A new Germanium-spectrometer for material screening

Werner Maneschg, MPI for Nuclear Physics, Heidelberg

- **Collaboration meeting**

Universitá degli Studi di Milano-Bicocca

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Ge-detectors at MPI for Nuclear Physics

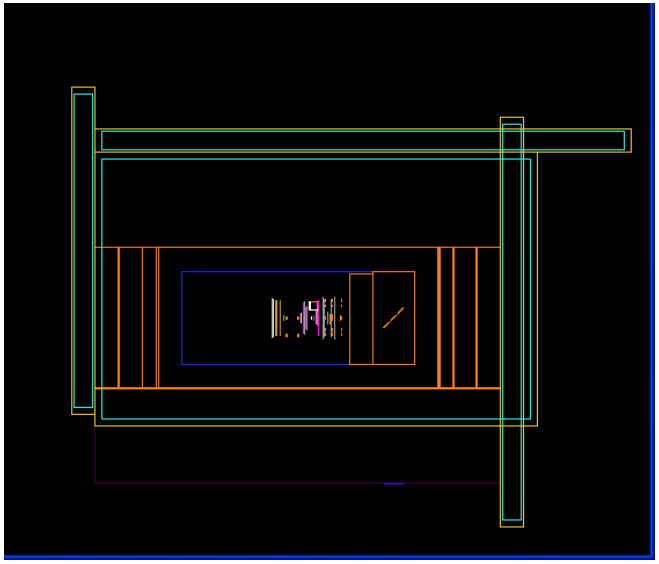
(see also GeMPI at LNGS)				
Detector	Bruno	Dario	Corrado	Adam
Type	Coax p	Coax p	Coax p	Coax well
Crystal size [diam x lenght] [mm^2]	54.5 x 55.7	59.7 x 61	61.5 x 62	47 x 47
Active volume [ccm] **Active mass [kg]**	120 0.63	158 0.83	177 0.93	90 0.47
Relative efficiency	22%	31%	37%	17
FHWM @ 1.332 MeV [keV]	3.1	2.6	2.3 (old estim.)	1.9 (old estim.)
Max. sample-volume [dm^3]	0.85 (max. 1.16 without lead-brick)	11.05 (e.g. steel: up to 80kg)	13.46 (e.g steel: up to 100kg)	0.0034
Possible configuration of sample	Cylindrical box („Standard-box“)	„Standardbox“; Marinelli-beaker	„Standardbox“; Marinelli-beaker	Only small samples
Operating status	Operational	Operational	Ready in few weeks	2007
Manufacturing year	Canberra/91	PGT/85	PGT/90 Canberra	DSG/96

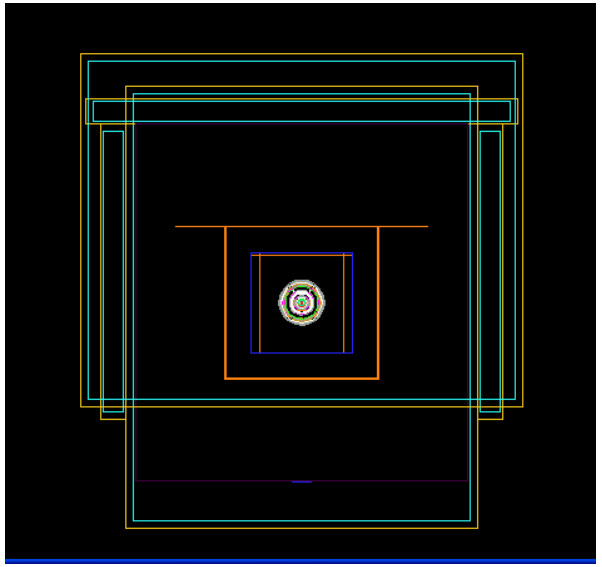
Improvement of sensitivity: background-reduction

Detector sensitivity: strictly connected with background reduction
Background reduction implies special requirements to the set-up/construction of the shielding systems

LLL at MPIK: mean shielding depth of about 15 m w.e. (soil, rock and concrete)

Main contributions to the background spectrum of Ge-detectors
1. Enviromental gamma radiation and radioactivity inside construction materials
2. Cosmic rays (shallow depths)
3. Airborne contamination



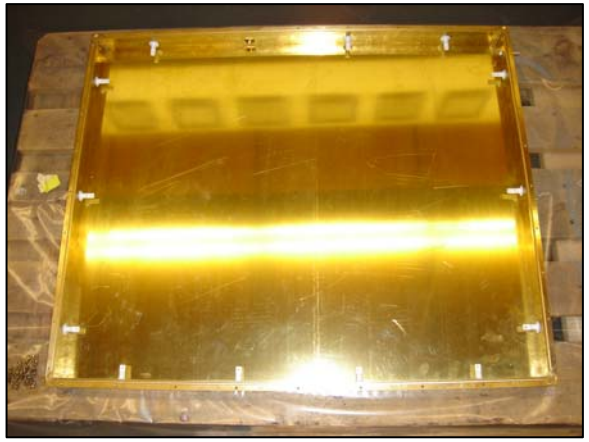


Building up the detector-chamber

<u>Passive shield:</u>
-4tons of lead
-300kg of ultrapure copper

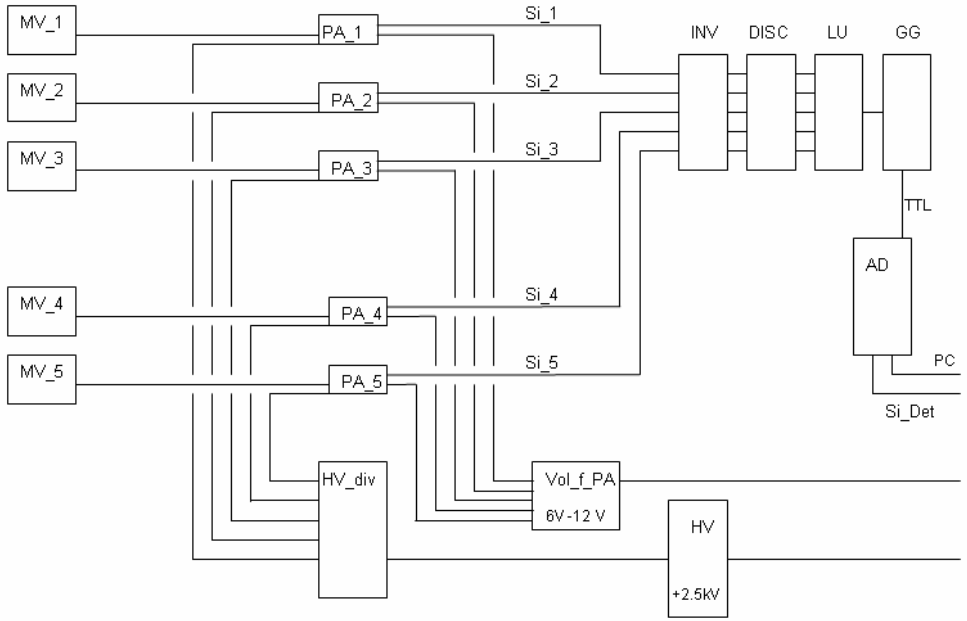
<u>N_2 flushing system:</u>
permanent flushing of the detector chamber at slight overpressure (boil-off N_2)

Background-reduction through muon vetoing

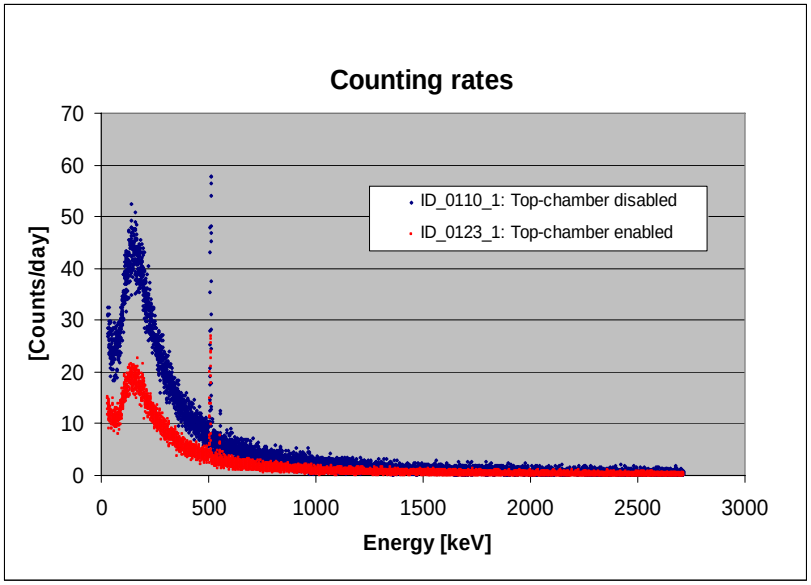


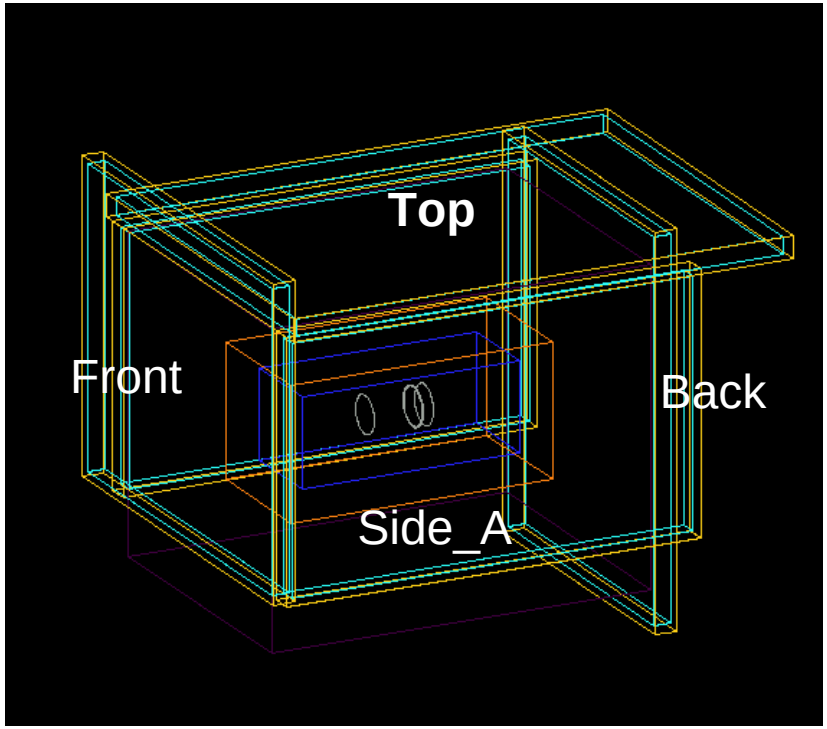
Muon-vetos:
-Multiwire-proportional chambers:
Potential applied to the anode wires: ca. +2.5kV; cathode planes grounded
-Anode wires : tungsten-gold; diameter: 50 µm
-Prop.gas used: P10 (90% Argon, 10% Methane)

Electronics assembly for the muon-veto system



Background spectrum: With and without **top**-chamber





Without Top-ch.*: ICR [(40-2700) keV]= **45115 cpd**

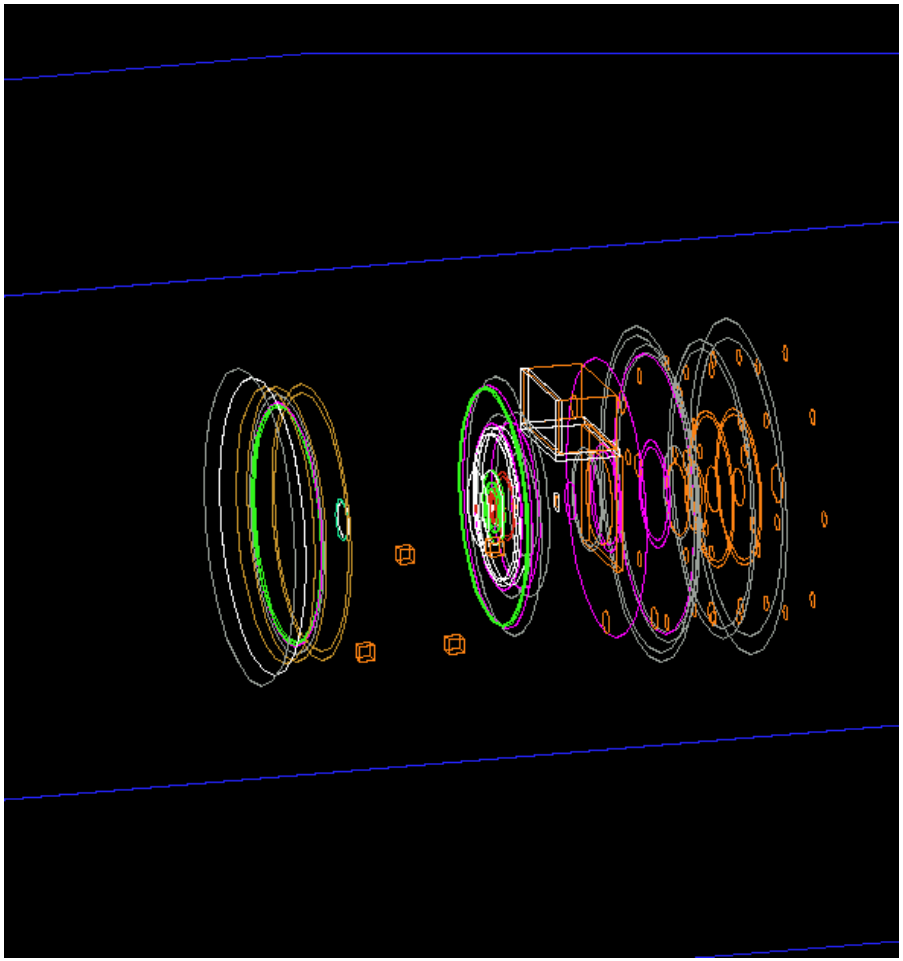
-55%

With Top-ch.*: ICR [(40-2700) keV]= **19929 cpd**

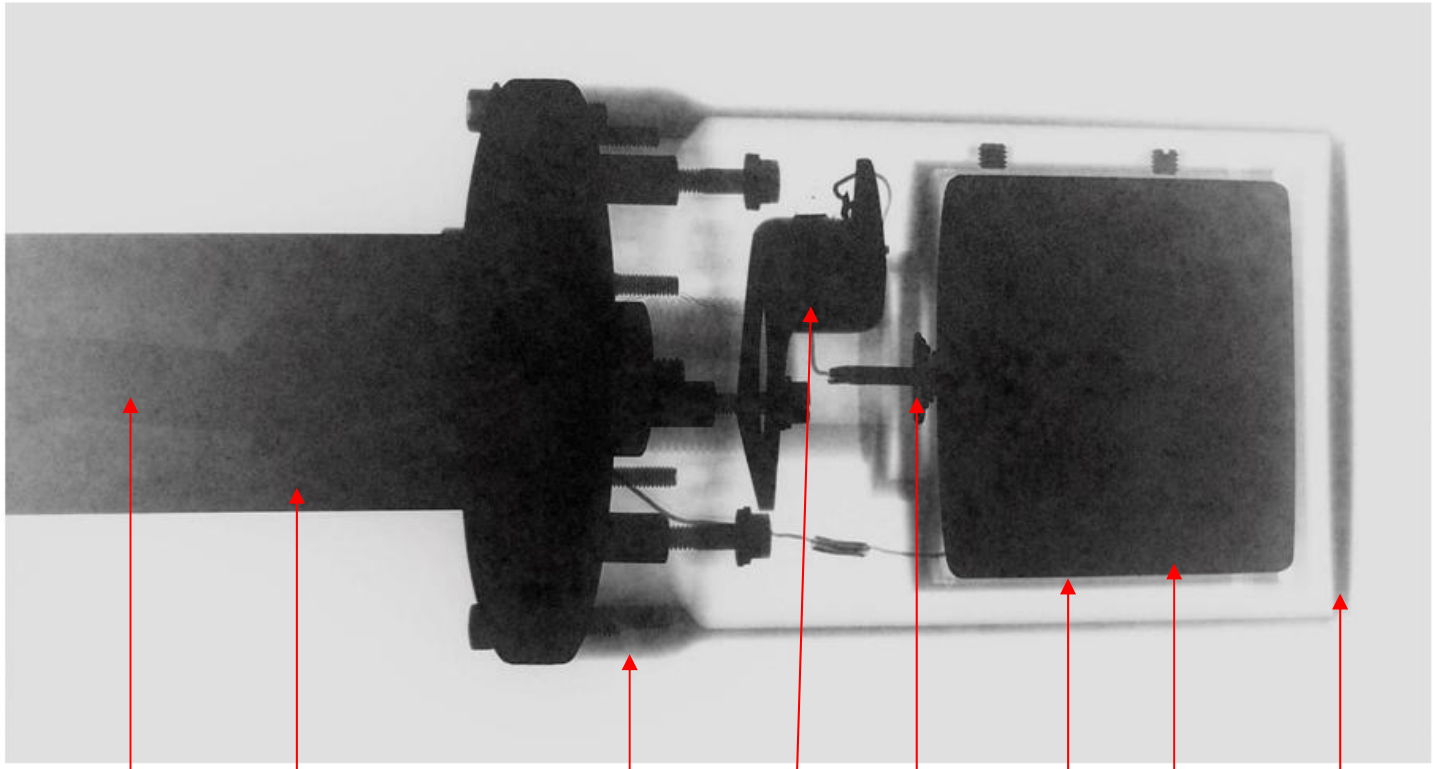
Expected reduction for full operational system: -90%

** Energy-range and unit according to CELLAR-proposal*

MC-Simulation of Corrado



Tools for the exact estimation of the geometry

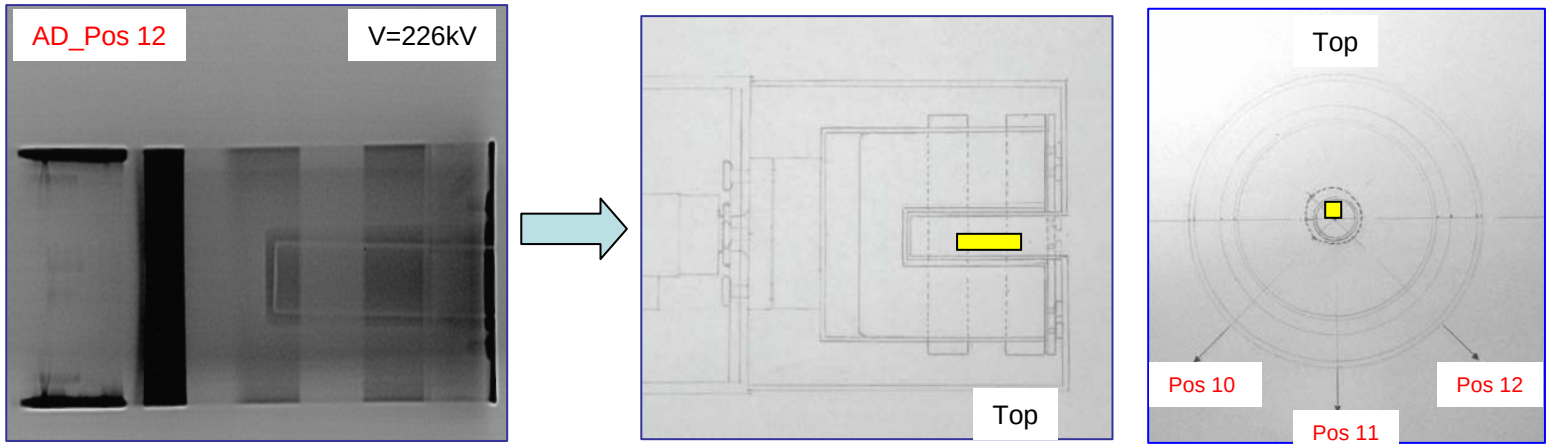


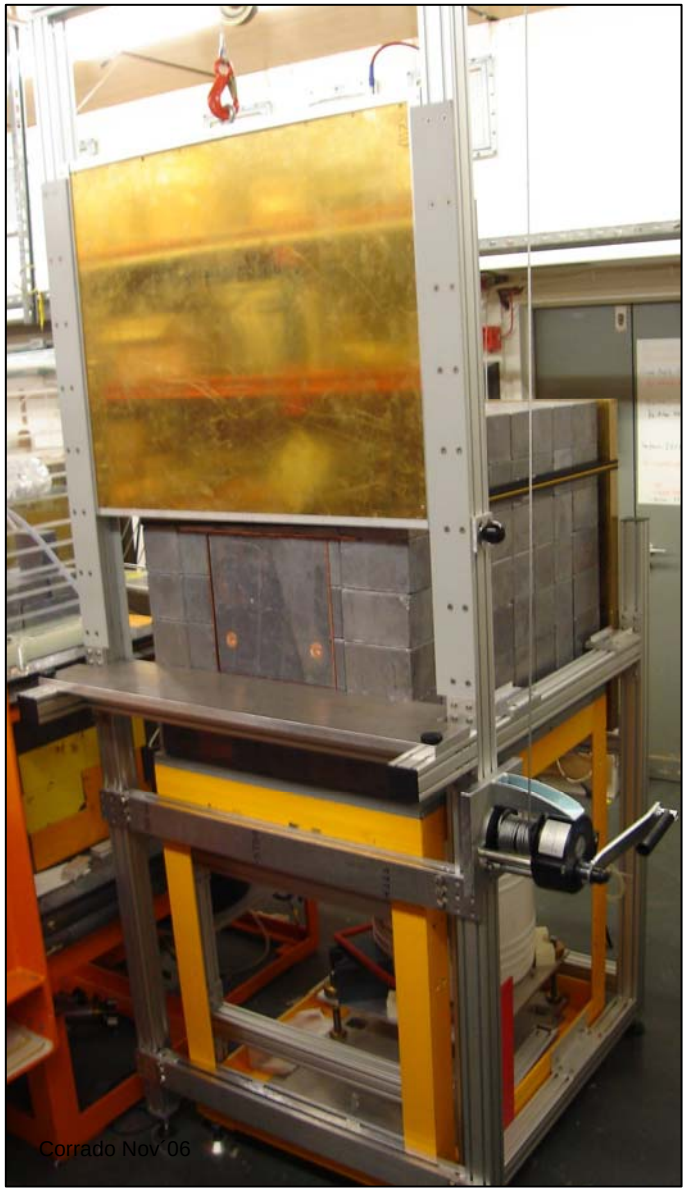
X-ray imaging: advantages and typical cases

- Voltages used for x-ray imaging: 40-230 kV

- Comparison of the sizes provided by the manufacturer with real sizes;
  NOTE: x-ray images are only complementary to producer´s drafts
  REASON: x-ray images -representing the „shadow“ of the detector-
  contains distortions; reconstruction to real sizes: error up to $\Delta q_i = \pm 1mm$

- Reporting some cases:
  #1: - missing parts: front vespel, FET
  - determination of used materials (high or low densities)
  #2: - displacement of the crystal with respect to the detector
  housing; example: coax-well detector





Status (15.11.06)

- Steel-structure and passive shielding (lead and copper) integrating a N_2-flushing system: **done**

- Building of 5 muon-chambers (Multi-Wire-chambers): **completed**

-Testing of the muon chambers (tightness, estimation of thresholds and ideal operational voltage): almost done

-Mounting of muon chambers: will be finished **next week**

-Providing of the complete electronics for all chambers: **ready in 1 month**

-Characterisation of the detector (background spectrum…) already started

-Detector operational: **beginning of 2007**

Summary & Outlook

- Beside Dario a second new detector with comparable chamber-volume will be operational at the beginning of 2007
  ⇒ Doubling our screening capacity

- Spring 2007: renovation of our LLL;
  screening will be interrupted for a short period

- I. Validation of the MC-code: for the first time the geometry of the detector is well known; x-ray imaging as inspection-tool

- II. Validation of the MC-code with standards of higher density; a copper-standard in „standard-geometry“ with a relative density of 4 g/ccm is now available.

- GeMPI III at LNGS: under construction