Simulation and Background Studies

Jing Liu on behalf of TG10

TG10 Summary Talk

Outline

- New Material Definition Method in MaGe
- Optimization of PMT placement
- MC verification by prototype testing
  - with gamma sources
  - with neutron source
- Upcoming activities
- Two MC papers accepted by NIM A

New Material Definition Method in MaGe

News from LNGS

Material Definitions On-the-fly

Old

Material definition hard-coded in MaGe

Problem

Every single & simple change needs recompilation

Terrible, if frequent change of materials needed

New

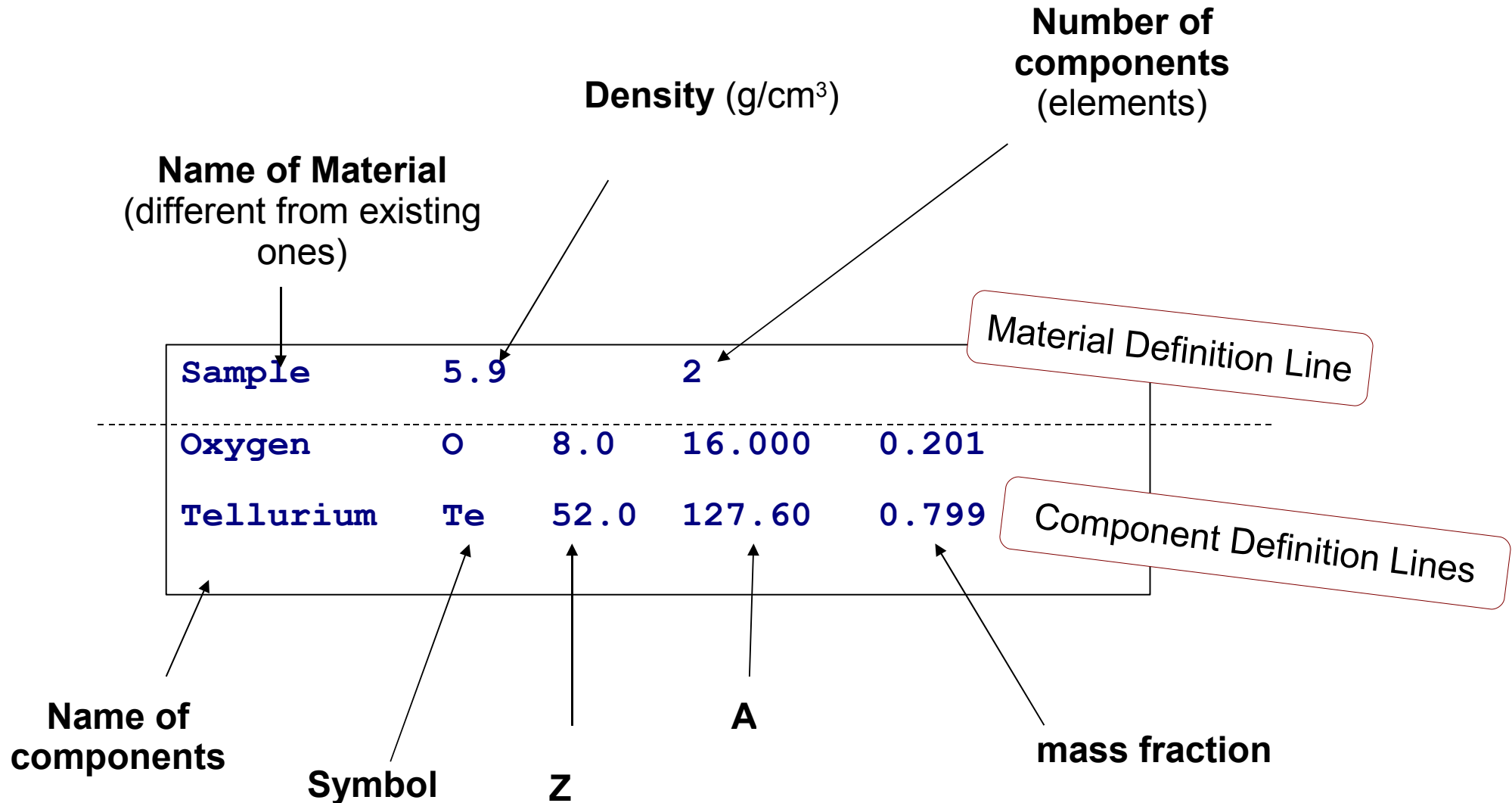Read Material definition on-the-fly from external text files

Advantage

Include a new material just one command:

`/MG/geometry/addMaterial ma.dat`

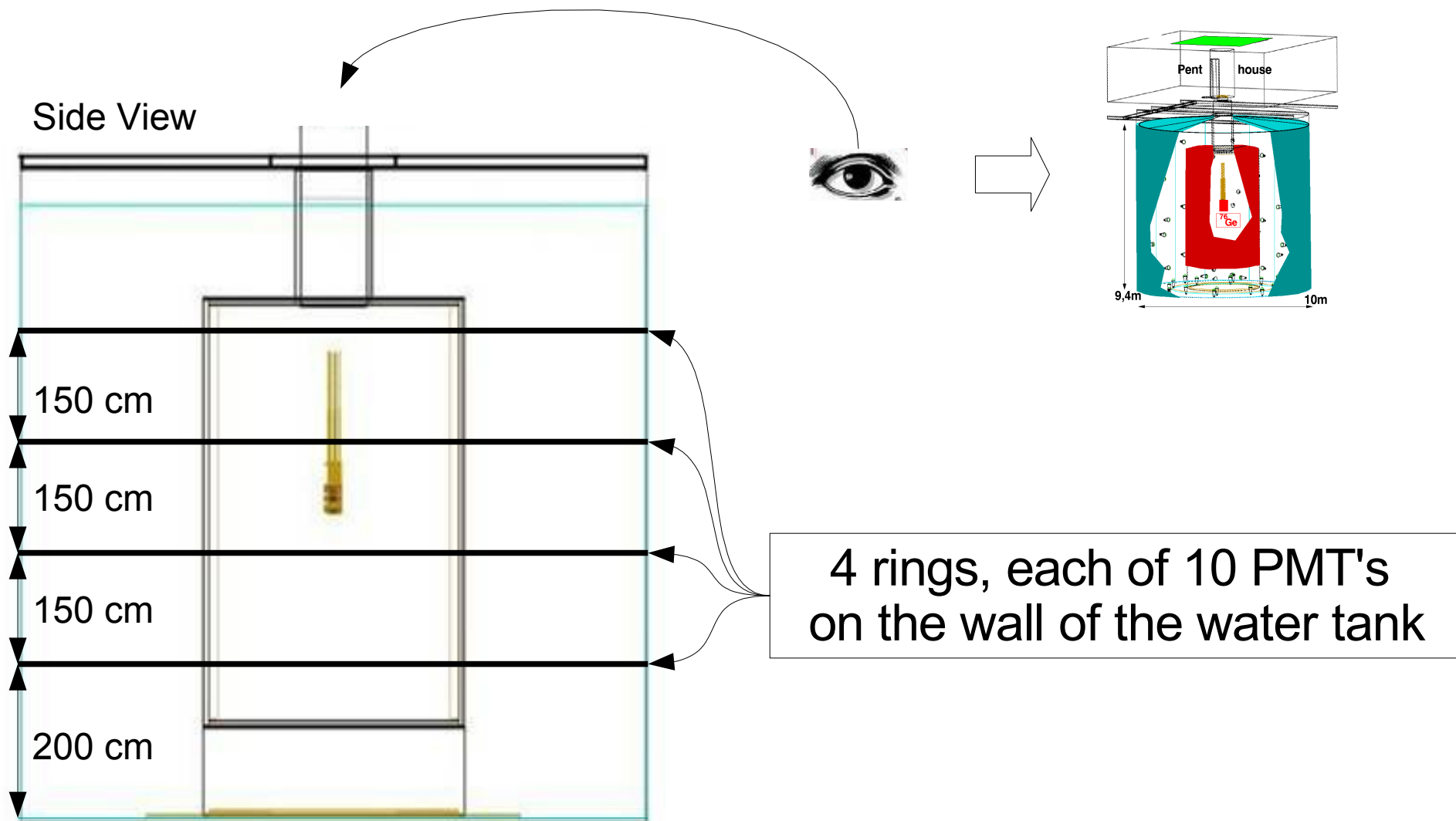Changes happen in text file, Don't need to recompile

Material Definition File

Density (g/cm³)

Number of components (elements)

Name of Material (different from existing ones)

Material Definition Line

Sample		5.9		2	
Oxygen	O	8.0	16.000	0.201	
Tellurium	Te	52.0	127.60	0.799	

Component Definition Lines

Name of components

Symbol

Z

A

mass fraction

If a component (element) is already defined in source codes, the definition in source codes is used

Optimization of PMT Placement

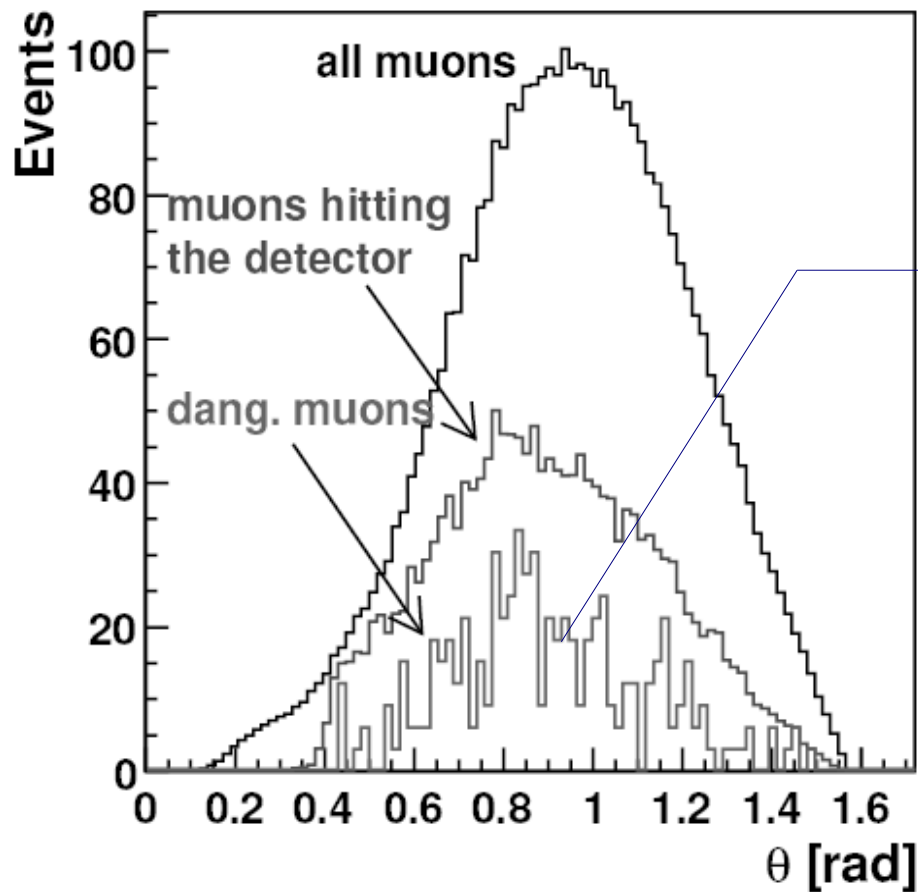*News from Tuebingen*

Side View of PMT's Placement

Side View

150 cm

150 cm

150 cm

200 cm

4 rings, each of 10 PMT's
on the wall of the water tank

Pent   house

^{76}Ge

9,4m   10m

Bottom View of PMT's Placement

Outer ring on the bottom of the water tank: 12 PMT's

Inner ring on the bottom of the water tank: 8 PMT's

6 PMT's in the Pillbox below the crystat

Water Tank

Bottom View

275 cm

425 cm

Pillbox

Pent house

9,4m

10m
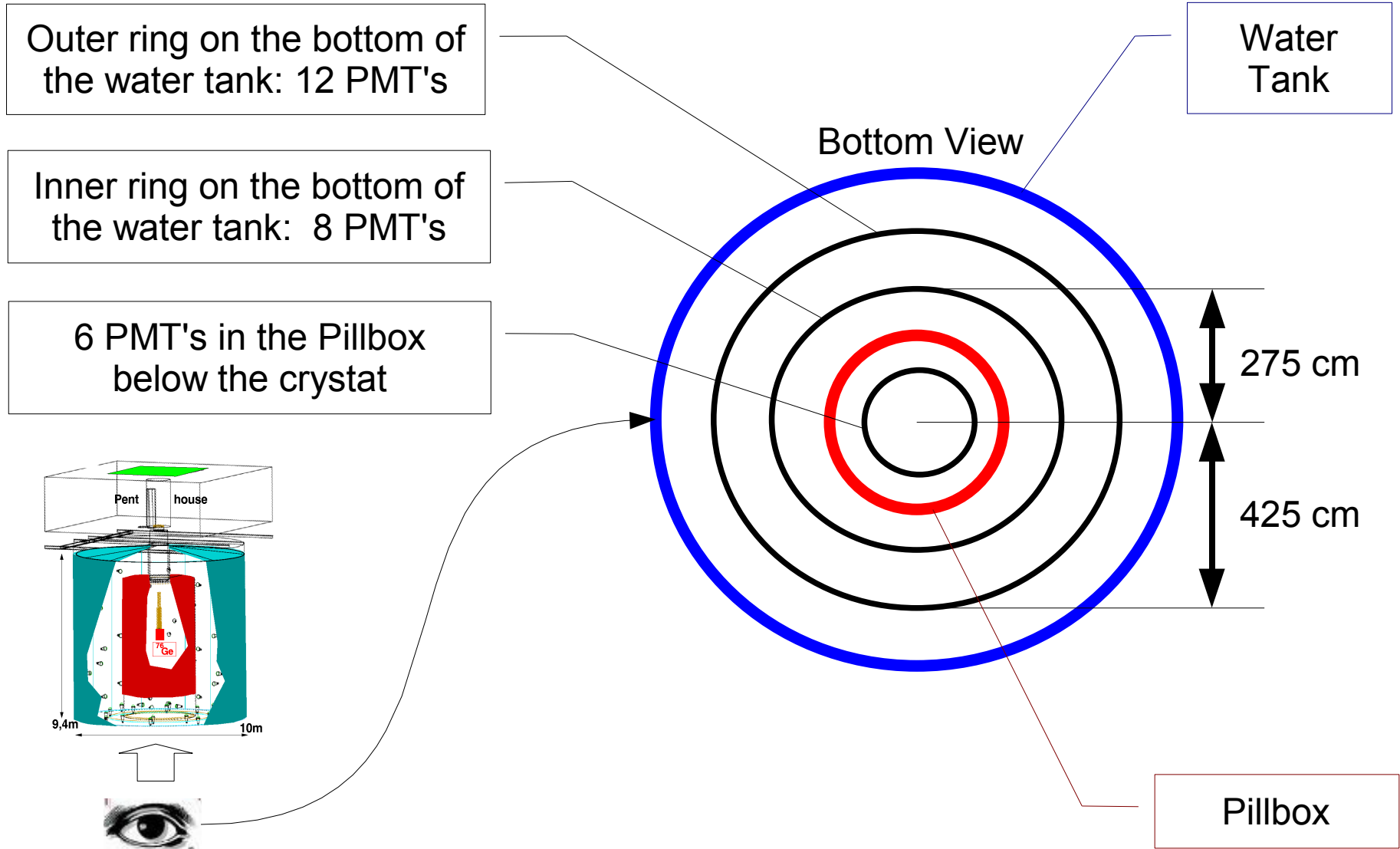
Results from MC Simulation

100% of dangerous muons detected

Muons hitting the detector and with Energy deposition around 2 MeV

• 89.1% of which are detected by PMT's on the wall of water tank

• 51.4% of which are detected by PMT's inside the pillbox

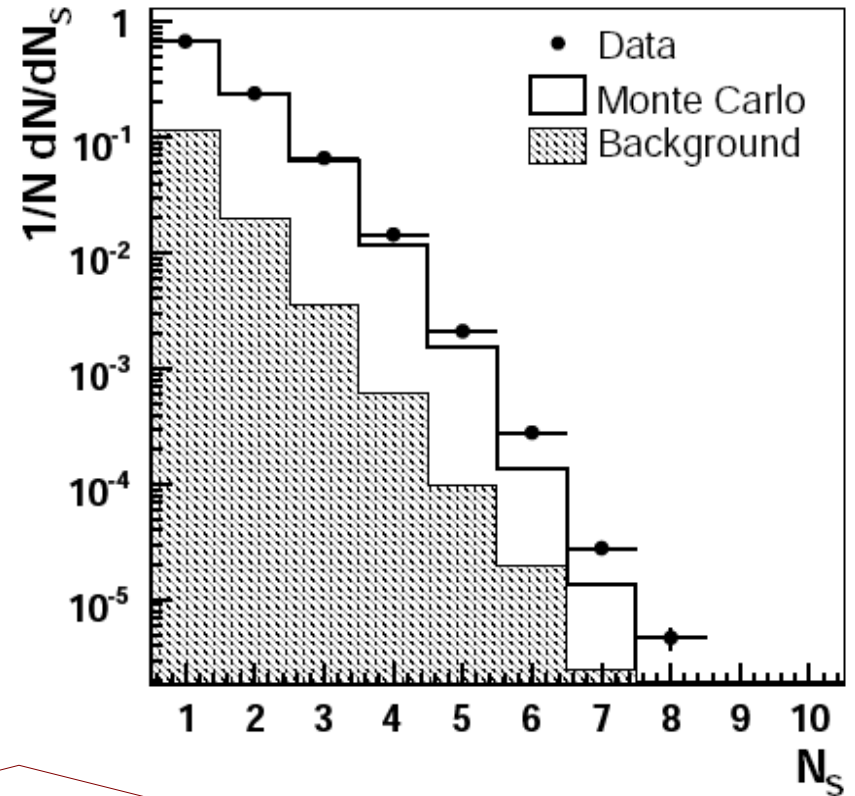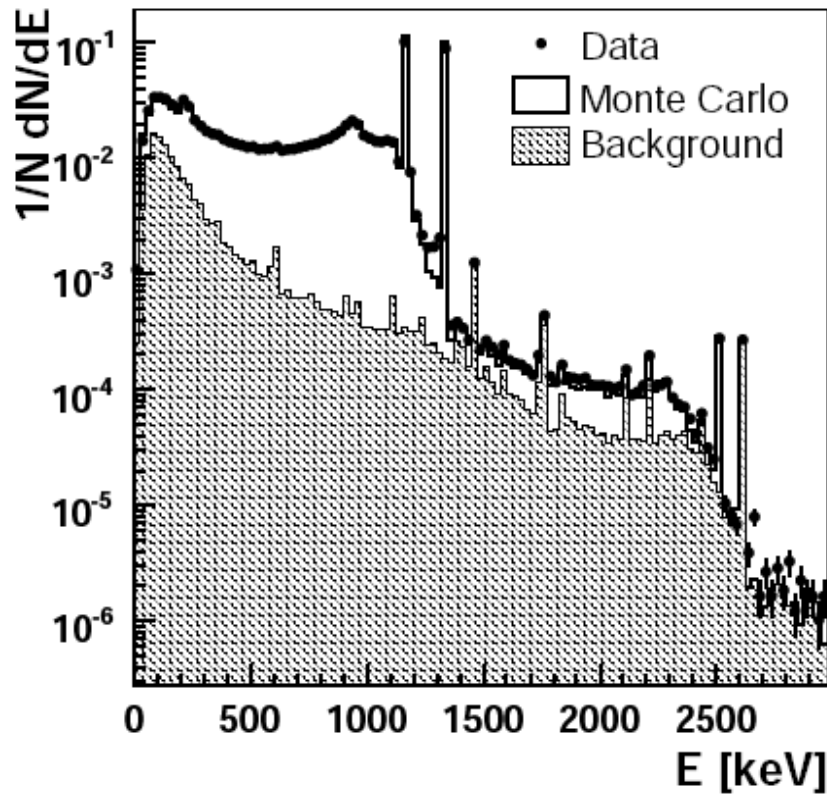# *MC Verification by Prototype Testing with Gamma Sources*

Source

Cryostat

Segmented HP Ge-diode

Refer to TG2 reports for detailed experiment setup
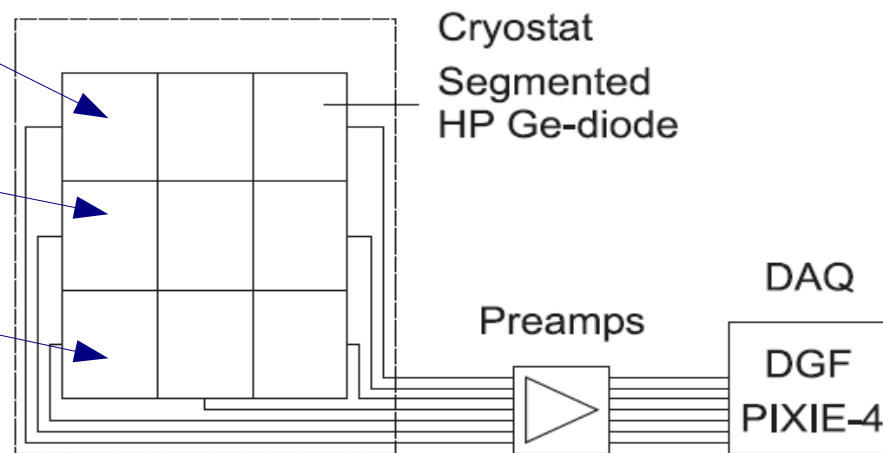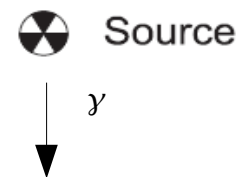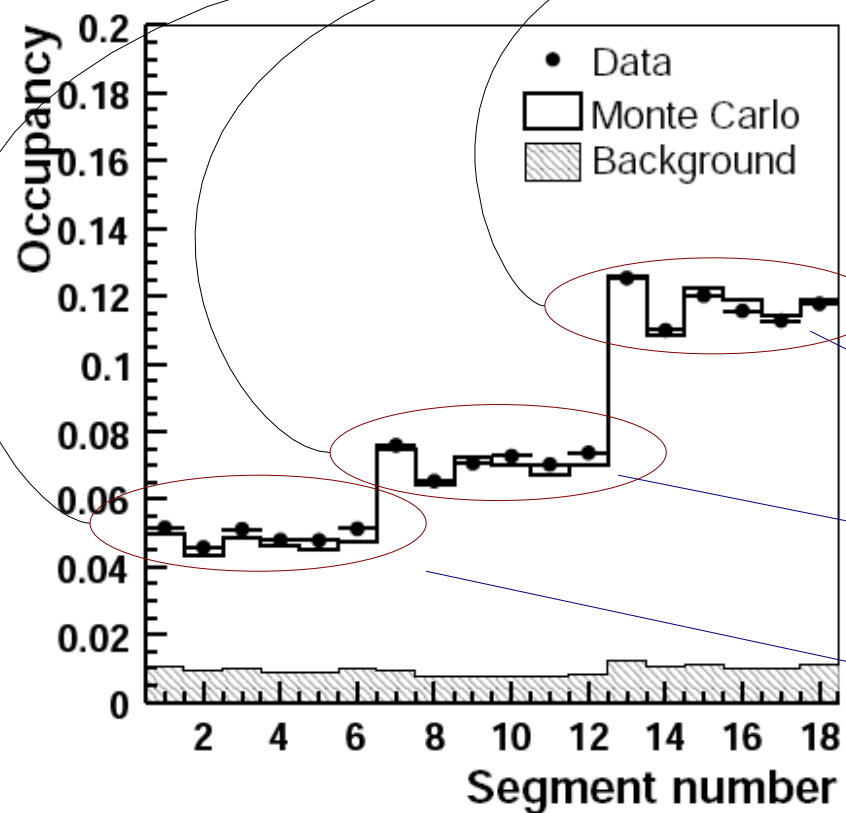
DAQ

Preamps

DGF PIXIE-4
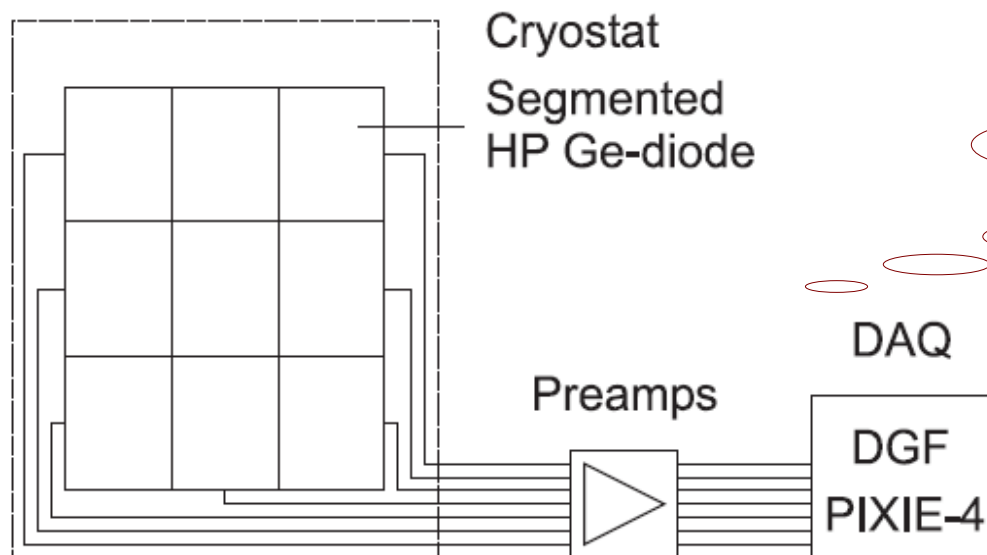
Energy Spectrum and Multiplicity Distribution

Average deviation between data and MC < 10%

Occupancy Distribution

Sub-structures show the drift anisotropy inside the crystal, which is estimated by an effective model
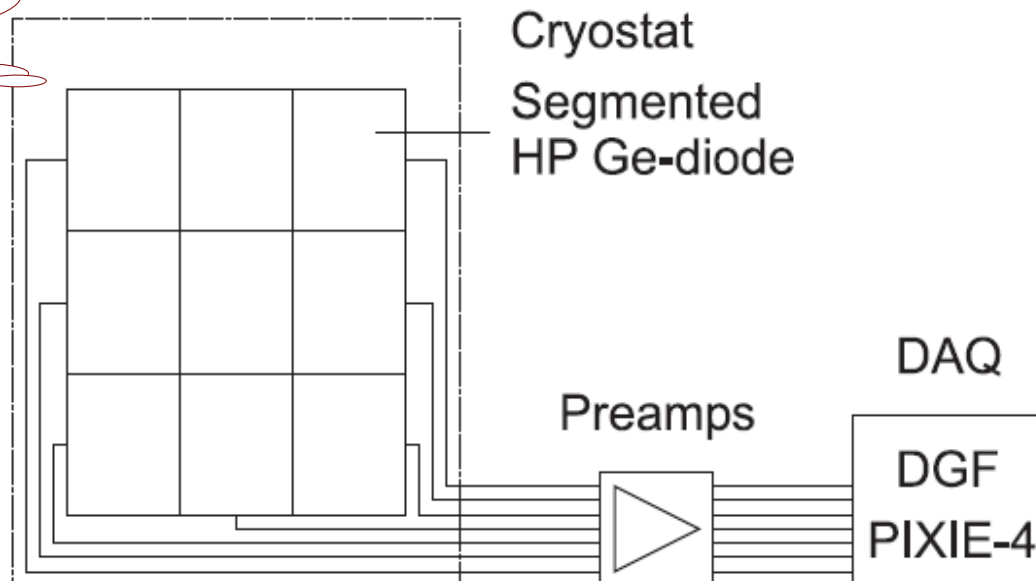
MC Verification by Prototype Testing with Neutron Source

Refer to TG2 reports for detailed experiment setup

Cryostat

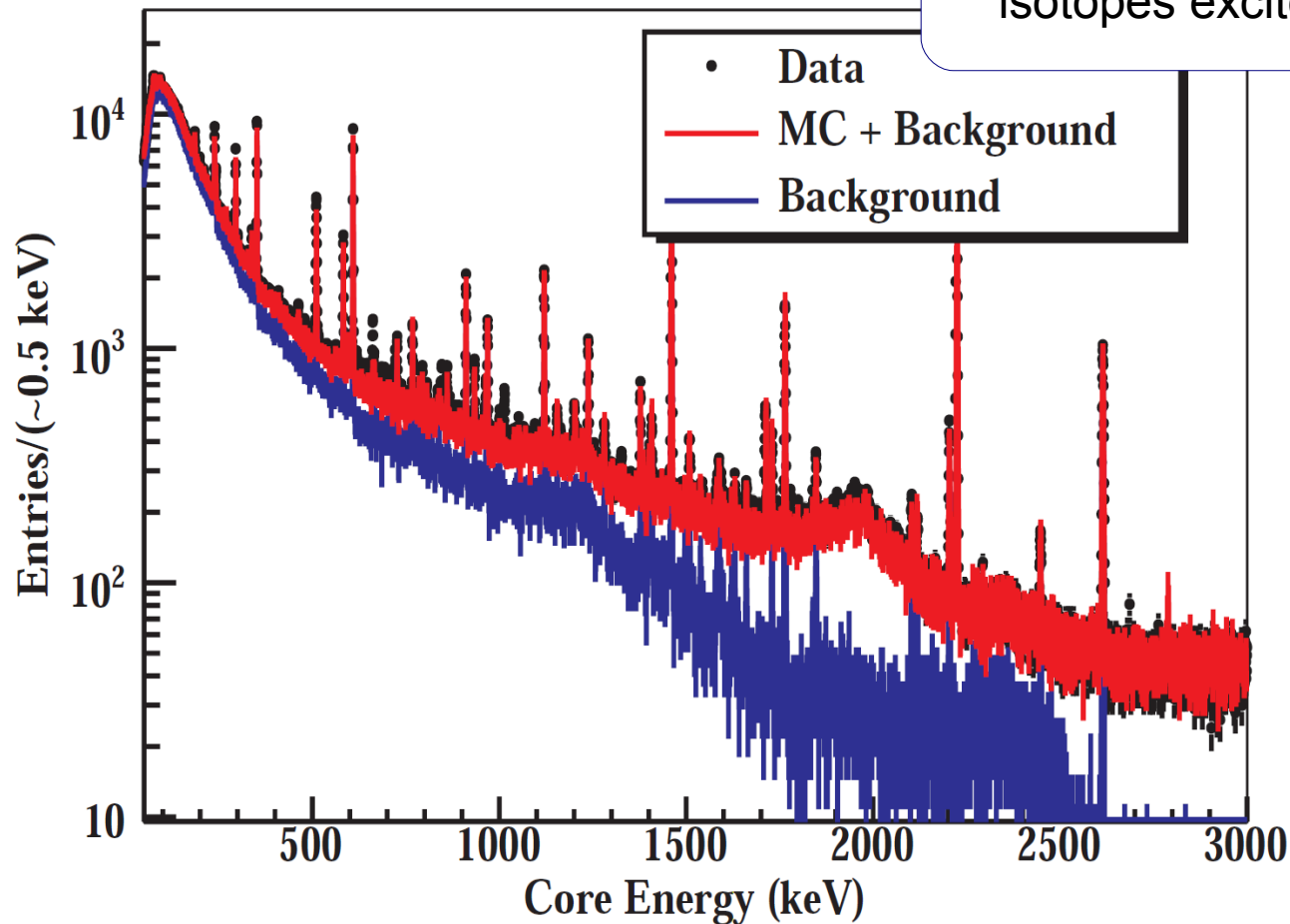Segmented
HP Ge-diode

Am-Be Neutron Source

DAQ

Preamps

DGF
PIXIE-4

Neutron Induced background Spectrum

Main gamma lines emitted from Ge isotopes excited by neutron found in MC
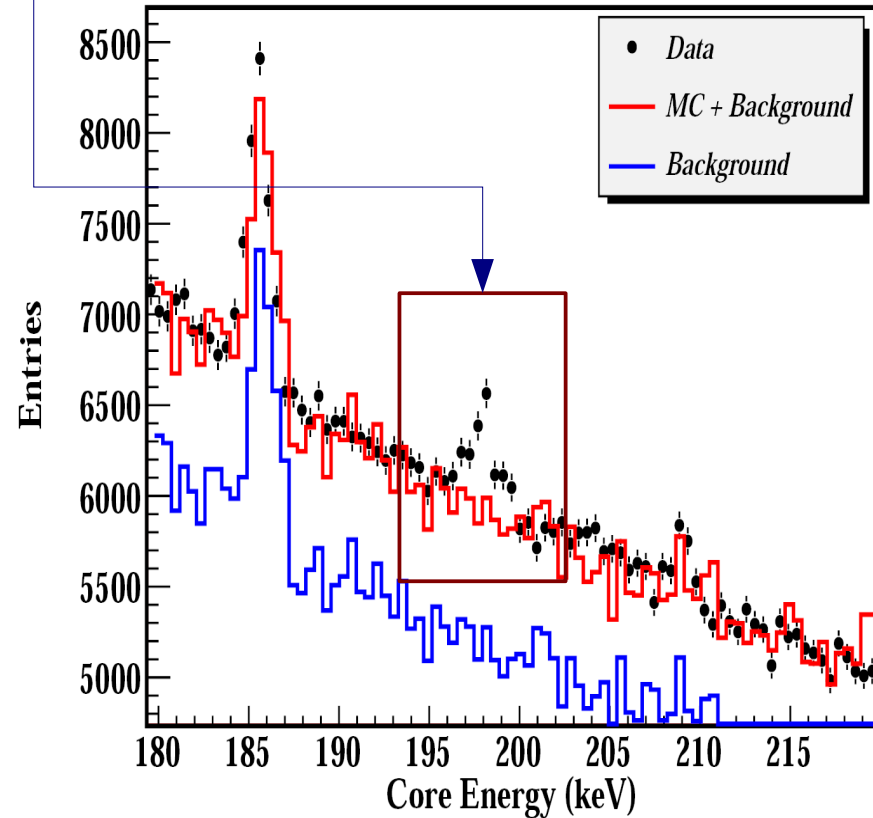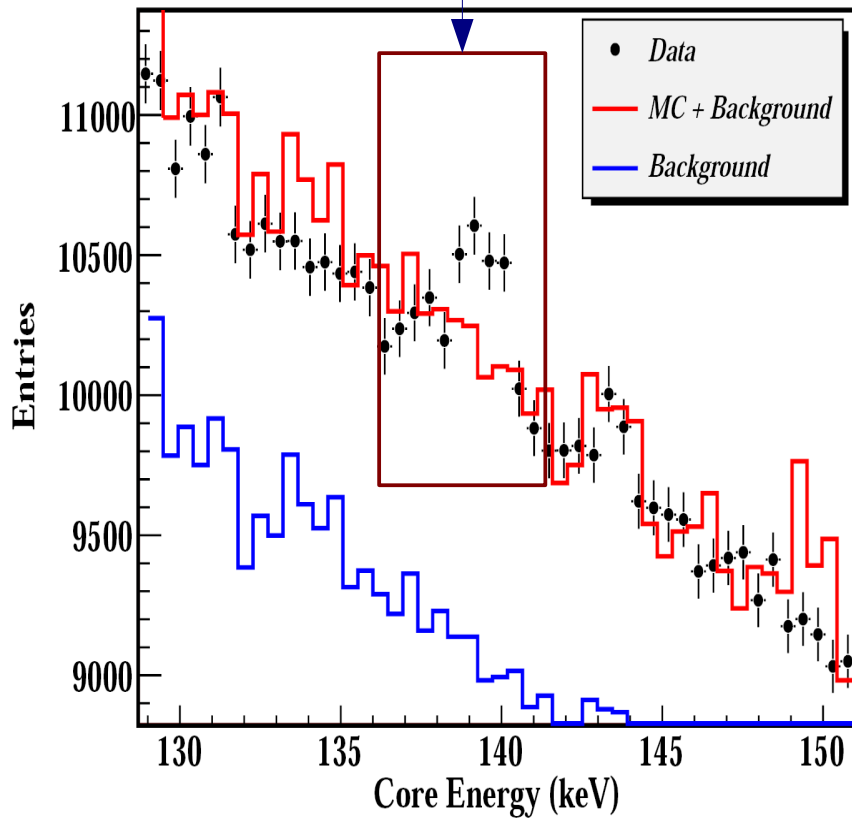
Peaks Missing

Missing from GEANT4 physics process database

139 keV gamma line from 75mGe

198 keV gamma line from 71mGe

Upcoming Activities

- Majorana-Gerda Joint MC Meeting
- New MC simulation campaign

Majorana-GERDA joint MC Meeting

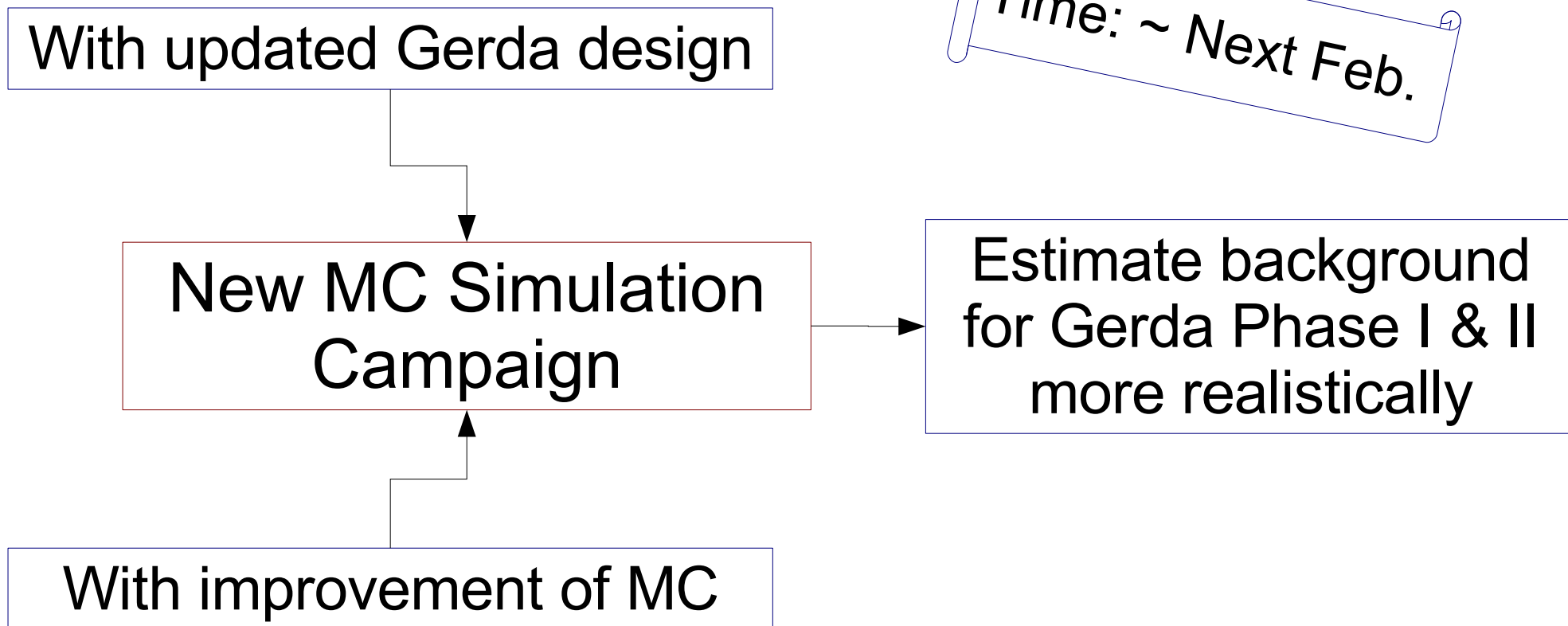| Place |
|---|
| Munich |

Time
Right after the Collab. Meeting in Munich

Agenda

* Draw up paper on MaGe, which can be referred to by other publications

• Share experience from MC & data comparison, discuss further improvement of MC

• Discuss internal issues: code development, documentation, etc.

* Propose development of Pulse Shape Simulation packages

New MC Simulation Campaign

With updated Gerda design

Time: ~ Next Feb.

New MC Simulation Campaign

Estimate background for Gerda Phase I & II more realistically

With improvement of MC

MC Papers Accepted by NIM A

News from EB

Monte Carlo evaluation of the muon-induced background in the GERDA double beta decay experiment

L. Pandola[a], M. Bauer[b], K. Kröninger[c], X. Liu[c], C. Tomei[a], S. Belogurov[d,e], D. Franco[f], A. Klimenko[d,g] and M. Knapp[b]

Background reduction in neutrinoless double beta decay experiments using segmented detectors - a Monte Carlo study for the GERDA setup

I. Abt[a], M. Altmann[a], A. Caldwell[a], K. Kröninger[a,*], X. Liu[a], B. Majorovits[a], L. Pandola[b] and C. Tomei[b]

Summary

- MaGe code development ongoing

- MC studies to guide GERDA design ongoing and planned

- So far comparison between data and MC very promising for GERDA

- MaGe joint meeting with Majorana people upcoming

- Two MC papers accepted by NIM A