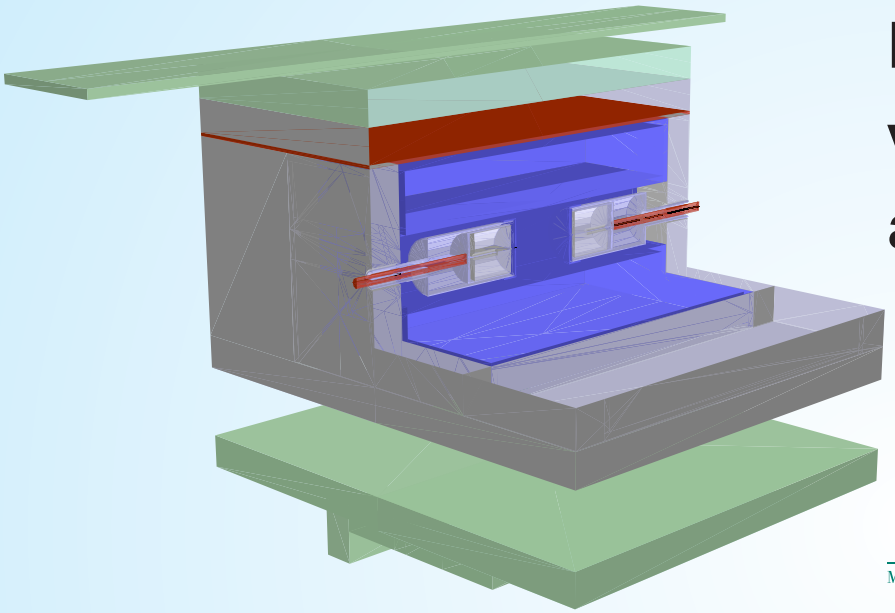
↳ **Go to shallow lab in Tübingen:**

expect S/B of 5 ~ 6

Measure background => independent of MC



Muon Induced Neutrons



But, of course,
we do Monte Carlo:
asked to join MaGe.

Cooperation

Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Get additional fast neutron detector from Tsinghua, space in Tübingen

Deutsch-Chinesische-Kooperationsgruppe

Development of High Purity Germanium Detector Techniques for Applications in Fundamental Research

Finanziell unterstützt durch: Chinesisch-Deutsches Zentrum für Wissenschaftsförderung Peking, China

中德合作研究小组

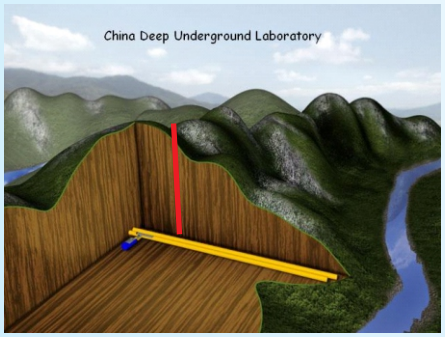
应用于基础研究的高纯锗探测器技术研发

资助者:中德科学中心 / 中国 北京

China Jinping Laboratory

May 2014 Symposium Beijing Visit to CJPL

cooperation members and guests



2400m of rock

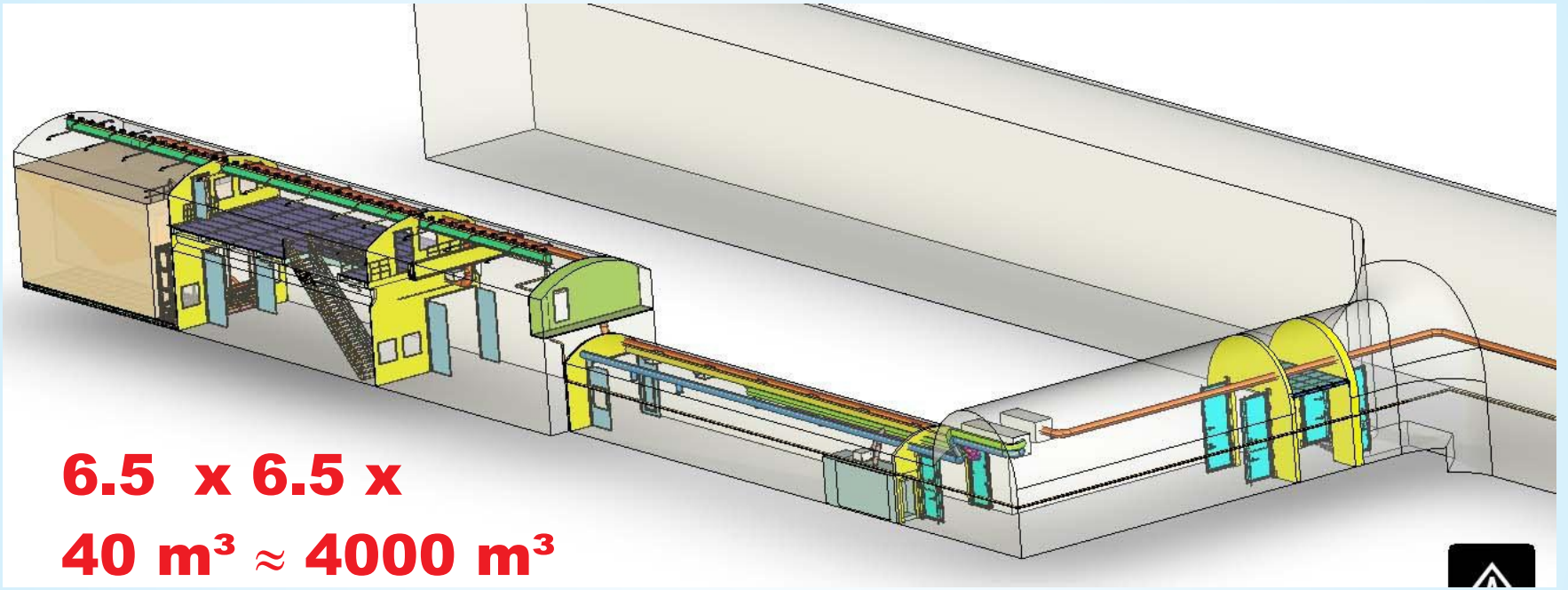
7500 mwe

60 muons /m²/y

China Jinping Laboratory

May 2014

China Jinping Laboratory



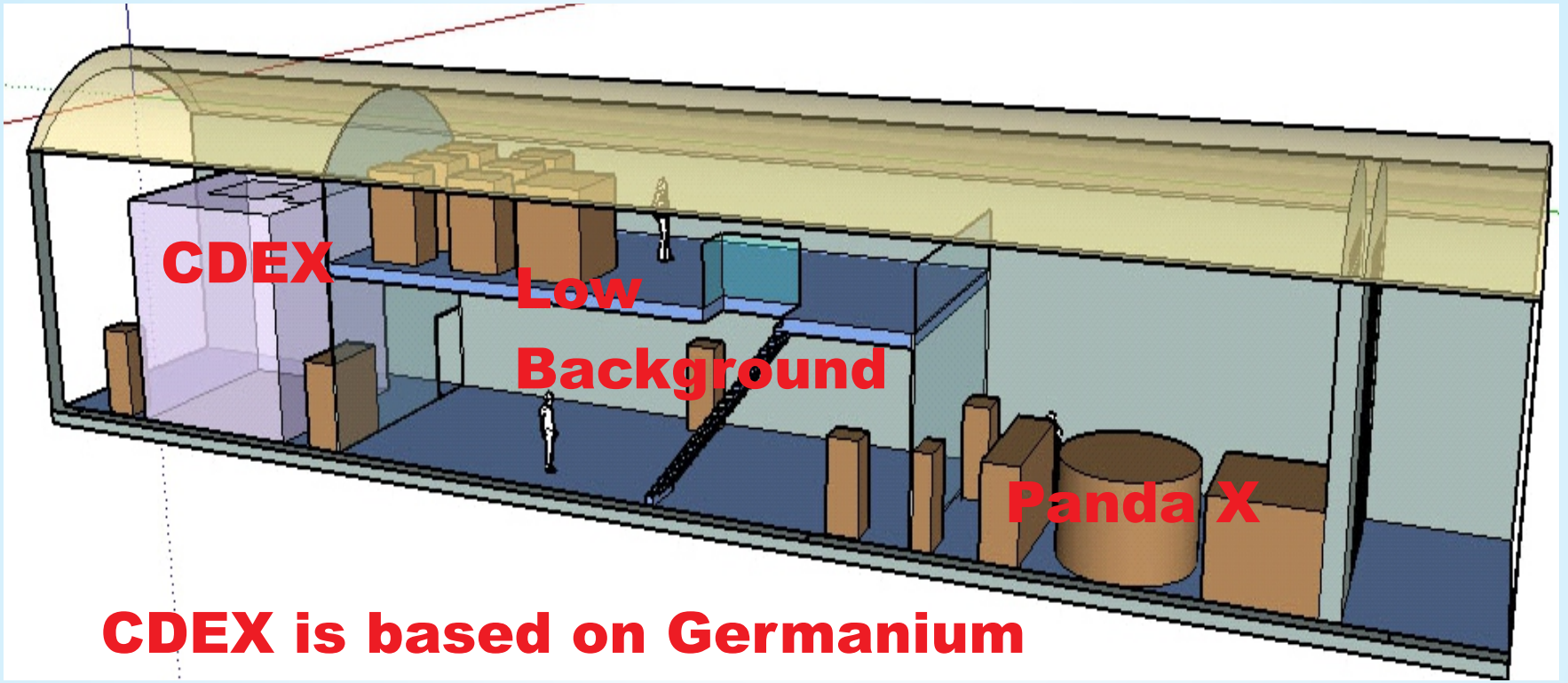
CJPL is a small laboratory.

But its construction is an impressive story.

Construction of CJPL

Construction in 2010

China Jinping Laboratory



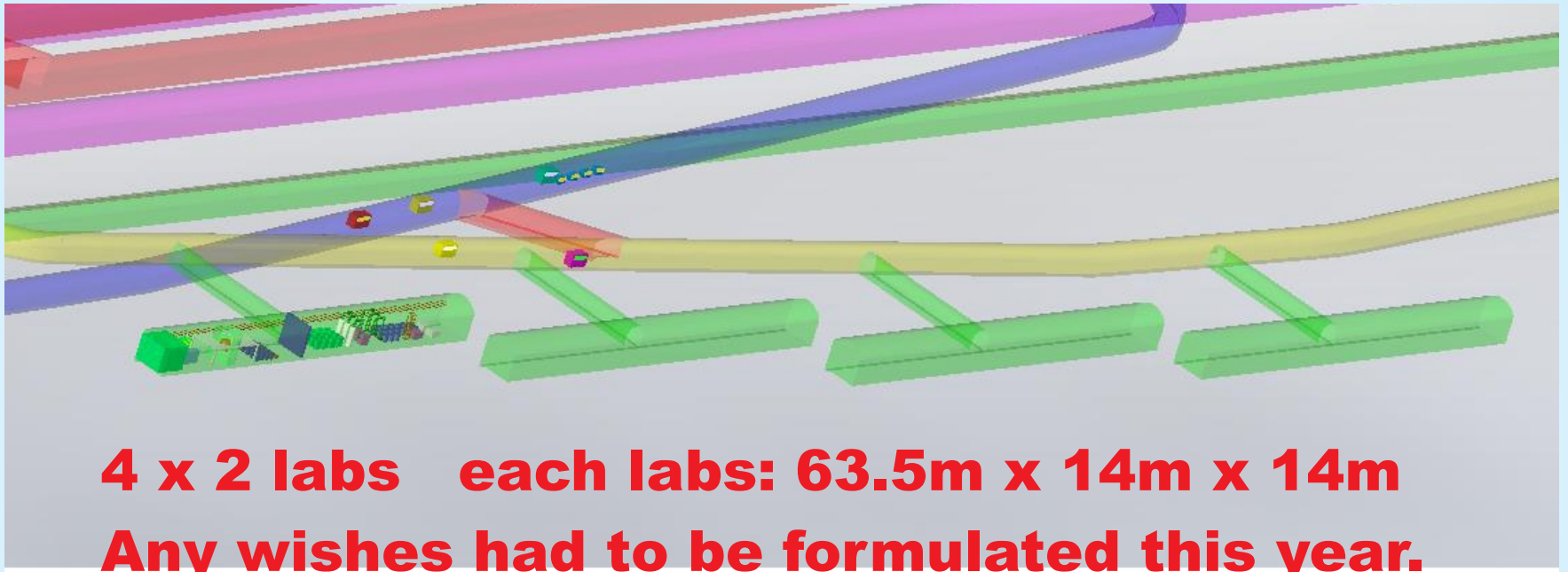
CDEX is based on Germanium

PandaX is based on Xenon

Both look for dark matter.

CDEX wants to add neutrinoless double beta decay to future 1 ton experiment

8 Laboratories of CJPL 2



4 x 2 labs each labs: 63.5m x 14m x 14m

Any wishes had to be formulated this year.

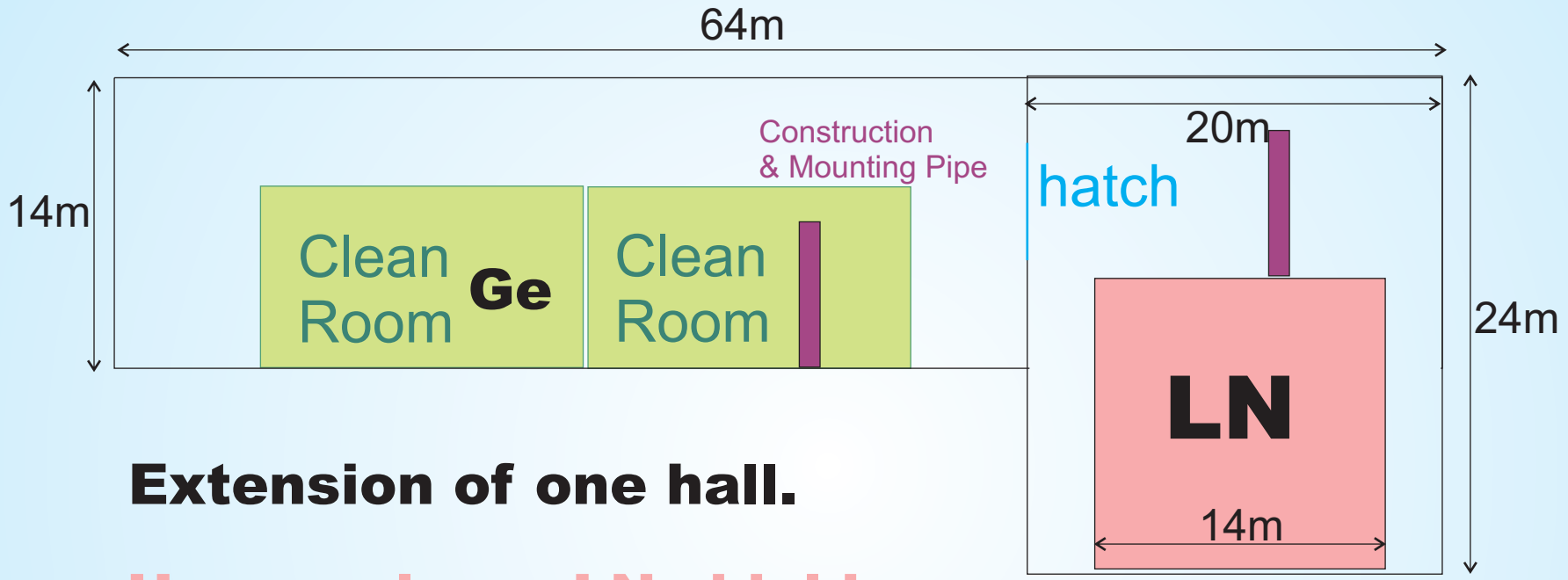
Rock work volume of 8 x labs	130591 m^3
Concrete work volume	26427 m3
Steel structure	912 T

Construction in 2015

Future will be interesting.

A. Caldwell is on international advisory board.

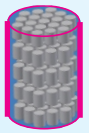
Wishes for CDEX 1ton

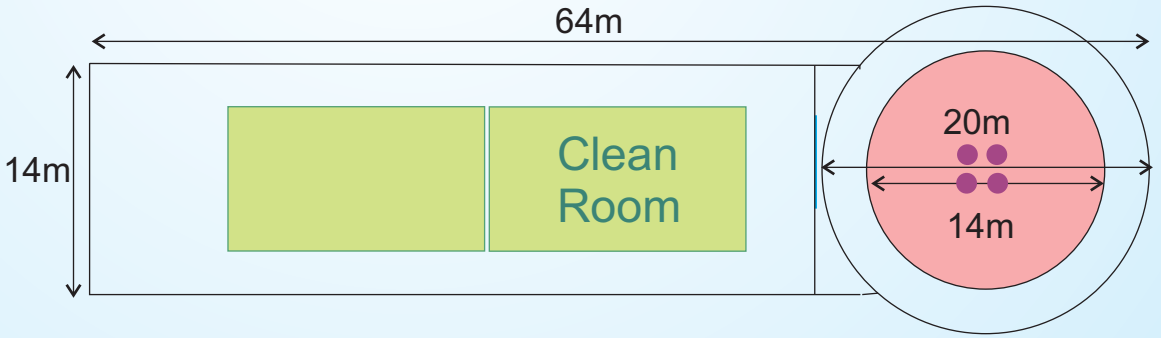


Extension of one hall.

Use one large LN shield.

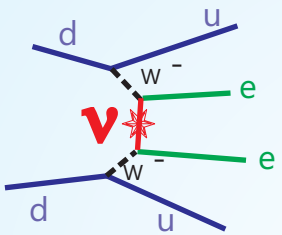
4 to 7 assem-blies



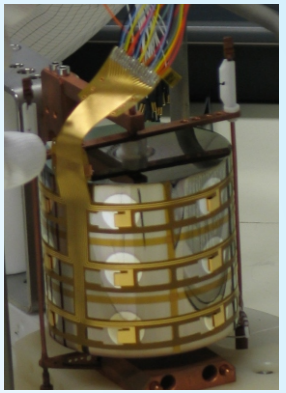


[In]Famous Last Words

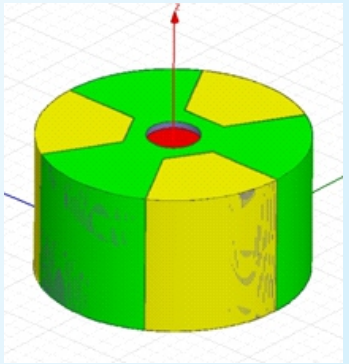
Germanium detectors might give us the chance to address some very fundamental questions.



.....



We need new detector technologies to get to the next level.



We work on detector development.

We try to evaluate future options.

Next October, we will have a final cooperation symposium at Ringberg.

Then, we will have to make some choices.