Co60 Background in Phase I

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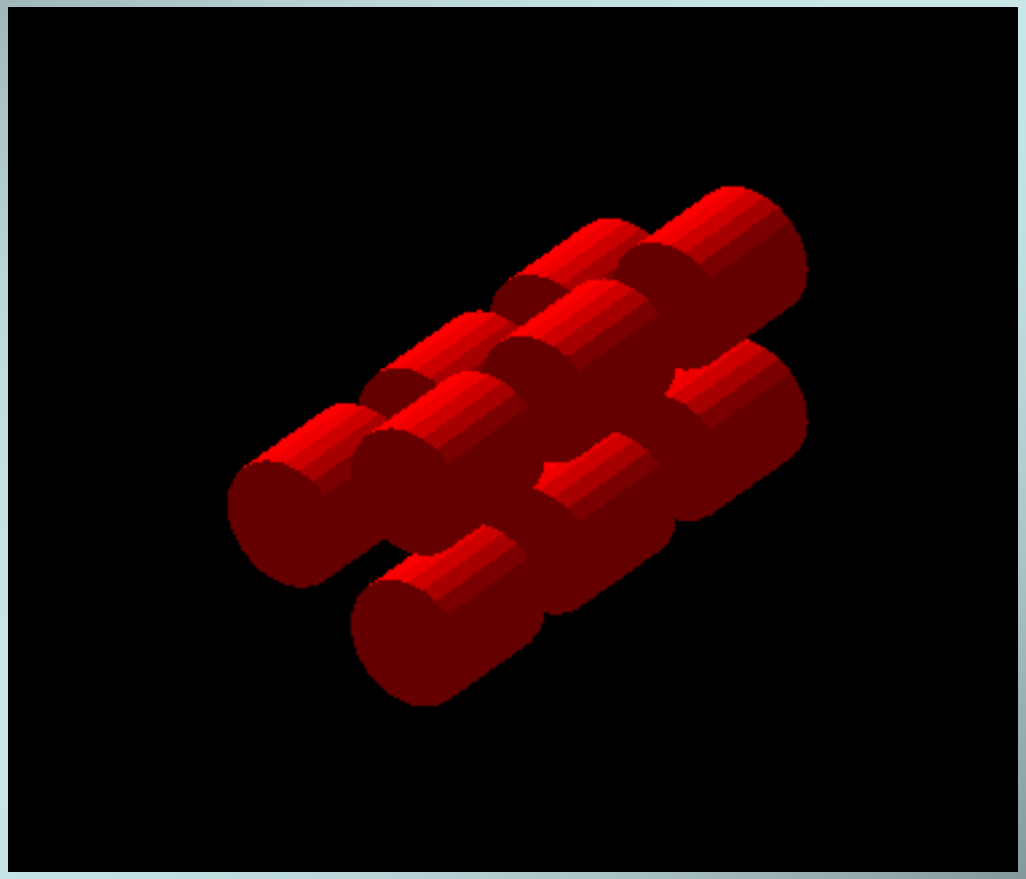
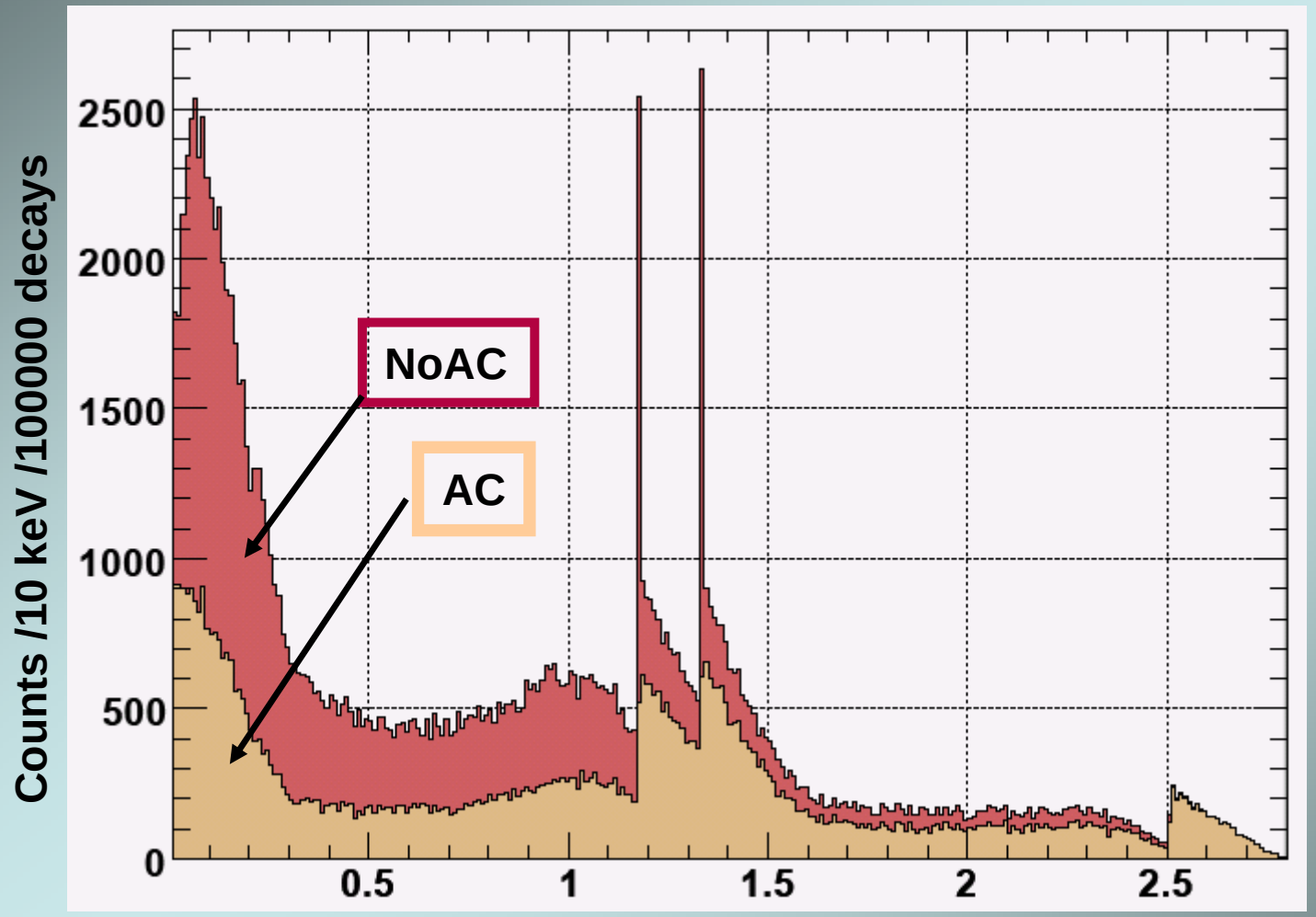
Heidelberg, February 2006.

Simulated configuration

(MaGe, Phase I)



Co60 (average detector)



For HD-M detectors Ge68 contribution is negligible

SP*, x10-3

Table 1. Average Detector

Nuclide	No AC	With AC	$\frac{NoAC}{AC}$
Co60	1.61	1.05	**1.53**
Ge68	2.32	1.88	**1.23**

*SP – Survival Probability – fraction of events with energy deposited in 10 keV window around 2039 keV.

SP*, x10^{-3}

Table 1. Average Detector

Nuclide	No AC	With AC	$\frac{NoAC}{AC}$
Co60	1.61	1.05	**1.53**
Ge68	2.32	1.88	**1.23**

Table 2. Detectors with different placement

Nuclide	Side detector		$\frac{NoAC}{AC}$	Middle detector		$\frac{NoAC}{AC}$
	No AC	With AC		No AC	With AC	
Co60	1.57	1.08	**1.45**	1.71	0.99	**1.73**
Ge68	2.34	1.98	**1.18**	2.28	1.69	**1.35**

*SP – Survival Probability – fraction of events with energy deposited in 10 keV window around 2039 keV.

SP*, x10^{-3}

Table 1. Average Detector

Nuclide	No AC	With AC	$\frac{NoAC}{AC}$
Co60	1.61 (1.58)	1.05 (0.75)	**1.53 (2.11)**
Ge68	2.32 (2.48)	1.88 (1.65)	**1.23 (1.50)**

(…) – case of zero distances between detectors

Table 2. Detectors with different placement

Nuclide	Side detector		$\frac{NoAC}{AC}$	Middle detector		$\frac{NoAC}{AC}$
	No AC	With AC		No AC	With AC	
Co60	1.57 (1.58)	1.08 (0.82)	**1.45 (1.93)**	1.71 (1.58)	0.99 (0.60)	**1.73 (2.63)**
Ge68	2.34 (2.52)	1.98 (1.72)	**1.18 (1.47)**	2.28 (2.39)	1.69 (1.50)	**1.35 (1.59)**

Production rate of Co60 and Ge68. Comparison of the SHIELD and other codes

(See Cebrian TAUB05)

In natural Ge ($kg^{-1}\ d^{-1}$)

	HMS-ALICE +YIELDX	GENIUS	Miley'92	SHIELD	Avignone'92 (MC)	Avignone'92 (exp)
^{68}Ge	77+12=89	58.4	26.5	81	29.6	30±7
^{60}Co	0.3+4.5=4.8	6.6	4.8	2.9		
^{65}Zn	36+41=77	79.0	30.0		34.4	38±6

We use SHIELD results for enriched Ge:
Ge68 rate: 5.6 ncl/kg/d
And for *conservative estimation* 2*"SHIELD results for Co60":
Co60 rate: 2*3.3 ncl/kg/d = 6.6 ncl/kg/d

Table 3. **History of the detectors**

	№	Mass, kg	Initial Activation*	Underground storage time, y		
HD-M	1	0.980	0.5 year	16		
	2	2.906		15		
	3	2.446		14		
	4	2.400		12		
	5	2.781		12		
IGEX				Storage time, y	Activation (Nov 2005)	Storage time, y
	6	2.2		12	1 day	0.25
	7	2.2		11	1 day	0.25
	8	2.2		10	1 day	0.25

* I.V. Kirpichnikov, private communication.

Results of the calculations.

Table 4. Co60 data

Det. Type	Total Mass, kg	Average ncl/kg	Final Average Detector				
			Mass, kg	Pr. rate, ncl/d/kg	Average ncl/kg	Decays, 1 /y /kg	BI, 10^{-3} cpy/keV/kg
HD-M	11.5	205	18.1	6.6	**231**	**30**	**3.3**
IGEX	6.6	277					

For HD-M detectors Ge68 contribution is negligible

Table 5. Ge68 data

Det. Type	Total Mass, kg	Pr. rate, ncl/d/kg	Average Ncl/kg	Decays, 1 /y /kg	BI, 10^{-3} cpy/keV/kg
IGEX	6.6	5.6	**4.5**	**4.2**	**0.8**

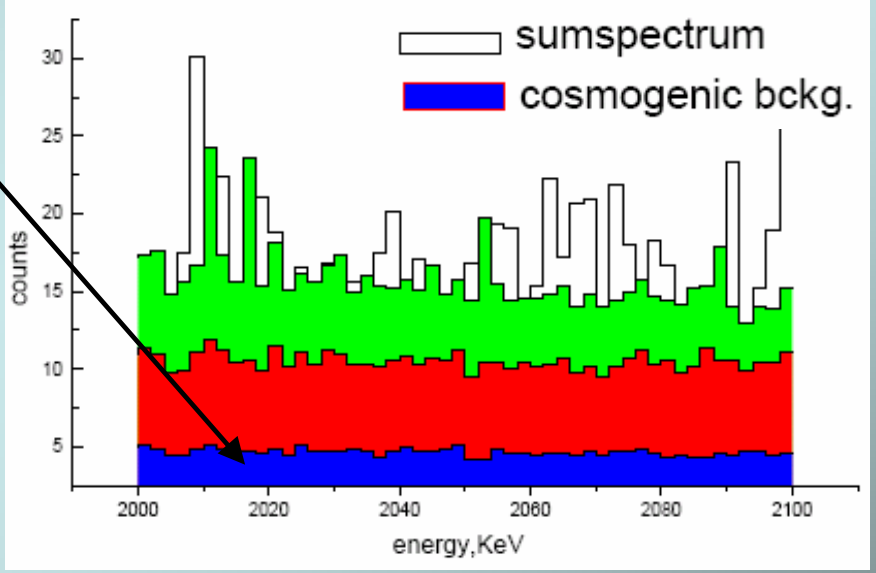
Comparison with HD-M Co60 BI estimation.

S. Zhukov, GERDA Meeting, September 2004

20 – 25 % are due to Co60

BI = 0.12 cpy/keV/kg (Klapdor's data)
⇒Co60 contribution ~ 0.03 cpy/keV/kg
~ 7 years elapsed

⇒**Expected Co60 contribution is**
~ 0.01 cpy/keV/kg, that is
3 times more than our result



Conclusion.

BI(Co60) ~ 0.003 cpy/keV/kg for Phase I.


GERDA
GRAZIE-SPASIBO-THANK YOU-DANKE-GRAZIE

Registration efficiency, %

Element	Side detector		Middle detector	
	No AC	With AC	No AC	With AC
Co60	99,0	65,4	99,2	56,4
Ge68	92,6	62,6	92,7	55,3