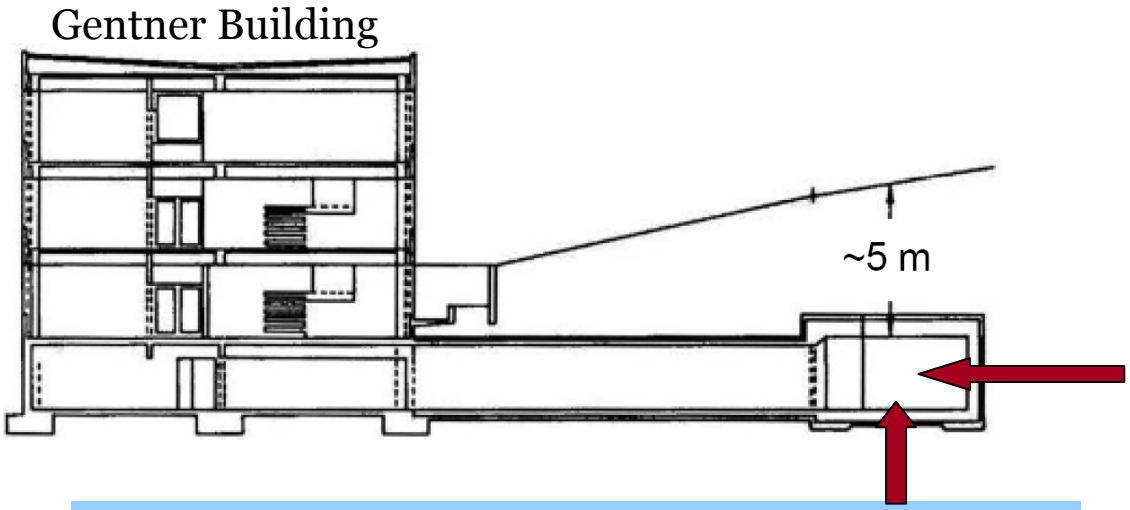
GERDA Meeting, September 2009, LNGS

News from Low-Level-Lab:
Attempt to Reduce Neutron Background at Shallow Depths

1. Motivation

1.1 Gamma Spectroscopy at MPI-K



Low-level-laboratory under 15 m we. overburden

Bruno Corrado

2 detectors with active muon veto (proportional counting chambers)

1. Motivation

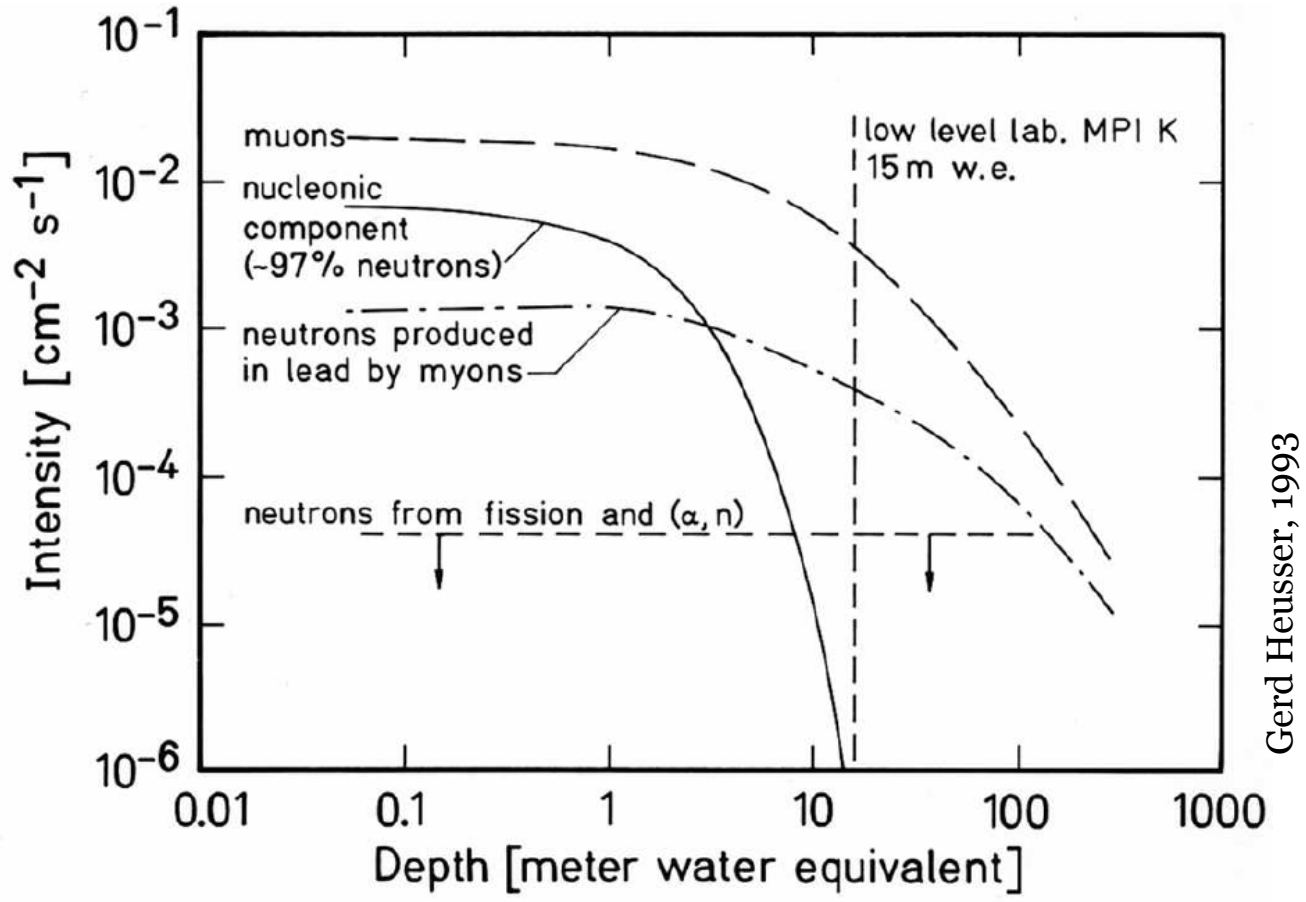
1.2 Comparison to GeMPI

	Corrado at MPI-K	GeMPI at LNGS
Overburden (mwe.)	15	3800
Active mass (kg)	0.94	2.15
Counts/day/mass [40-2700 keV] (1/d/kg)	3830	30
Sensitivity U/Th (mBq/kg)	~ 1	~ 0.01

2 orders of magnitude discrepancy in sensitivity

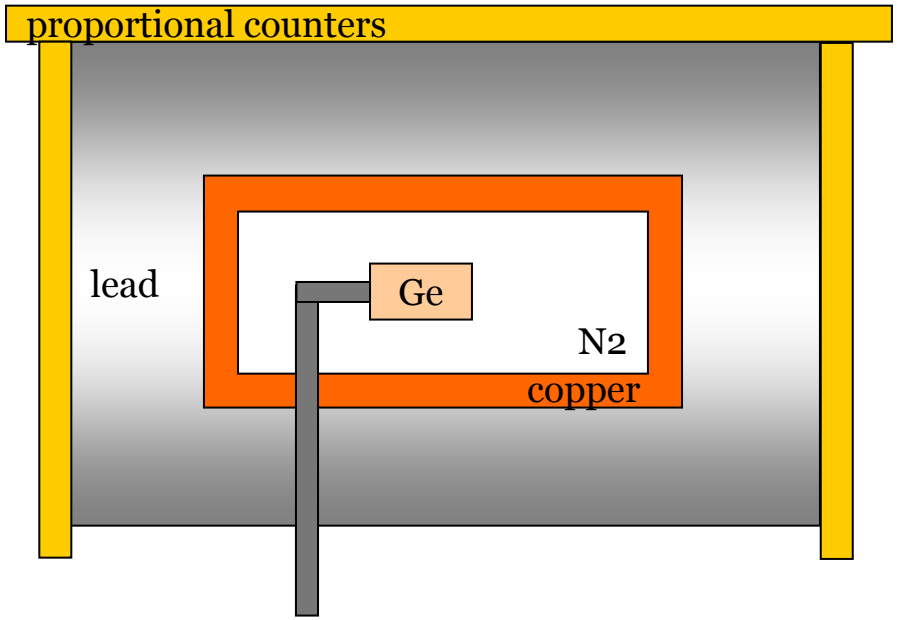
1. Motivation

1.3 Background Components



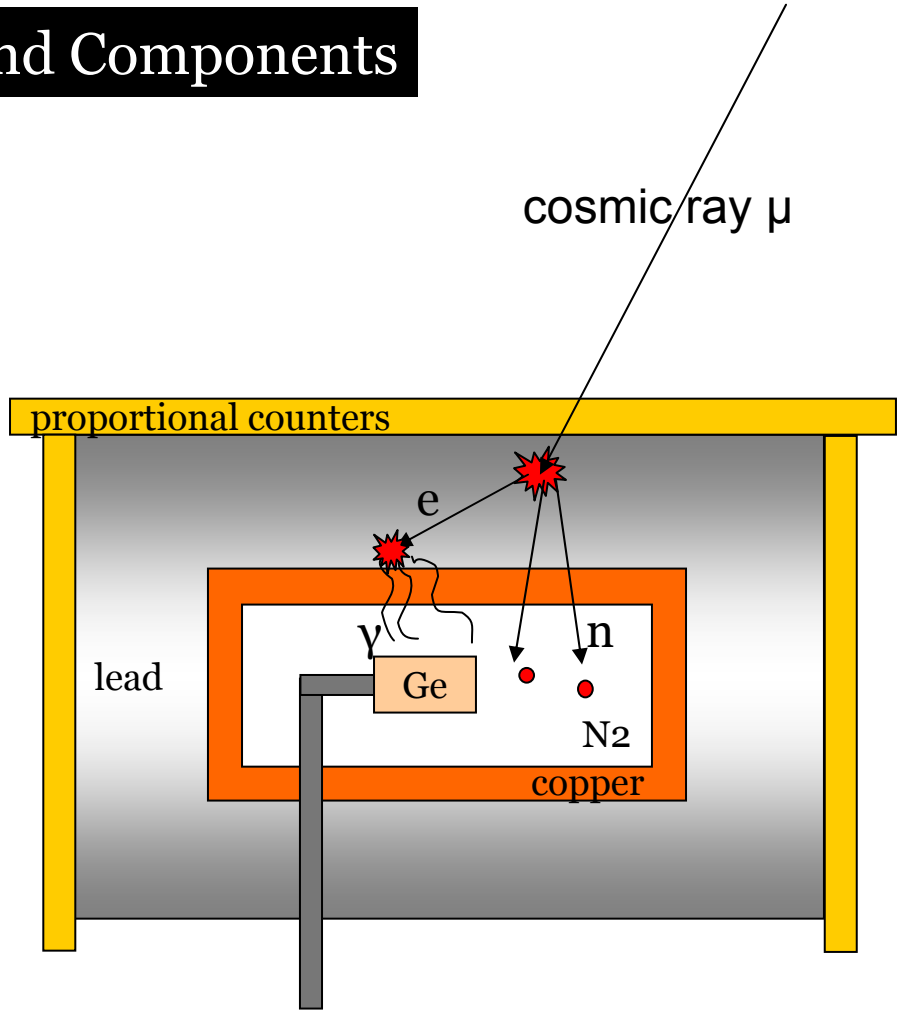
1. Motivation

1.3 Background Components



1. Motivation

1.3 Background Components



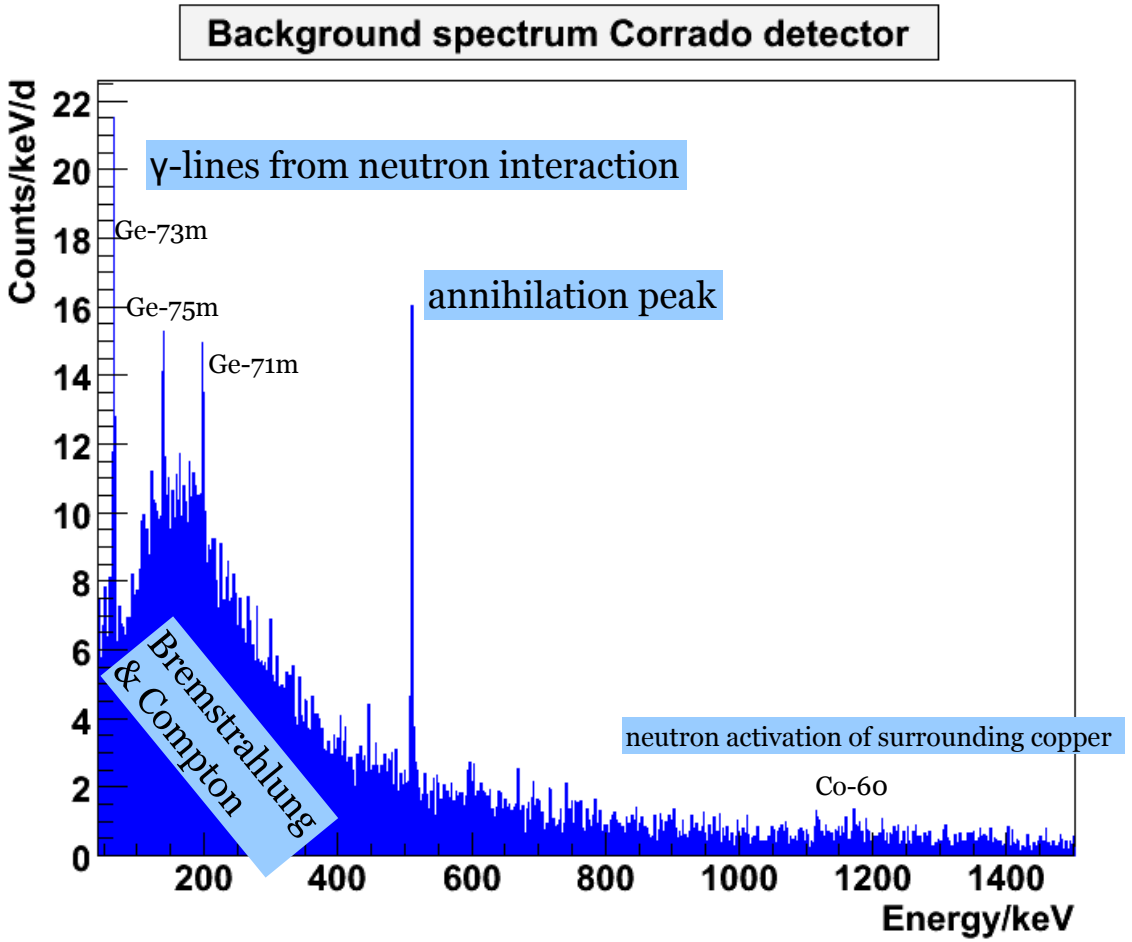
proportional chambers provide anti-coincidence veto for e.m. components

but

delayed neutrons from nuclear interactions difficult to detect

1. Motivation

1.3 Background Components



1. Motivation

1.4 GIOVE: a New Detector

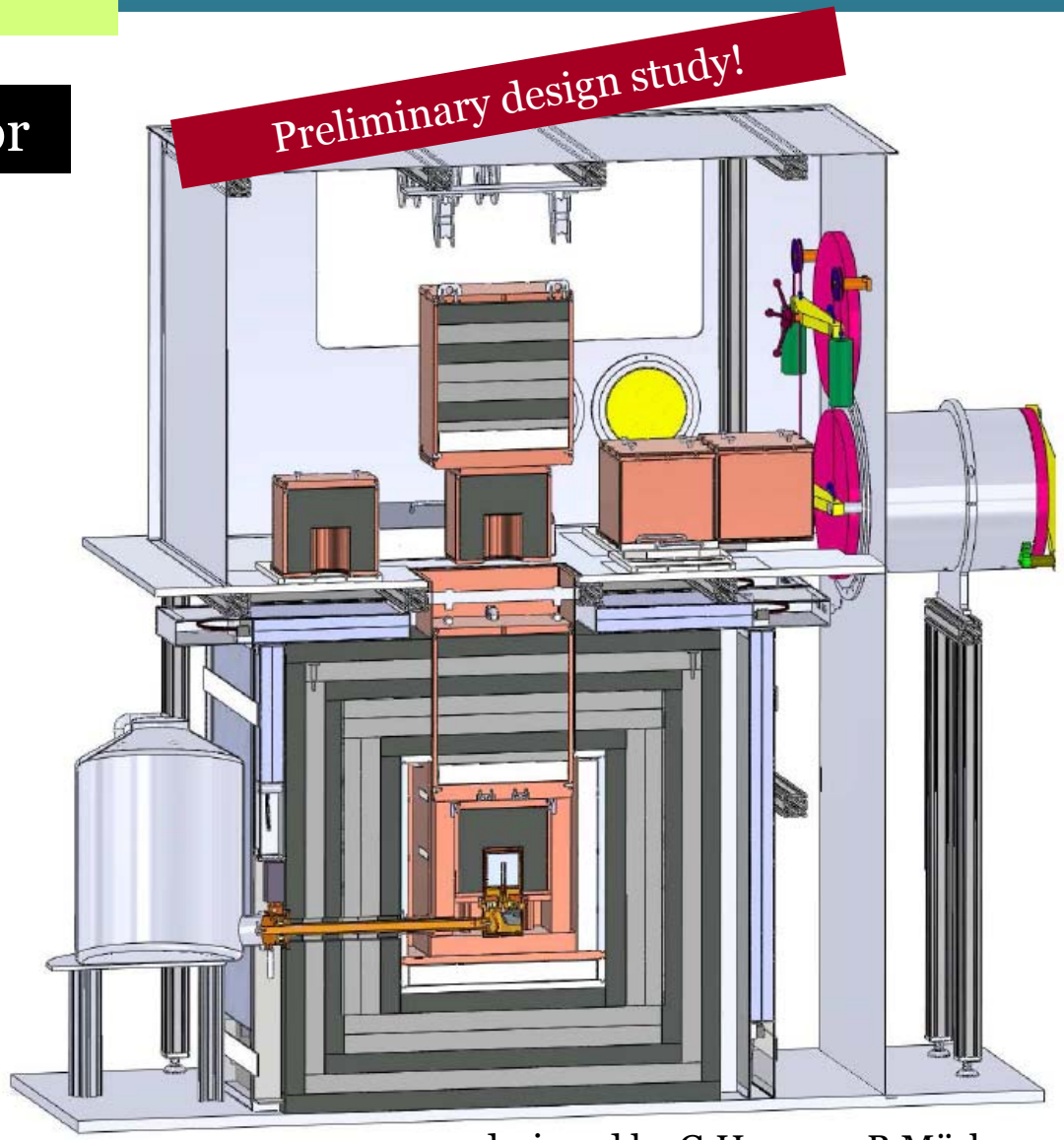
Goal: increase of sensitivity by a factor of 5-10 by efficient neutron background reduction

GeMPI-oriented construction

plus

Inner and outer veto system
Use of plastic scintillators

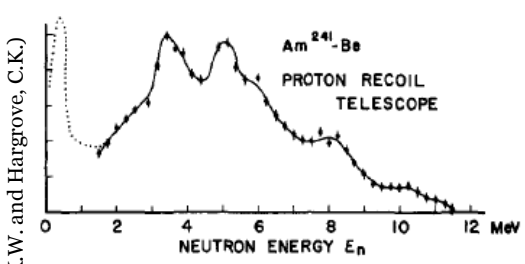
Borated polyethylene as a neutron shield



designed by G.Heusser, B.Mörk

2. Experiments

2.1 Investigation of Neutron Flux Reduction by Borated PE



(Geiger, K.W. and Hargrove, C.K.)

2. Experiments

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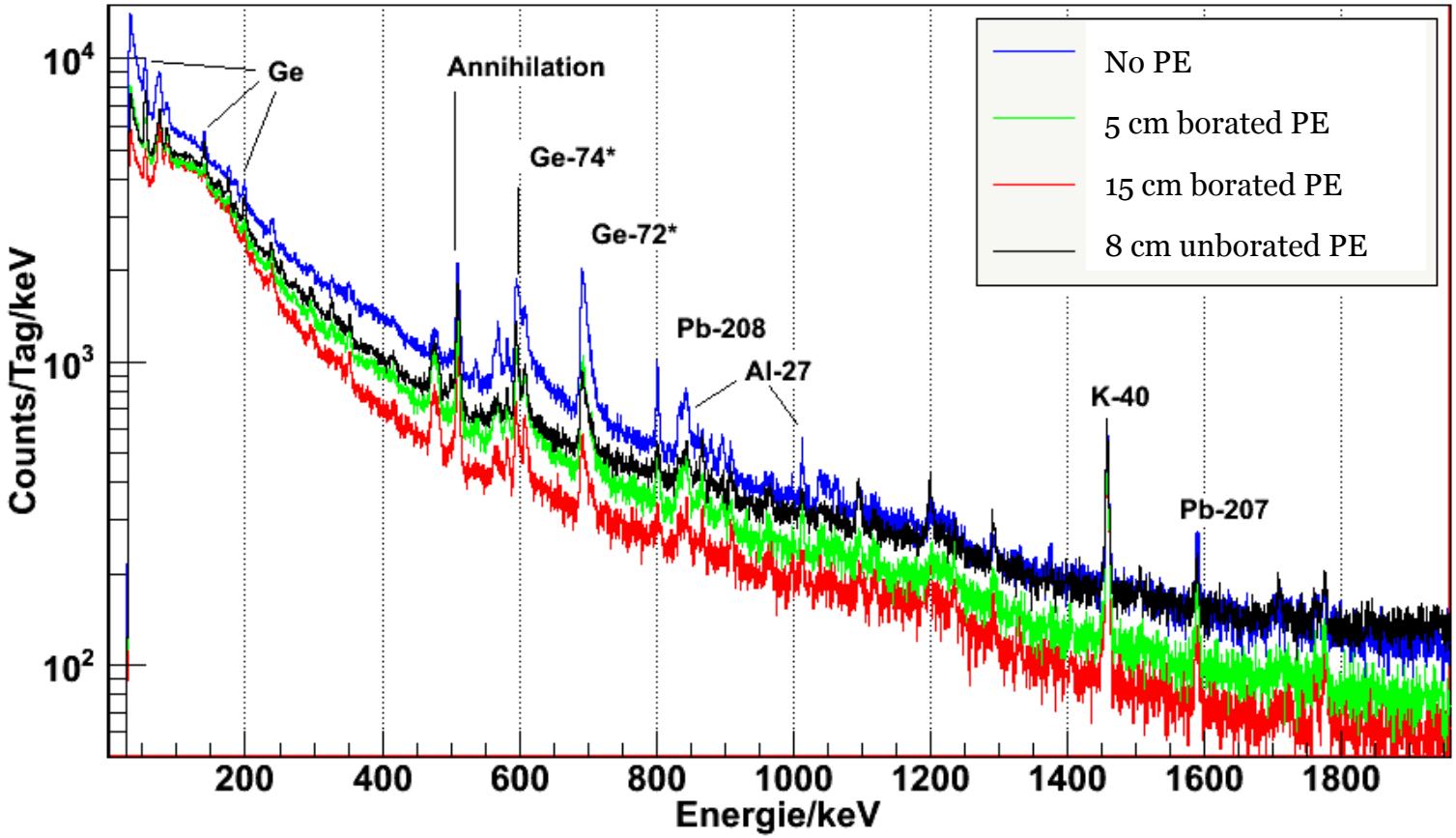
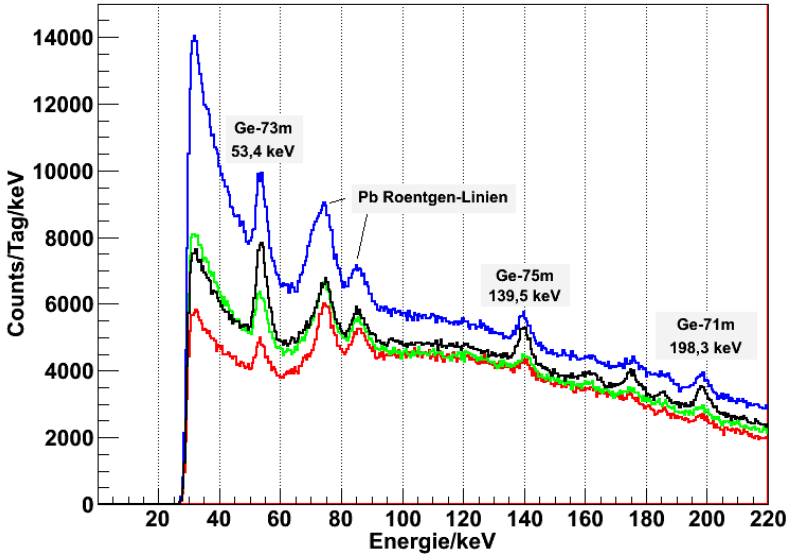


2. Experiments

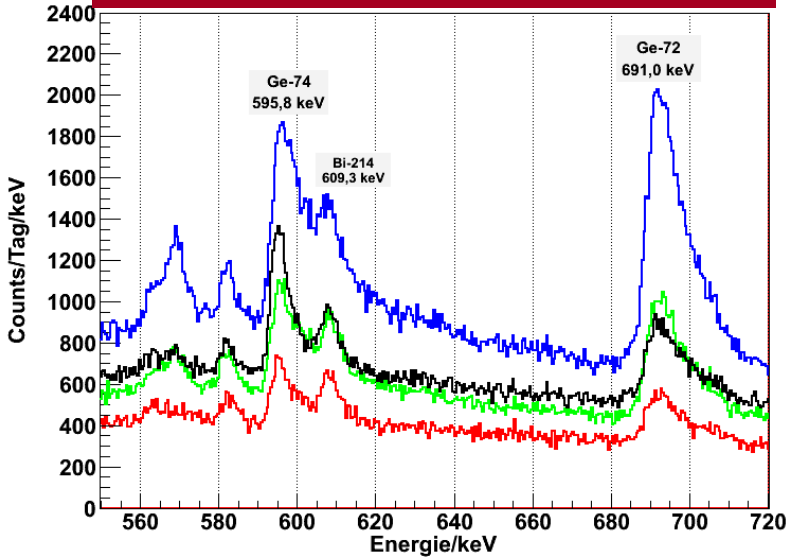
2.1 Investigation of Neutron Flux Reduction by Borated PE

Ge(n,γ) capture reactions



mostly induced by thermal neutrons

Ge(n,n') scattering reactions

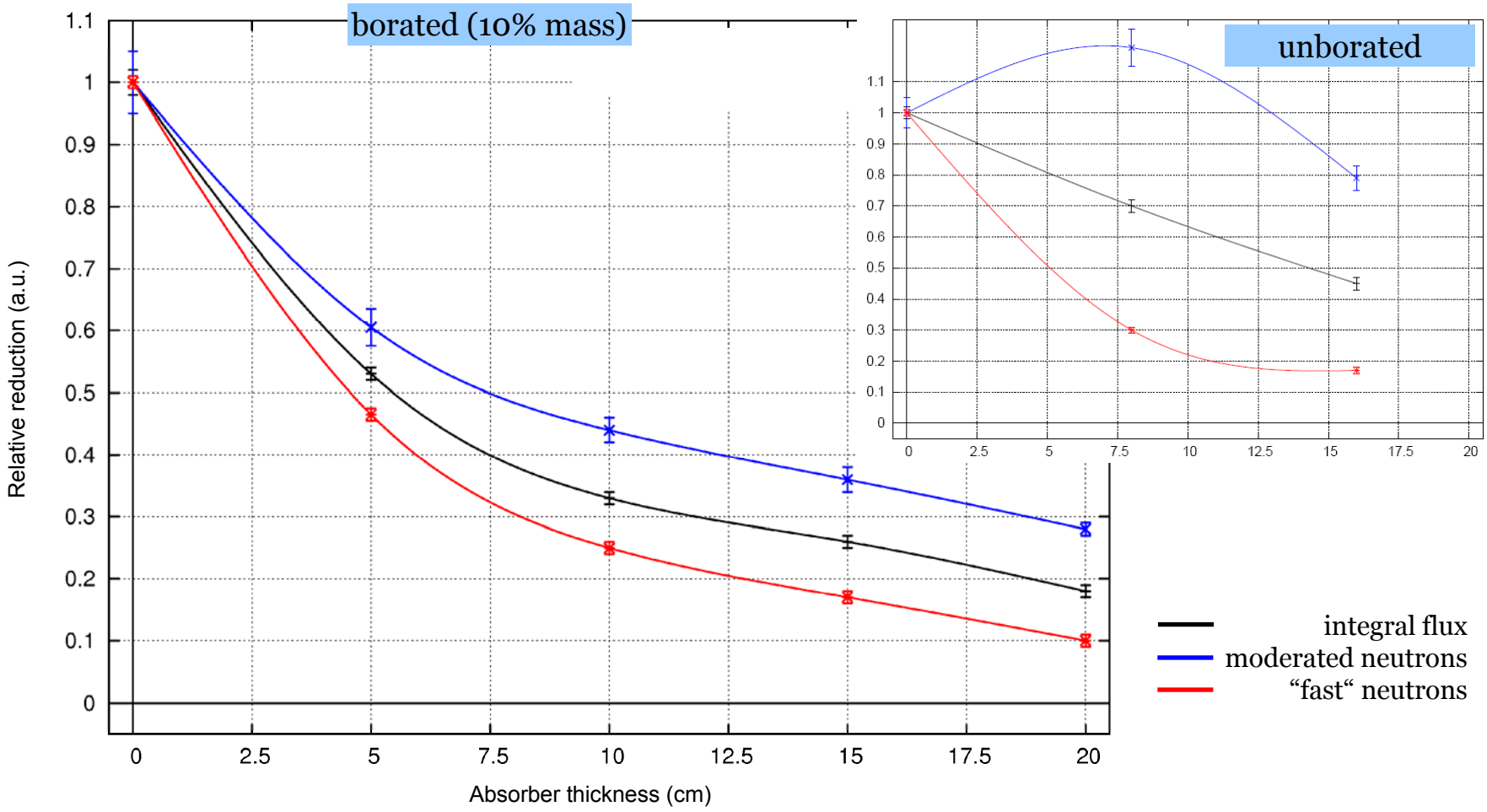


mostly induced by fast neutrons

- No PE
- 5 cm borated PE
- 15 cm borated PE
- 8 cm unborated PE

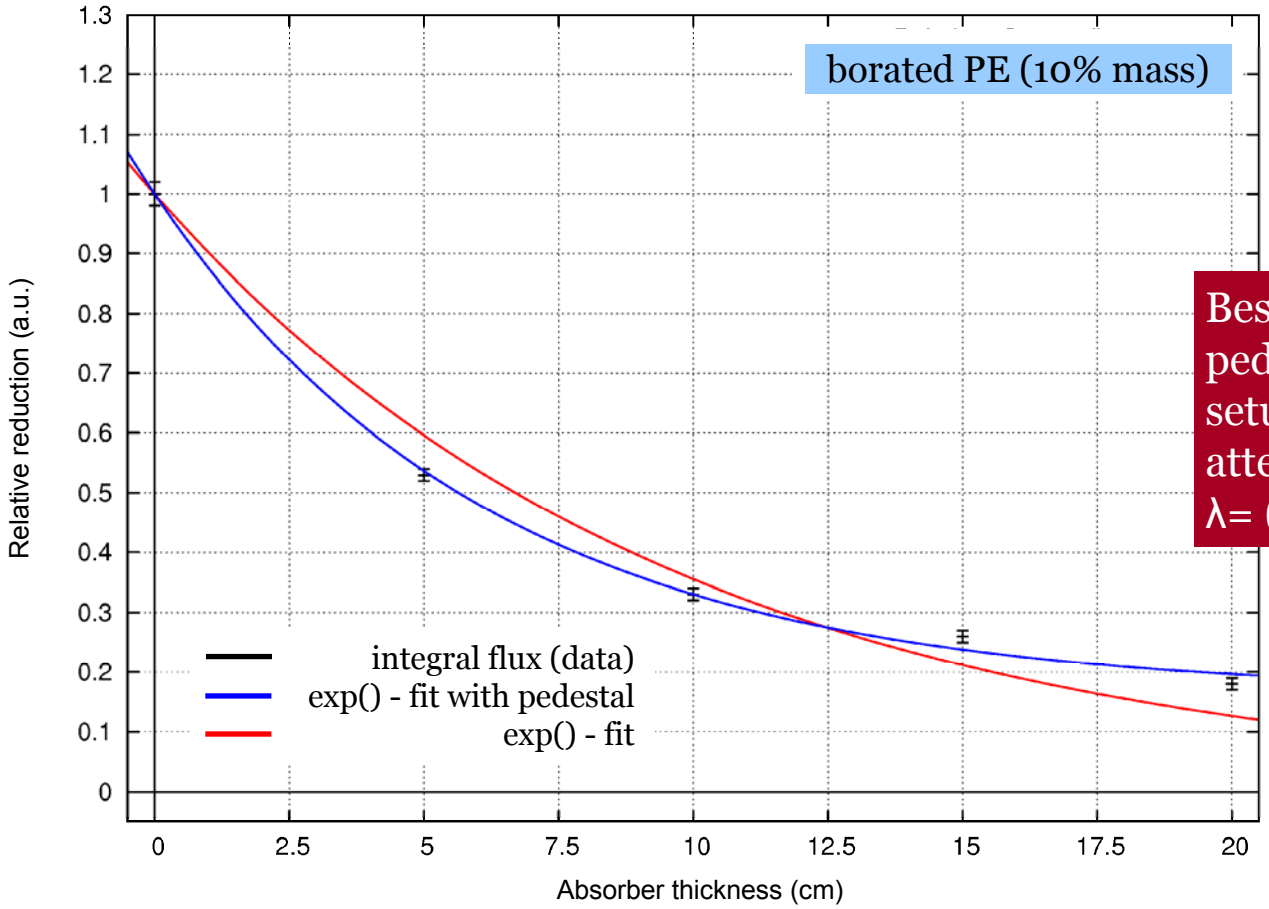
2. Experiments

2.1 Investigation of Neutron Flux Reduction by Borated PE



2. Experiments

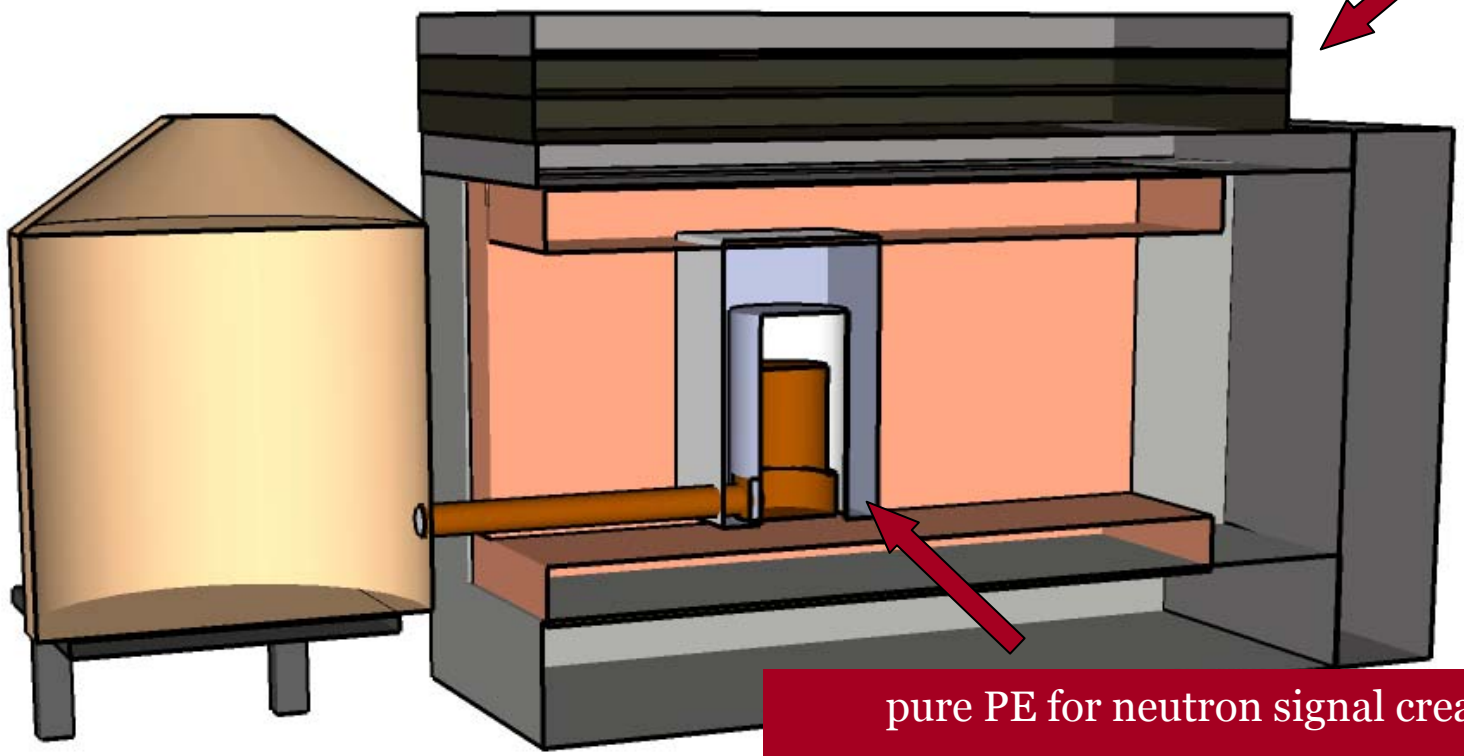
2.1 Investigation of Neutron Flux Reduction by Borated PE



Best fit with correction for pedestal due to experimental setup yields mean attenuation length of
$\lambda = (6.2 \pm 0.6)$ cm

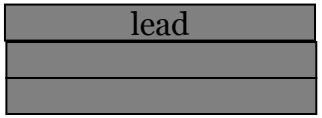
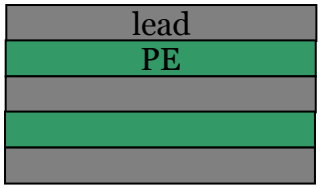
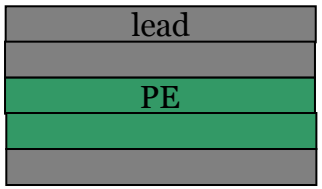
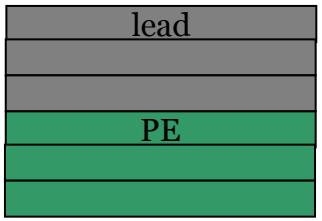
2. Experiments

2.2 Current Test Stand for PE/Lead Configurations



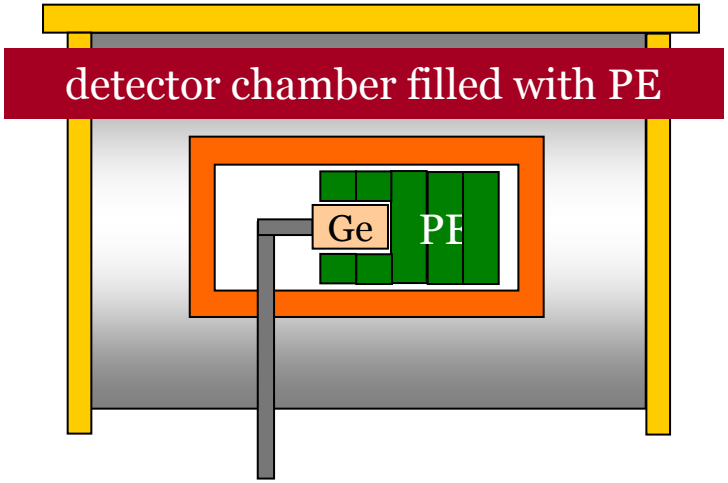
2. Experiments

2.2 Current Test Stand for PE/Lead Configurations

Sequence on top	Peak Area at 2223 keV (counts/day)	Ratio (%)
	90±6	100
	68±4	76
	67±4	74
	69±3	77

2. Experiments

2.3 Radio-Purity



Activity (mB/kg)	Pure PE	5% B-PE	10% B-PE	B_2O_3
Ra-226	< 4	130 ± 3	53 ± 3	573 ± 18
Th-228	< 203	12 ± 2	9 ± 2	50 ± 9
K-40	< 17	22 ± 7	33 ± 8	70 ± 32

about 7 cm of inner copper layer needed for sufficient gamma suppression

3. Conclusions

3.1 The Giove Design

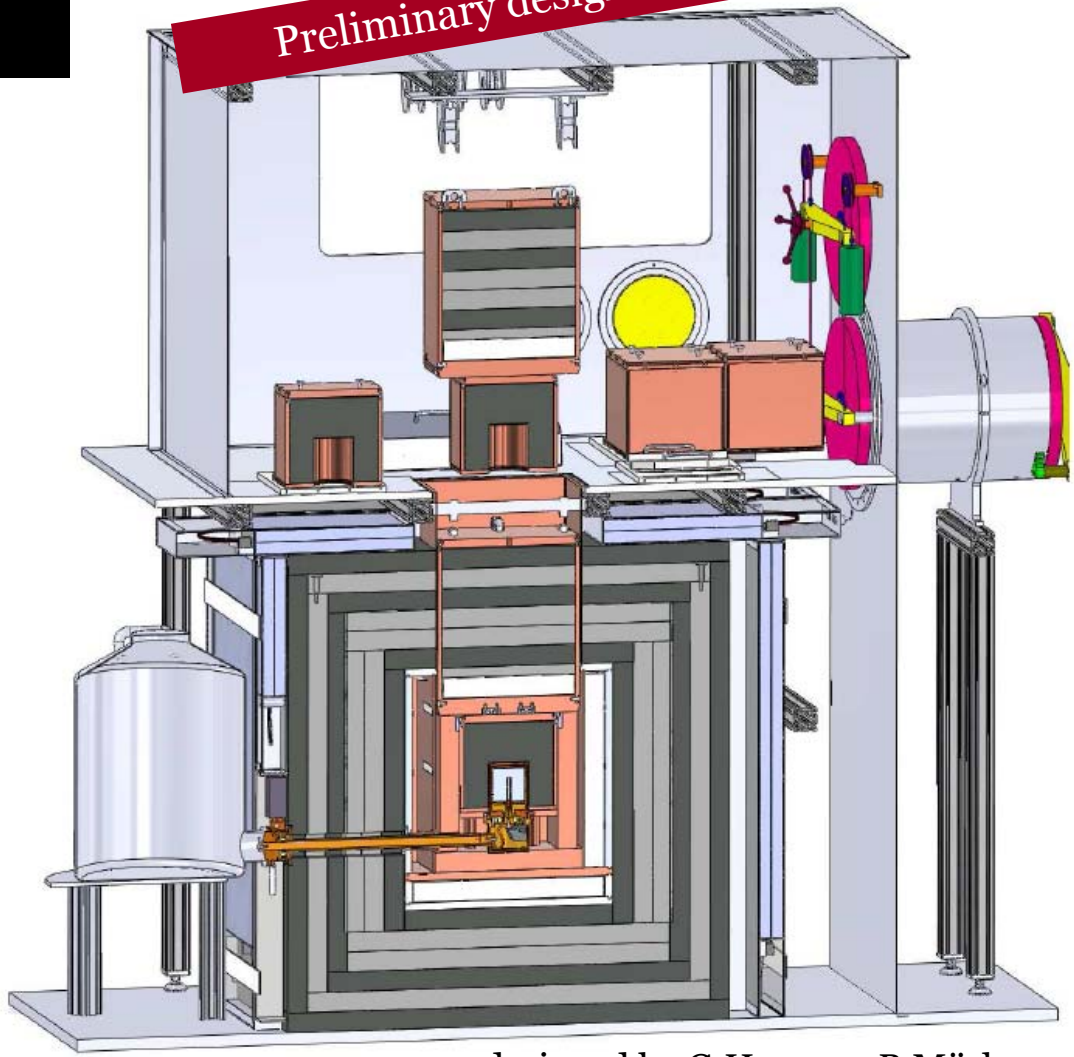
GeMPI-oriented construction

plus

Inner and outer veto system
Use of plastic scintillators

Borated polyethylene as a neutron shield

Preliminary design study!



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