

LAr vs. LN₂

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Meeting about new Ge-76 experiment at LNGS, Feb 26-27, 2004

New concept under study: Ge in liquid Ar – new ideas

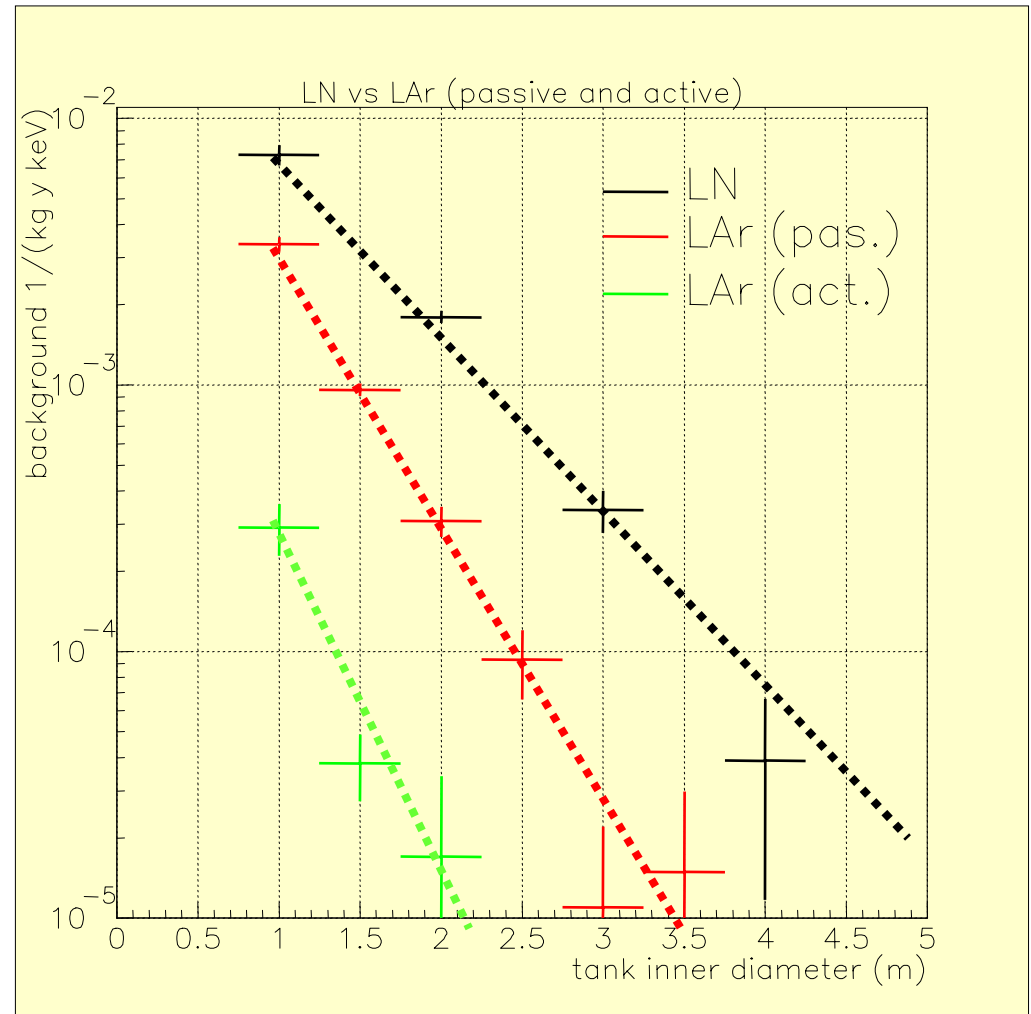
- Replace LN ($\rho_{\text{LN}}=0.8 \text{ g/cm}^3$, 77 K)
by LAr ($\rho_{\text{LAr}}=1.4 \text{ g/cm}^3$, 87 K)

$$\Rightarrow \lambda_{\text{LAr}} / \lambda_{\text{LN}} (2.615 \text{ MeV}) = 0.62$$

- Scintillation yield: 40,000 photons / MeV \Rightarrow **Active shielding medium!**
(4 x organic liquid scintillator) Emission in XUV (~130 nm)
 - Wavelength shifting required : Organic WLS and/or Xe addition
- High potential for suppression of cosmogenic activities: Co-60, Ge-68, ...
- All unidentified sources
- What's about Ar-39, Ar-42, Kr-85 ?

Example: How small could a tank be?

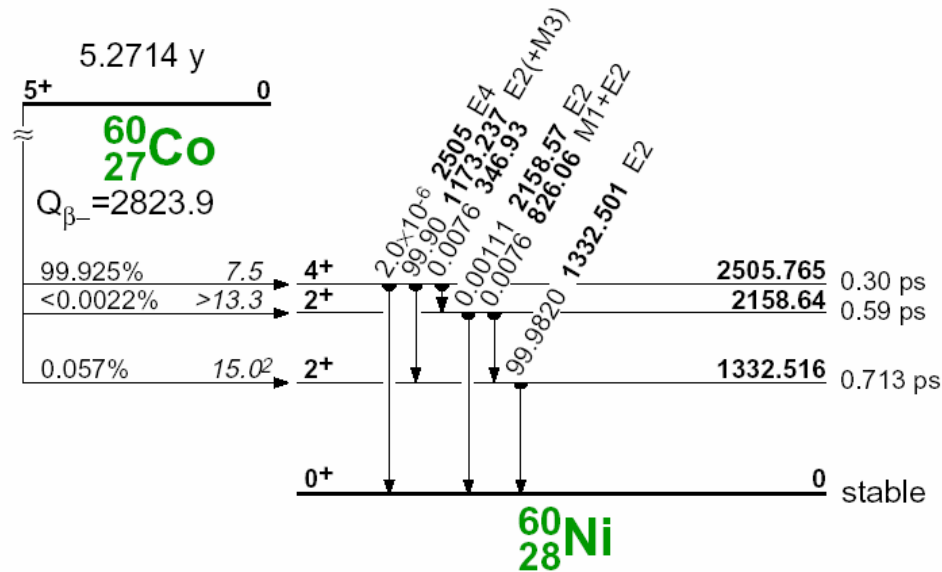
- Lead layer submersed in LAr
- ^{232}Th activity of lead \Rightarrow tank \emptyset
- Preliminary results $\leq 30\mu\text{Bq/kg}$ \Rightarrow



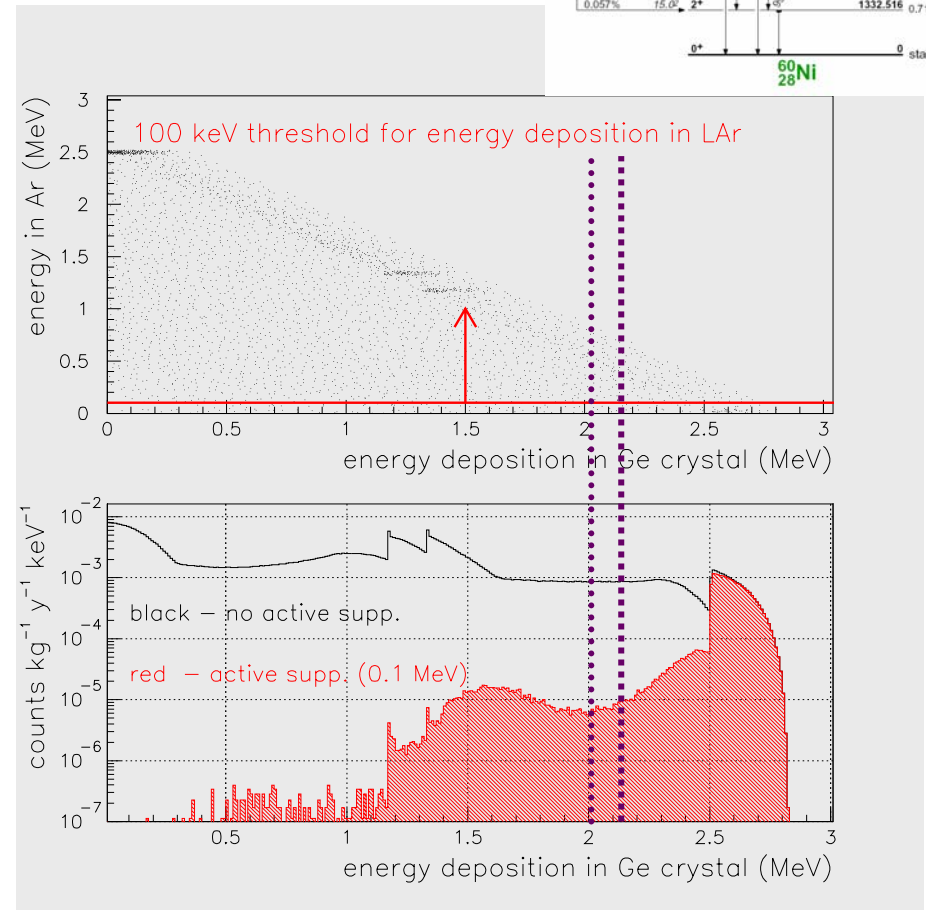
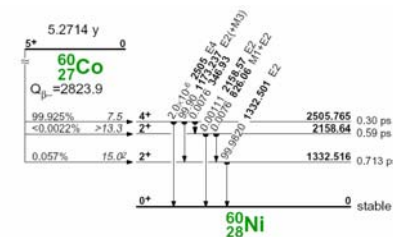
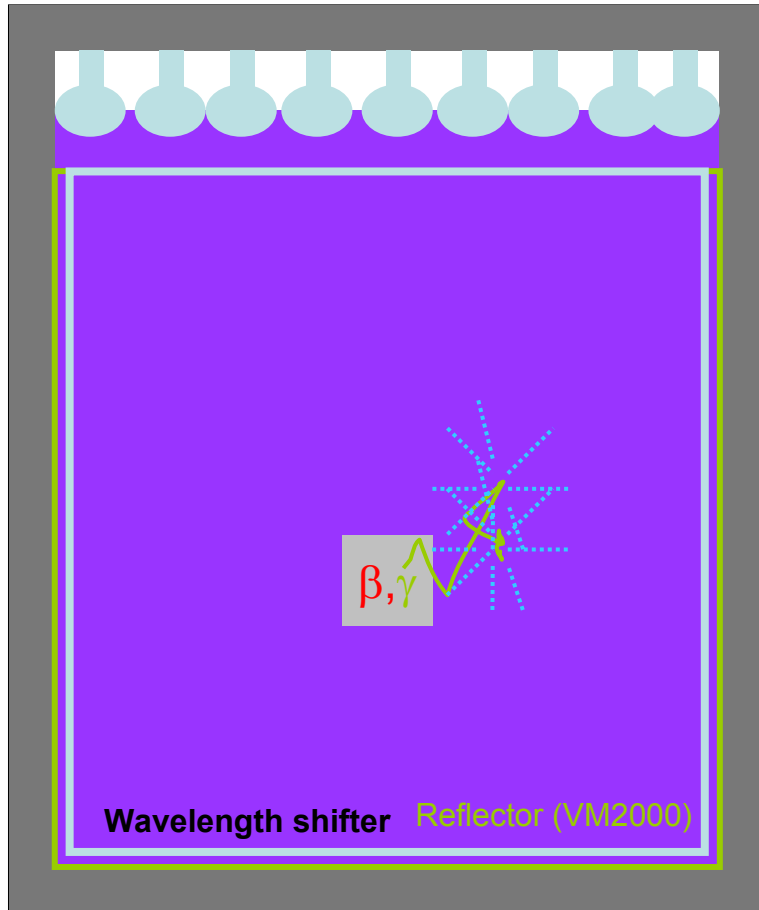
Internal bgd: example ^{60}Co

Cosmogenic activities:

- Production after completion of crystal growth
- Exposure to cosmic rays above ground for 10 days: $0.18 \mu\text{Bq/kg}$ [GENIUS]



^{60}Co : no vs. active suppression

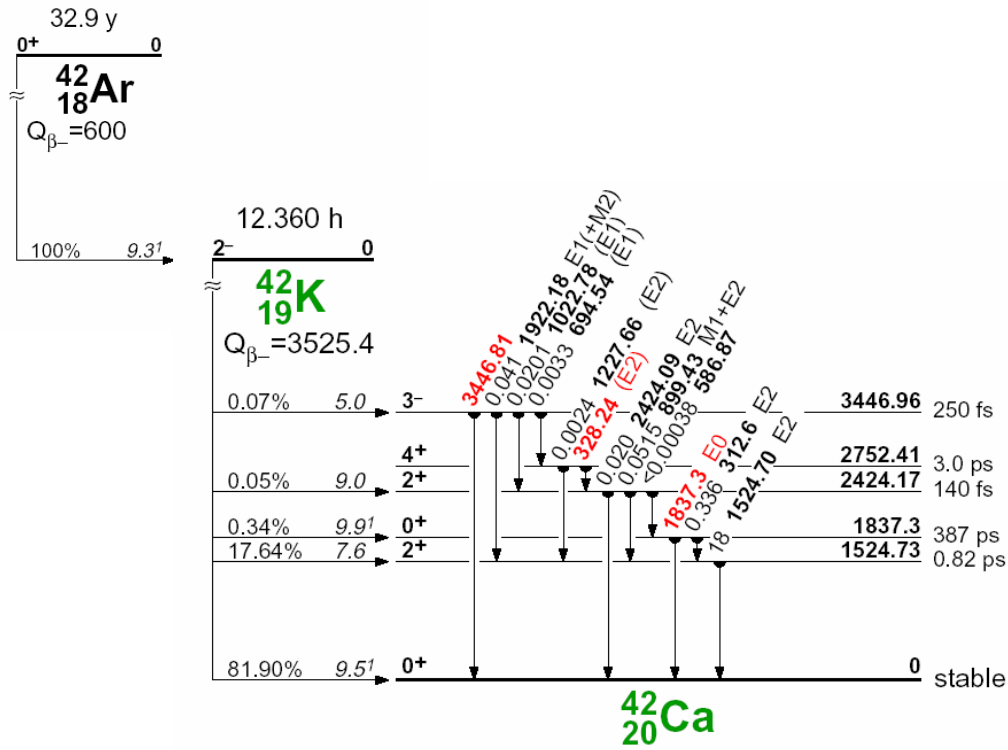


Reduction factor ~ 100

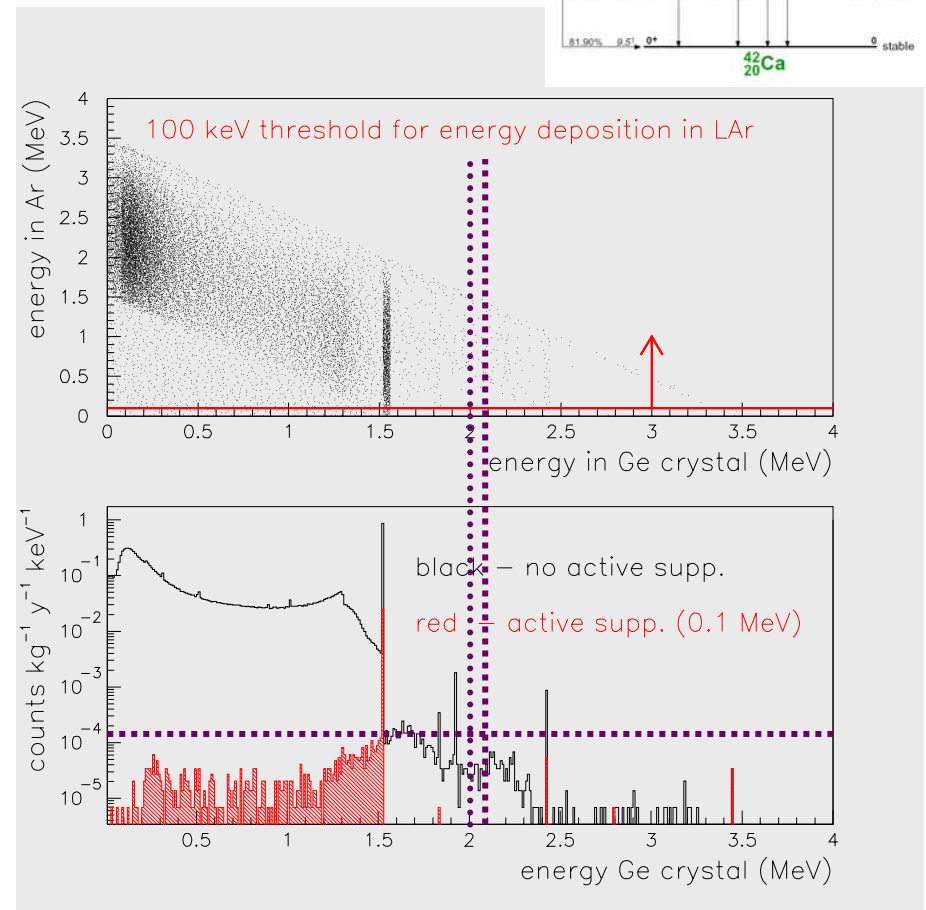
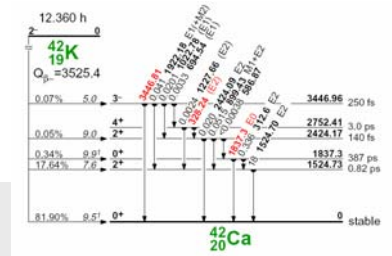
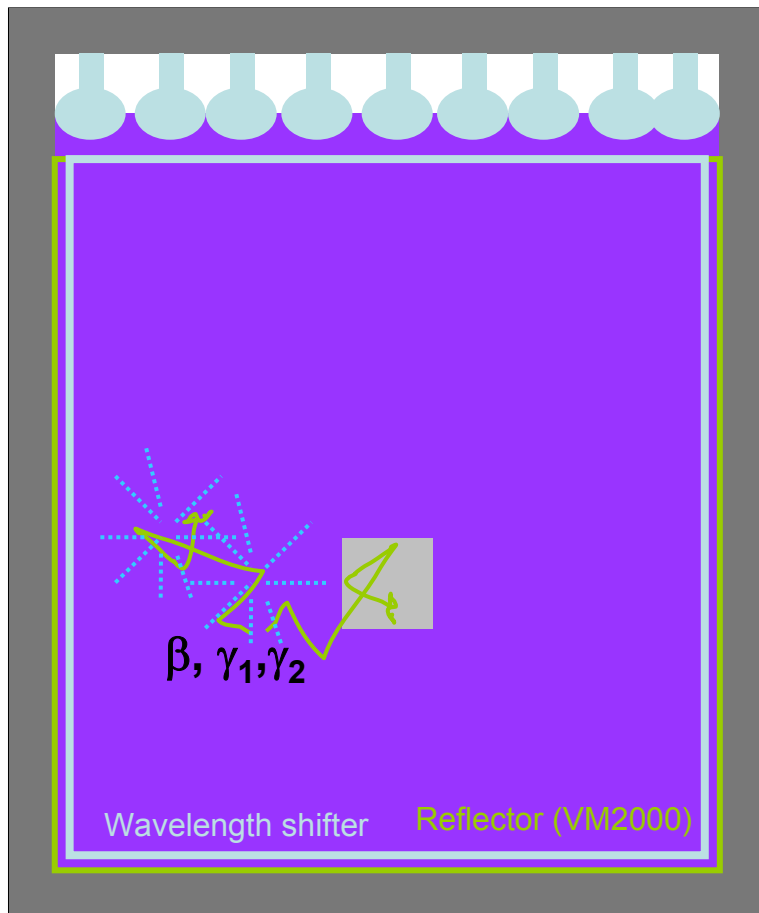
Bgd. in LAr: example ^{42}Ar

$^{42}\text{Ar} / \text{natAr} = 3 \cdot 10^{-21}$ (30 $\mu\text{Bq/kg}$)

[Barabash et al., LAr-TPC @ LNGS]

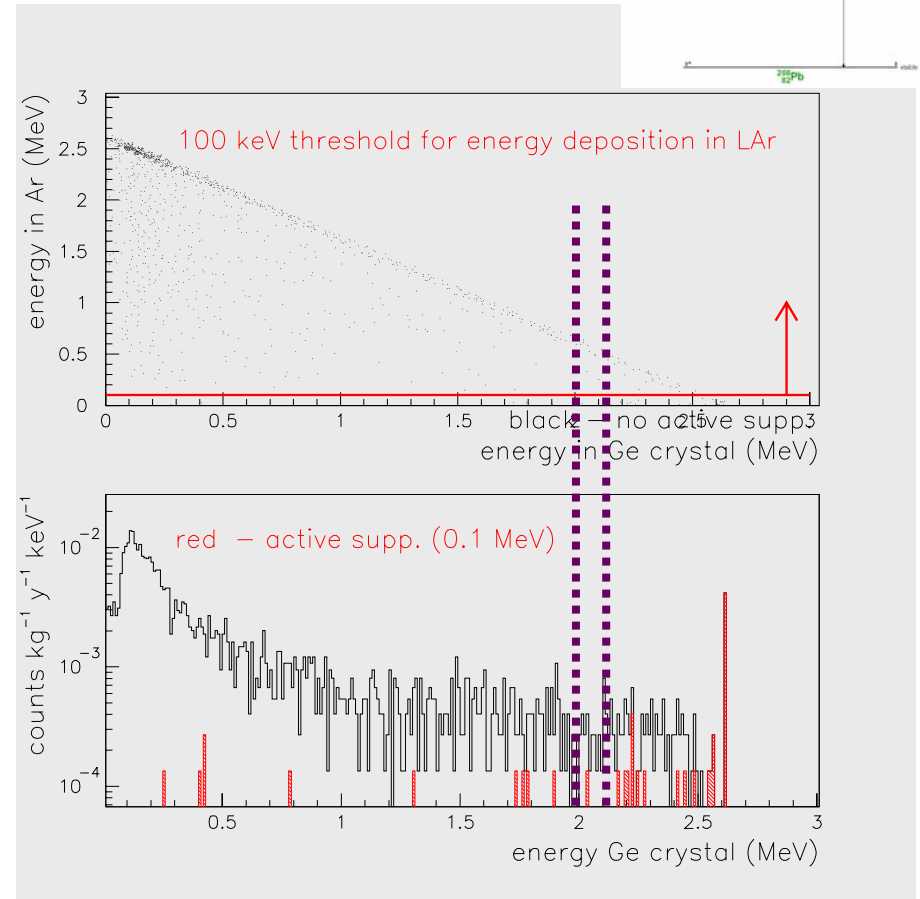
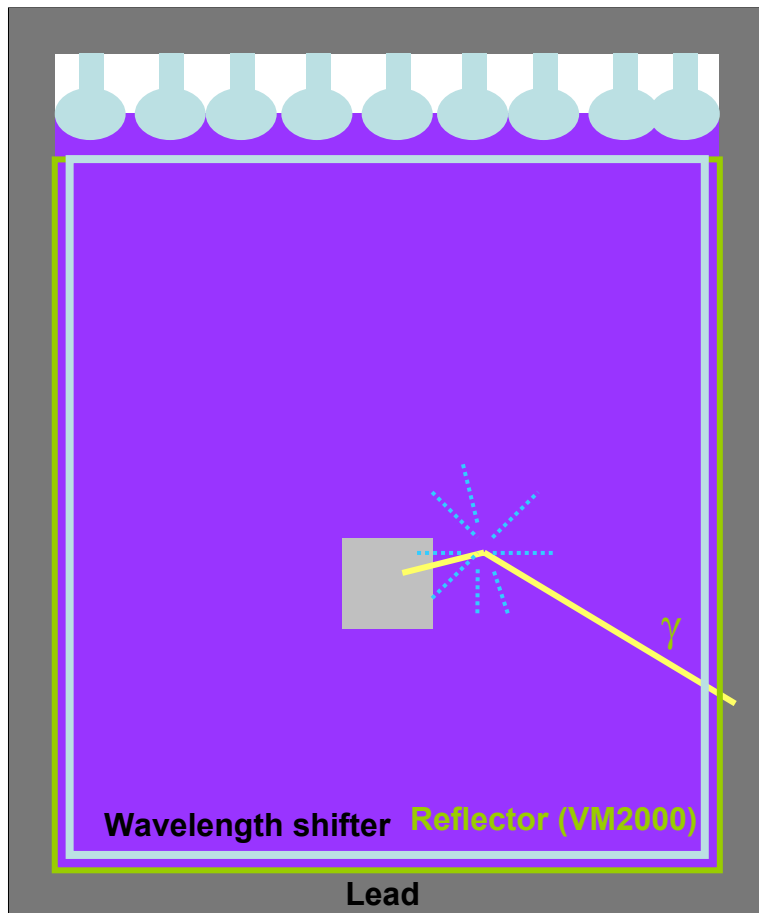
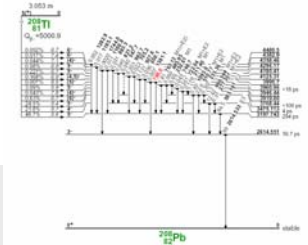


^{42}Ar : no vs. active suppression



No issue for DBD even without active suppression!

^{232}Th (^{208}Tl): no vs. active suppr.

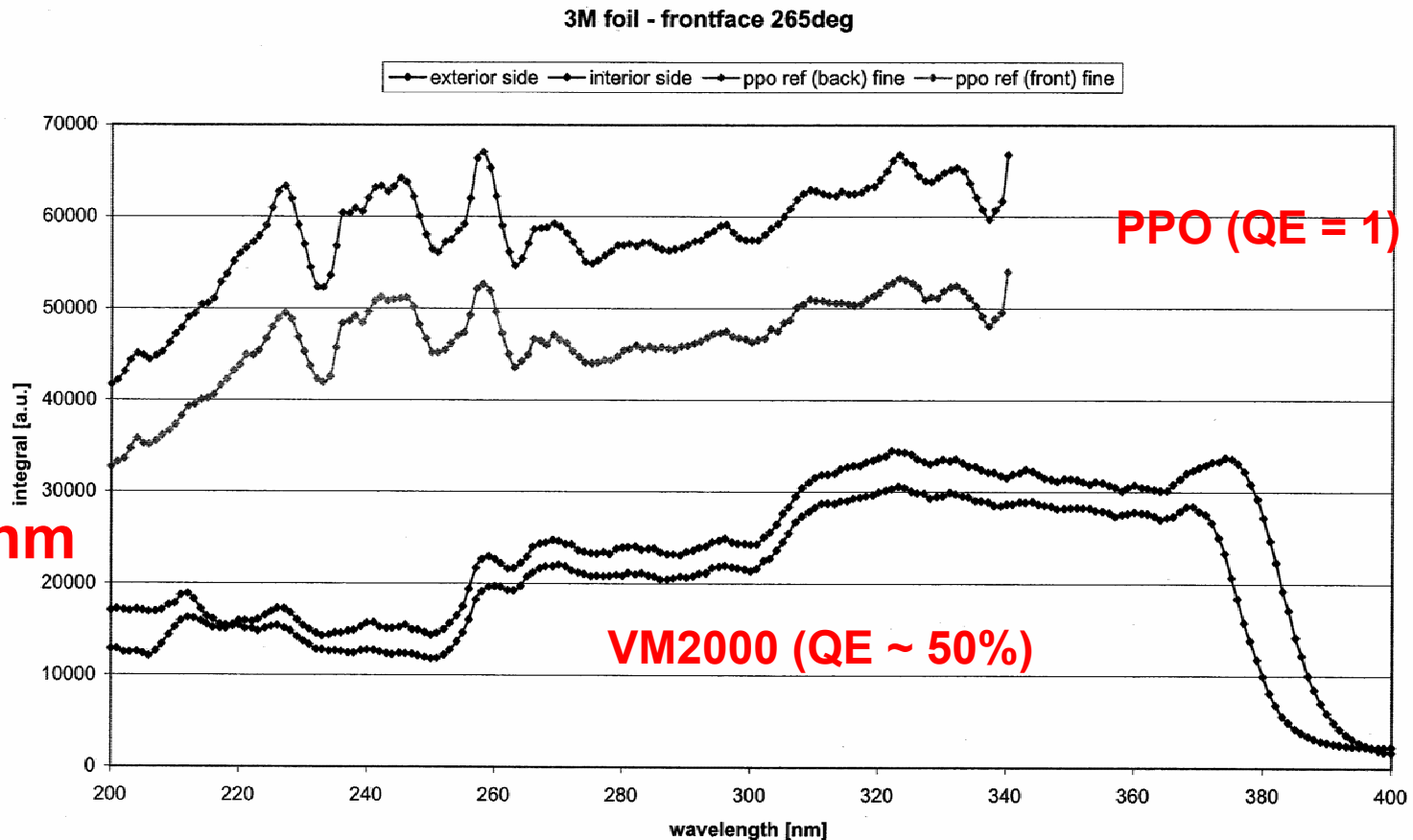


Simulation for $30 \mu\text{Bq/kg}$, inner- \varnothing : 2m, height: 2 m

Challenges of scintillation light readout

- Efficient wavelength shifting of Ar scintillation light => low energy threshold
- Ar-39 background single rate:
1 Bq / kg together with slow component of scintillation (1 micro sec)
=> visible volume << 100 t
- Close packing of diodes to be avoided (shadowing)
- Distance of ultra-low background PMTs from diodes
- Kr-85 => H. Simgen's talk
- Impact on DM study appears minor; further studies needed (simulation of Ar-39 Bremsstrahlung)

Example for reflecting & wave length shifter: VM2000



NEW WLS material: DESY-Zeuthen / MPIK cooperation:

THV-WLS: Transparent foil > 350 nm,
Shifter < 350 nm : QE~80-90%

Prototype ready to go

