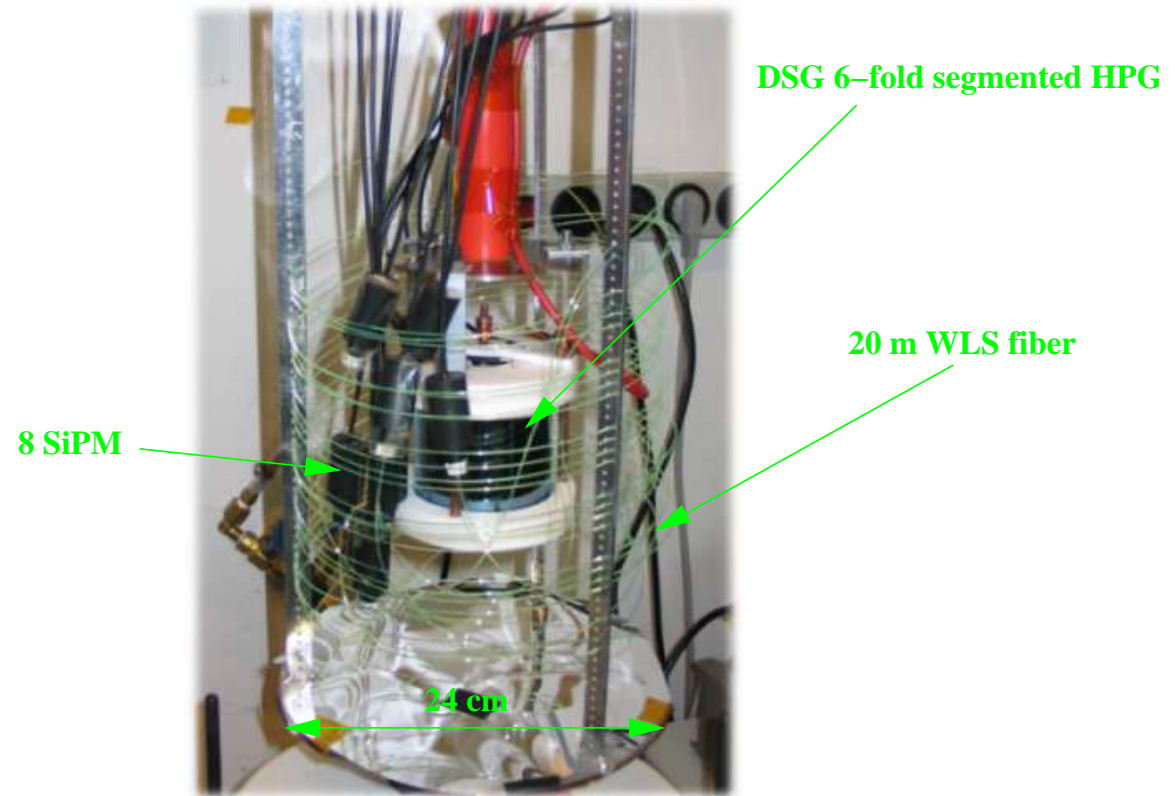
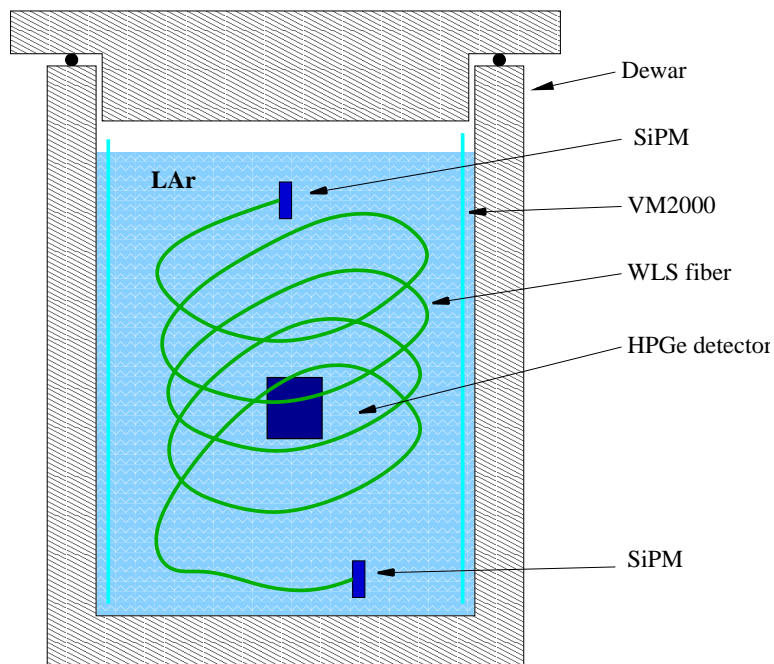


Silicon Photomultiplier tests in LN, LAr

Janicskó József, Aghaei Khozani Hossein



Little space left for LAr. ($X_0 = 14$ cm, space left 7 cm)



Setup



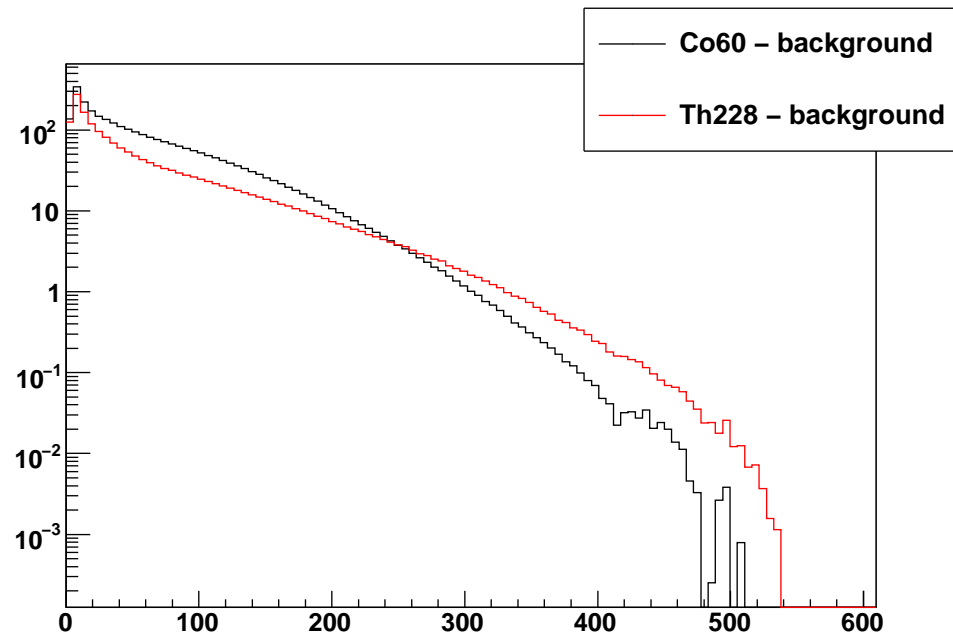
- 4 x 5m WLS fiber total surface:
 600cm^2
- 8 x SiPM with 100 pixels
- charge sensitive preamps
- VM2000 foil, home made TPB coating
- VM2000 surface about 3000 cm^2
- 18 l active volume (or less), 25kg LAr



Co60, Th228 - background



Plenty of light seen, hundreds of pixels fired, no features in the sum spectrum.



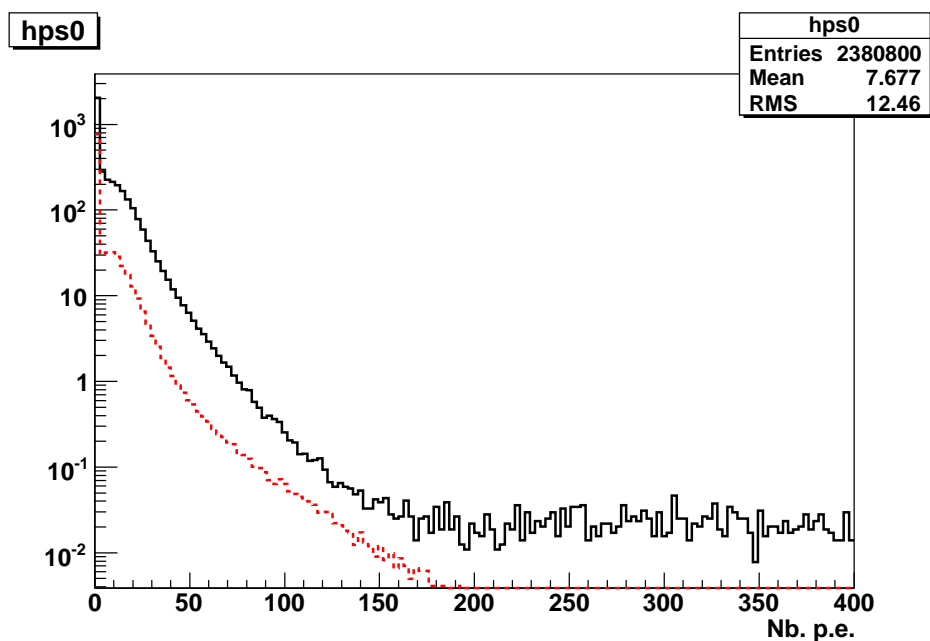
Sum spectra of 8 SiPM's for Co60 and Th228 external source. (number of pixels fired)



Contamination of LAr with Air

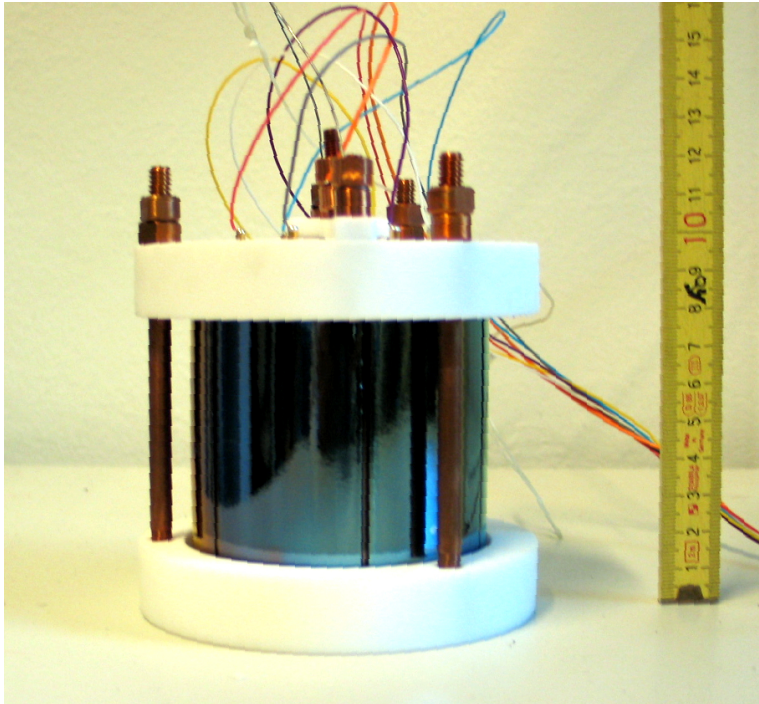


The proof that we detect scintillation light:



Contamination of LAr with air reduced the detected light intensity by 10X

The HPGe detector used:



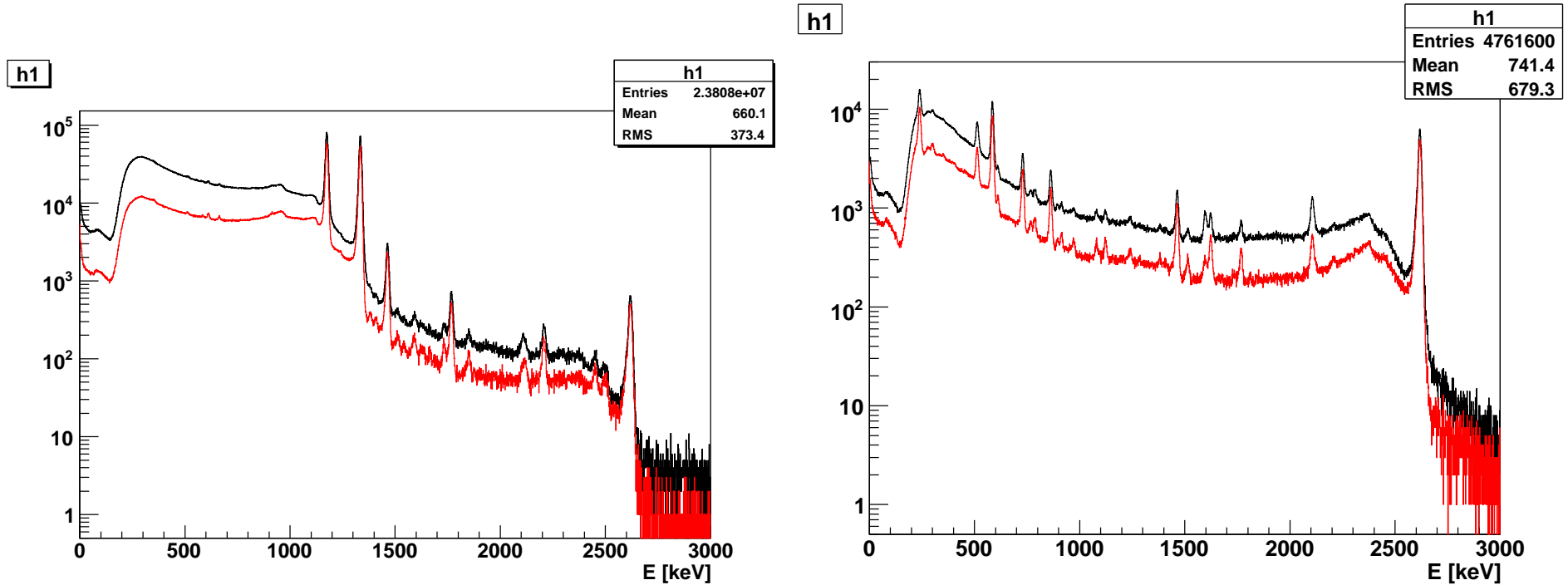
- DSG 6 fold segmented detector
- \sim nA leakage current
- \sim 10keV resolution



Anti Compton veto



suppressed spectrum for Co60 and for Th228, 1 p.e. threshold



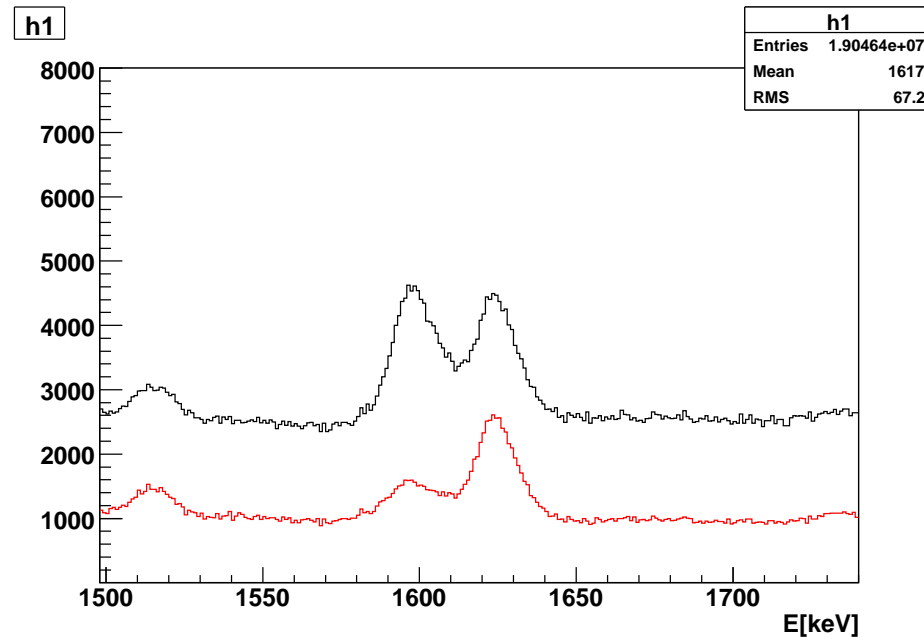
The flat (Compton) background is suppressed by about a factor two.



DEP



- DEP peak suppressed 3.7 times, gamma line 1.13 times with 1 p.e. threshold
- The flat background around the DEP peak was suppressed by 2.5 times.

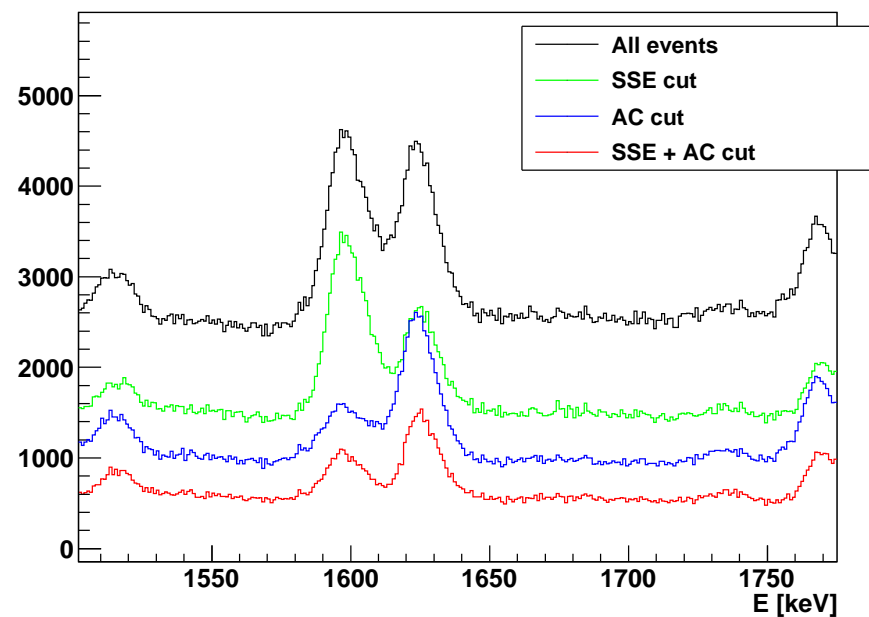
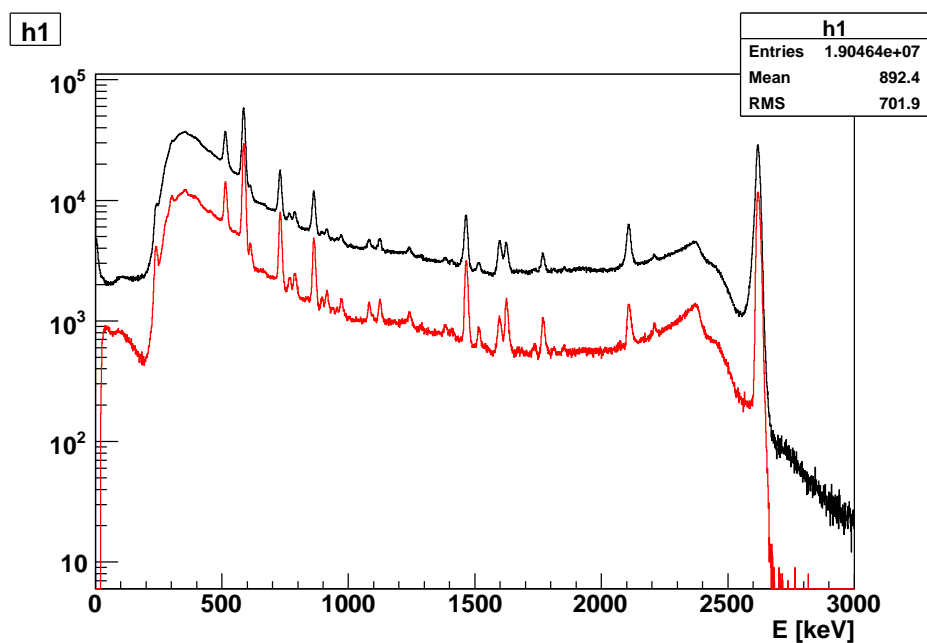




Single segment cut + anti-Compton



Segmented detector + anti-Compton veto
Single segment cut with anti-Compton veto together 4 to 5 times suppression of the flat background.





Next steps



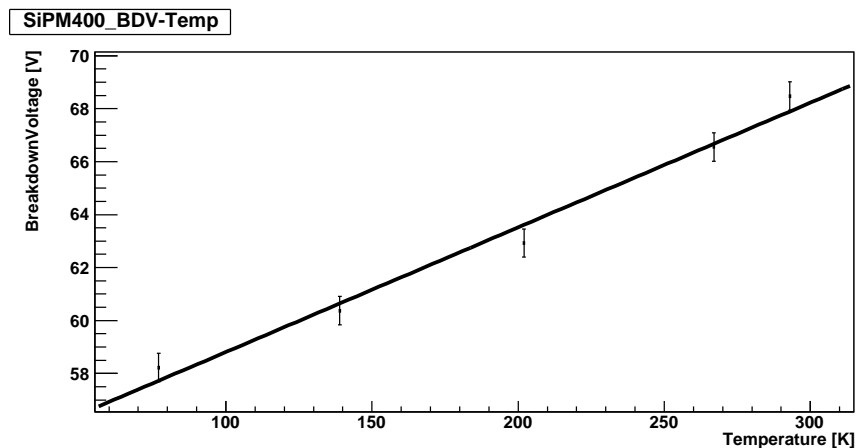
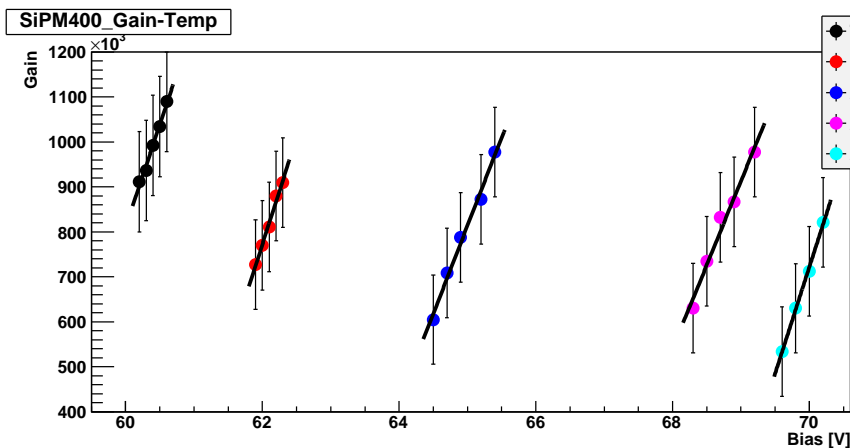
- Anti-Compton veto with SiPM's was demonstrated

R&D plans for an improved setup:

- Understand the SiPM properties better: Breakdown voltage, gain, dark rate, Xtalk, afterpulsing
- WLS fiber: BCF-92 \Rightarrow BCF-91A better match for TPB
- WLS fiber: from $\bigcirc \Rightarrow \square$ fiber, from 5.6 to 7.3% trapping efficiency
- Improve TPB coating and try other fluor
- More SiPM's (?)

Gain and break down voltage measurement:

- Breakdown voltage = Biasvoltage (Gain = 0)
- Is important to define the overvoltage. $V_{Bias}(T) = V_{Breakdown}(T) + V_{Over}$

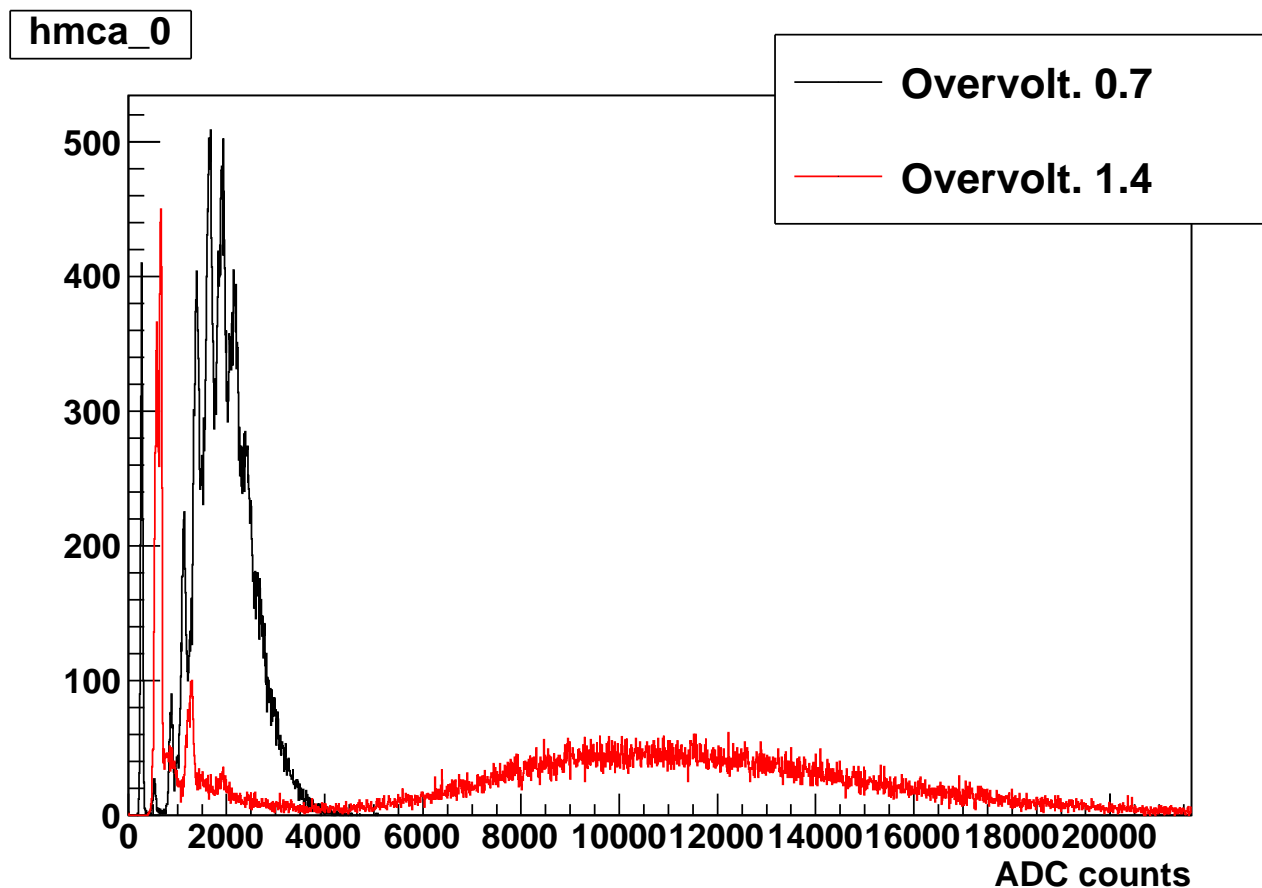




Q.E. & noise v. overvoltage



Q.E. increases with overvoltage, xtalk and afterpulsing as well



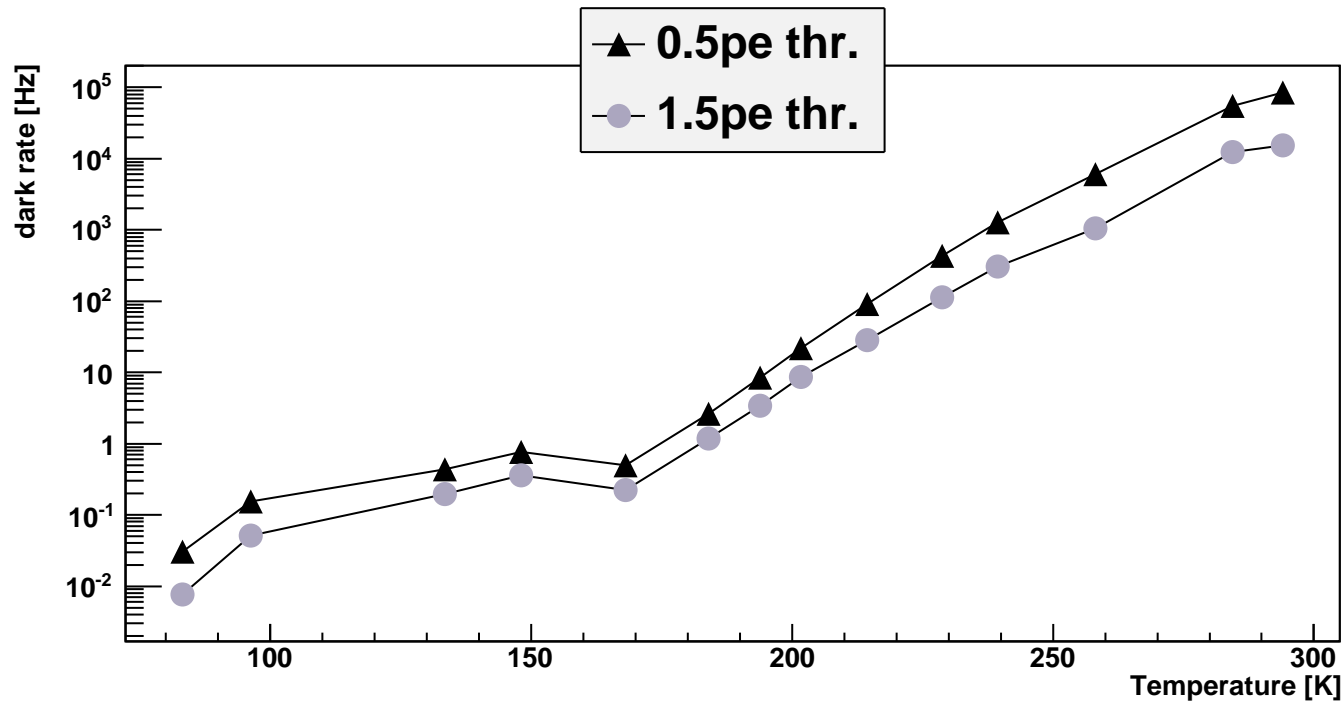
Same light intensity, different over voltage



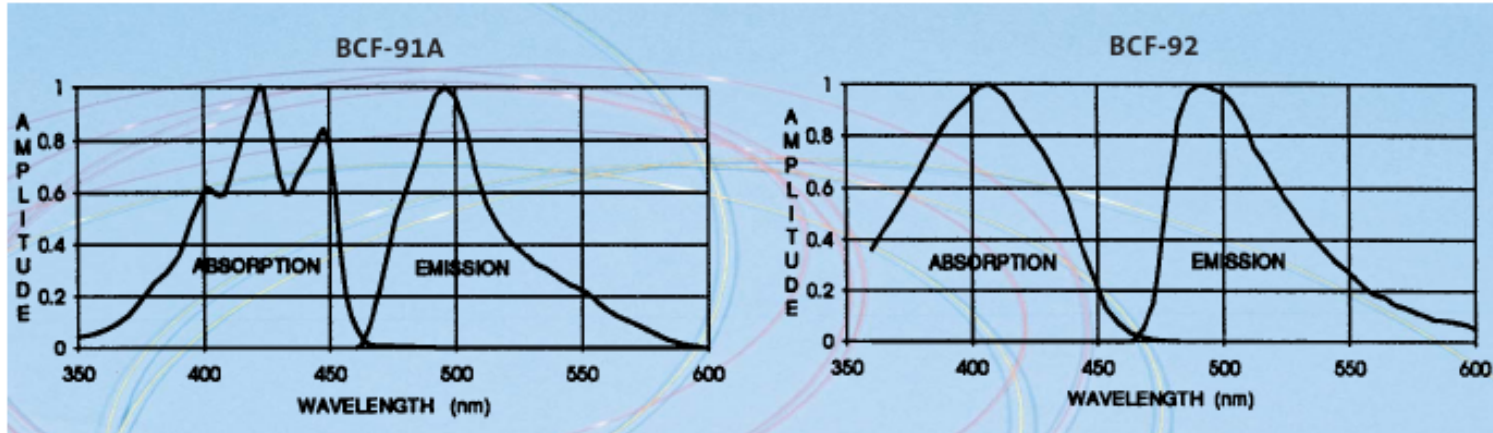
Dark Rate v. Temperature



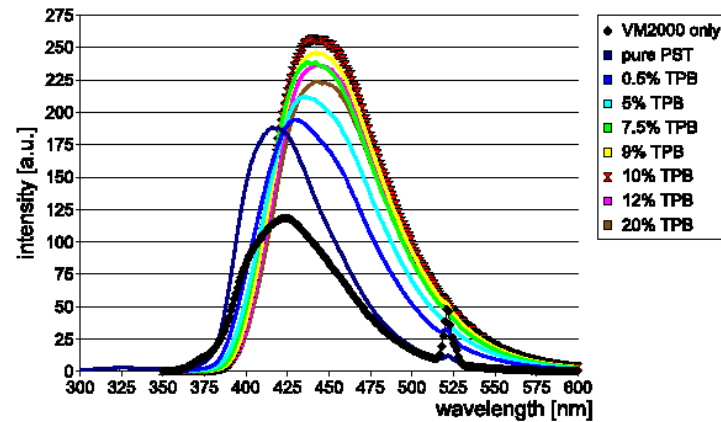
We always knew that the dark rate is small:



⇒ In LN 1 p.e. threshold is reasonable because the dark rate is so small.



which one is a better match for the TPB emission spectra?



BCF-92 \Rightarrow BCF-91A expect 20% improvement, from $\bigcirc \Rightarrow \square$ fiber another 30%



Last slide



- We are working on it, next experiment with HPGe detector in a few month
- expect 100% improvement to the previous experiment
- for 1000 p.e./MeV new (bigger, better) setup is needed

To be continued ...