

# Status report on

1) Response of PWO crystals to photons in the low-energy range

2) Light-yield non-uniformity of PWO crystals

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# The response of PWO to low energy photons, $E > 10 \text{ MeV}$

Measurements done at the tagged photon facility at MAX-lab

Single crystals                      in 2007

3 x 3 matrix of crystals          in 2008

5 x 5 matrix of crystals        in 2009

- Type:                      Forward end cap
- Energy range:        12.7 – 71.2 MeV (two settings of the tagger)
- Temperature:        -25 °C

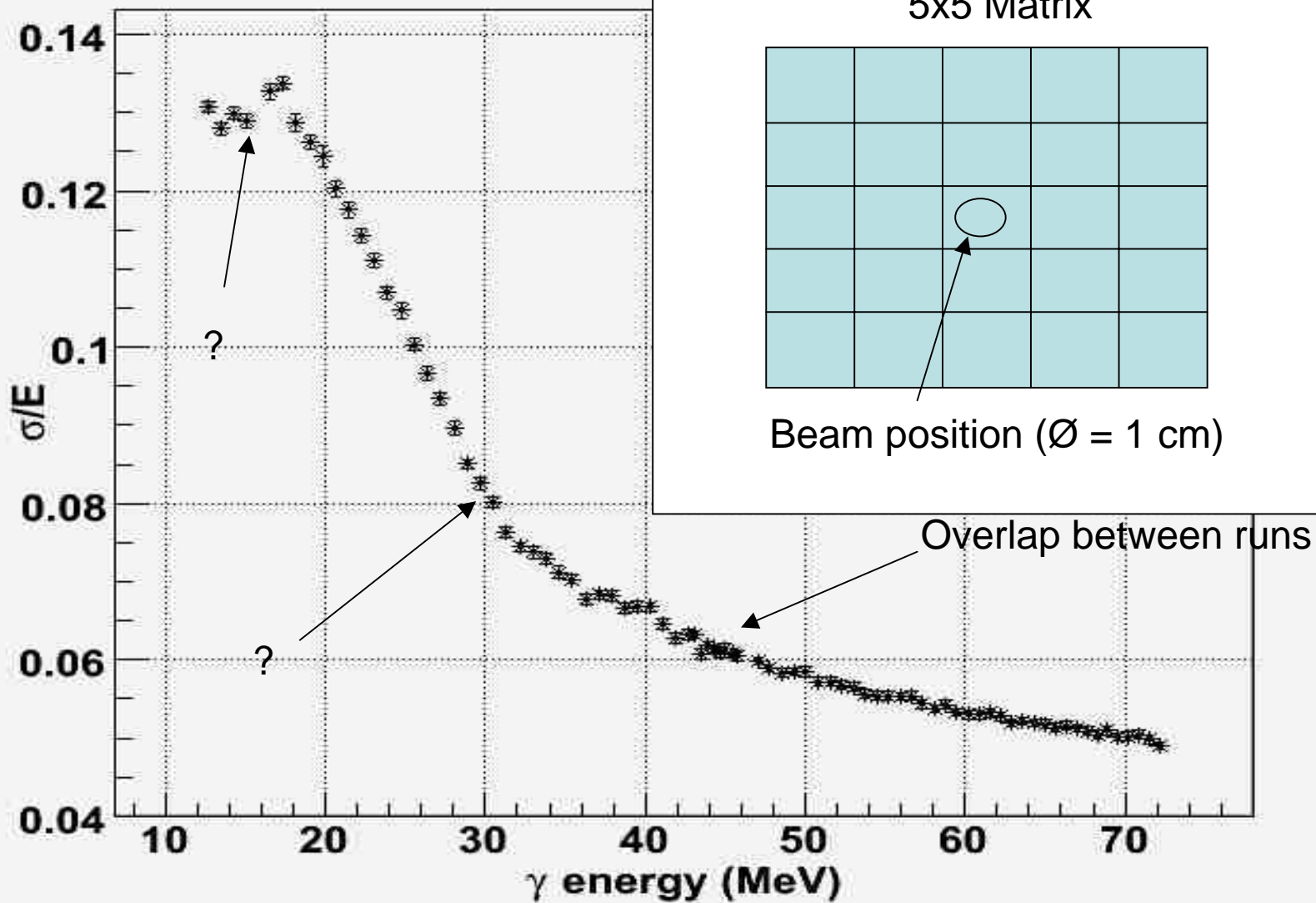
# Experimental setup



- Tapered crystals with tight wrapping
- Temperature sensors
- Properly aligned PM-tubes
- Coordinate table
- Climate chamber

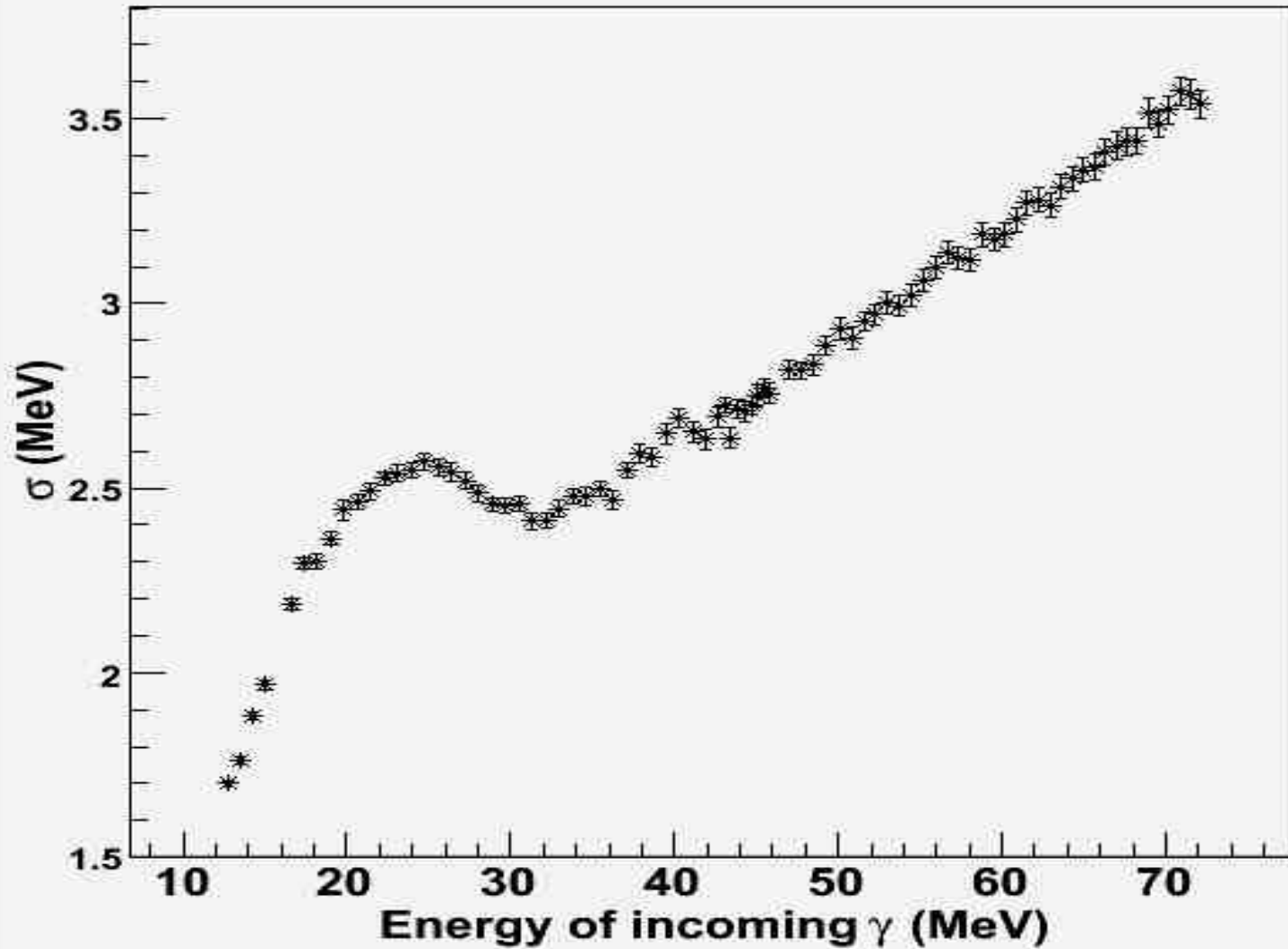
# Relative Resolution as function of photon energy

(from Klas Marcks)



Width (= FWHM/2.35) of summed tagged photon spectra as  
function of energy

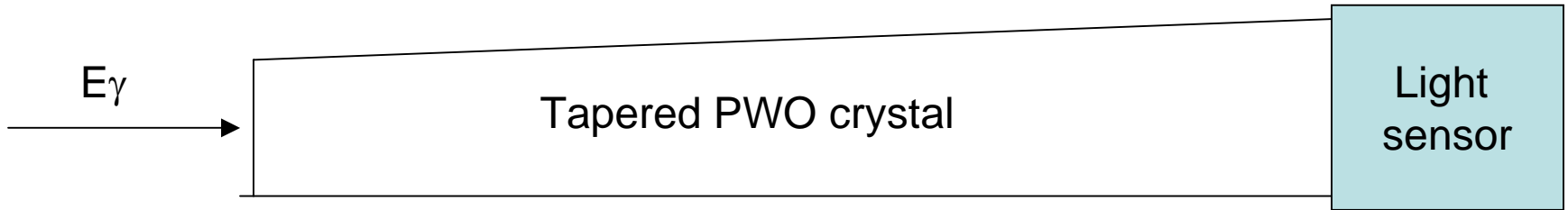
(from Klas Marcks)



# More to do

- Investigating resolution as function of position (data exist)
- Temperature dependence (data exist)
- Investigating reasons for unexpected response at 20 – 30 MeV
  
- Go down to 10 MeV – January 2010 at MAX-Lab
- Realistic mechanical frame and material budget (alveoles etc) – January 2010
- Replacing PM-tubes by Vacuum Triodes (VPTs)
  
- Response to monoenergetic neutrons (The Svedberg Laboratory)

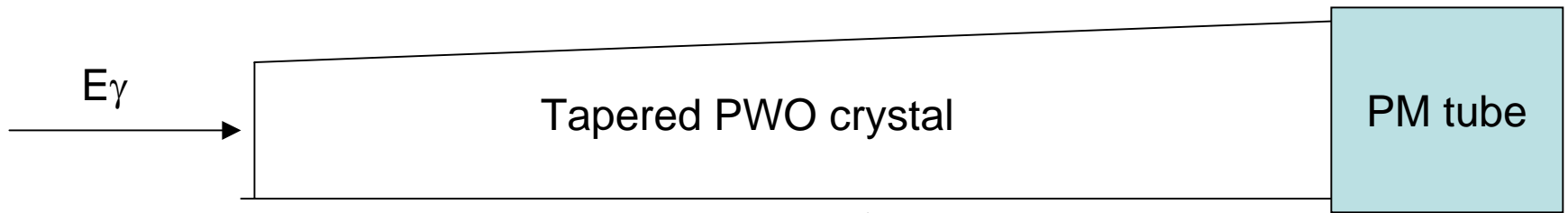
# Measurement of light-yield non-uniformity



The amount of light reaching the light sensor  
(and thus the signal from the light sensor)  
depends on where in the crystal the energy is deposited.

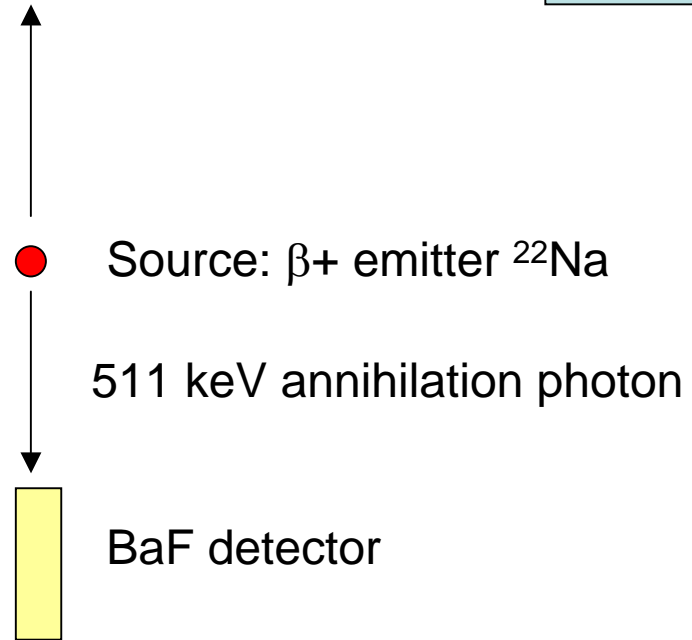
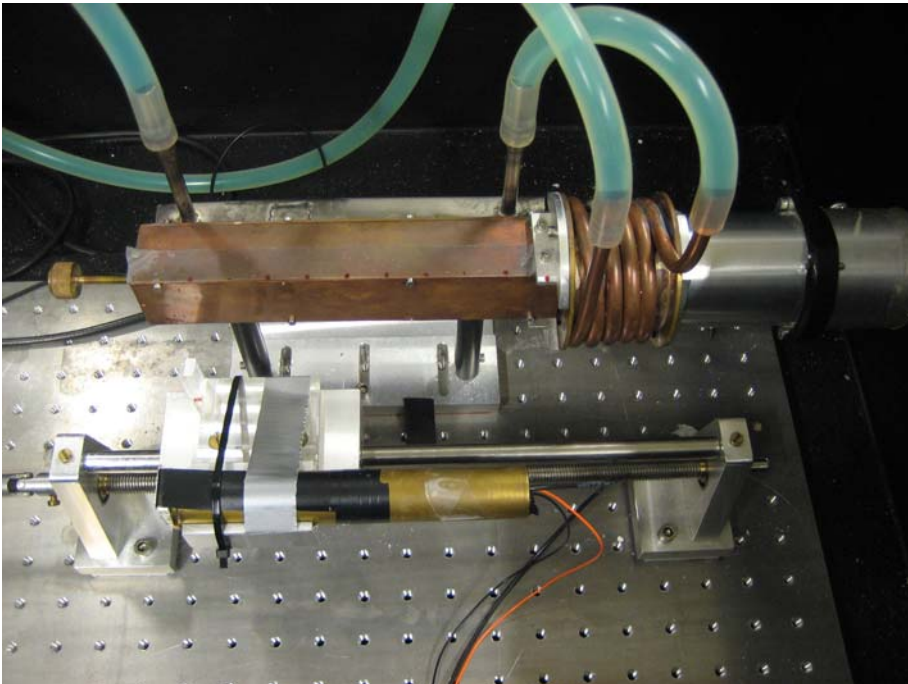
Affects the energy resolution

(Affects the energy calibration)



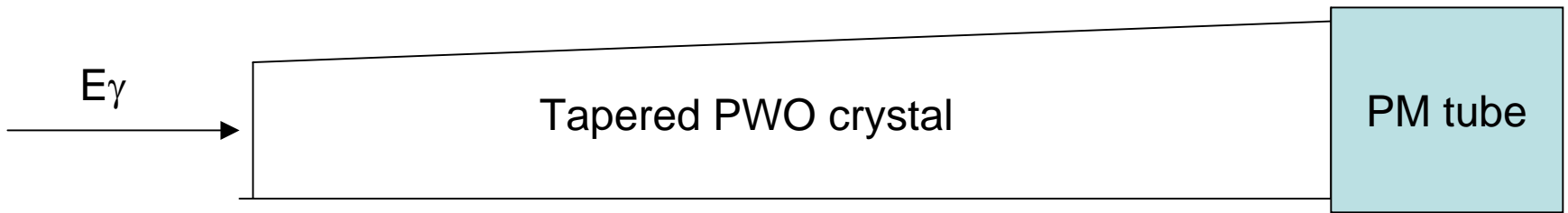
## Experiment

Barrel crystals: 11 shapes  
 Forw end cap: 1 shape

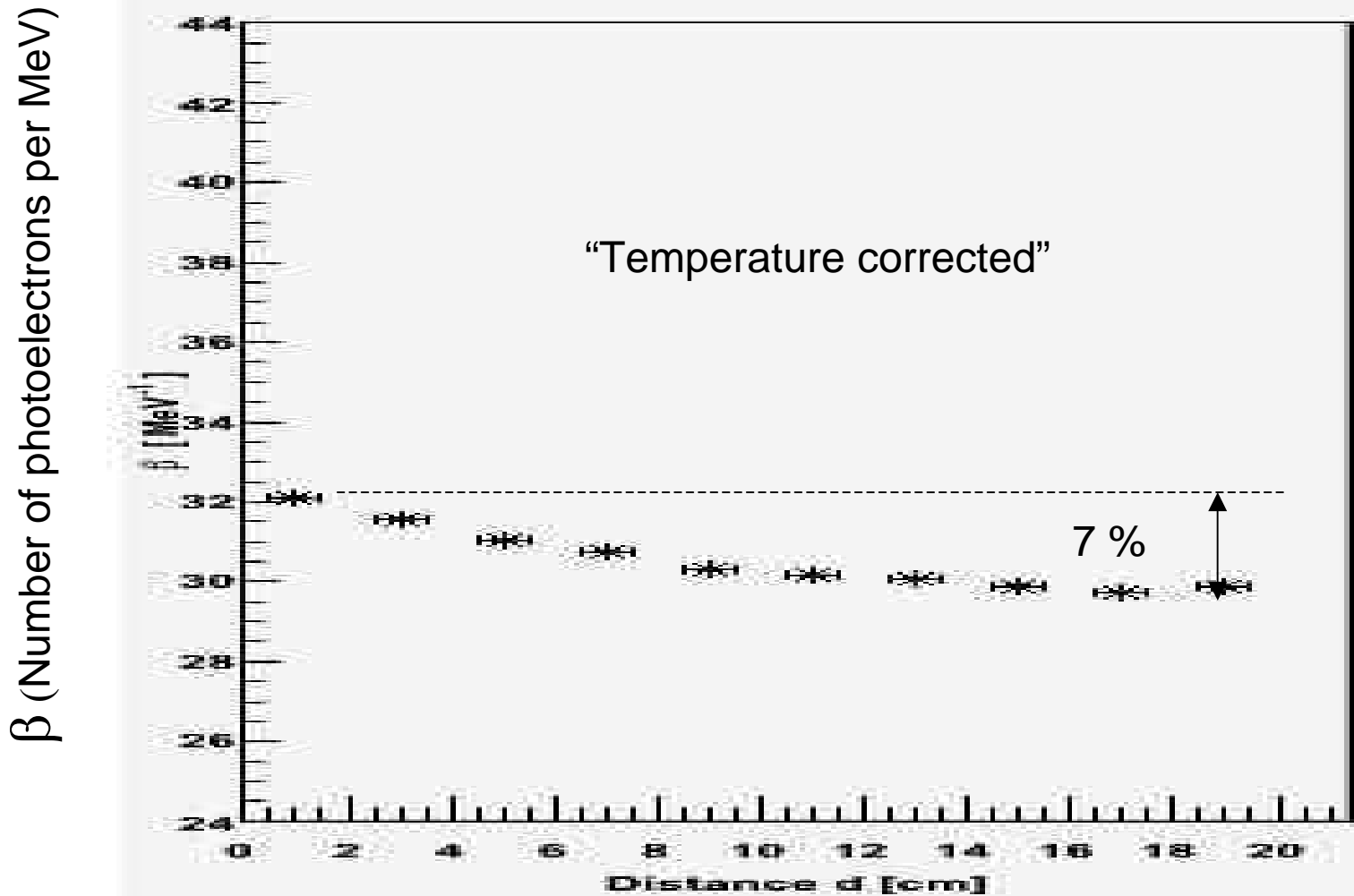


Coincidence requirement:  
 the position of energy deposition in  
 the PWO crystal known.  
 Advantage: Internal activity does not  
 interfere.





Type 10      Tapering angle(s):  $1.0^\circ$       (from María Marteinsdóttir)



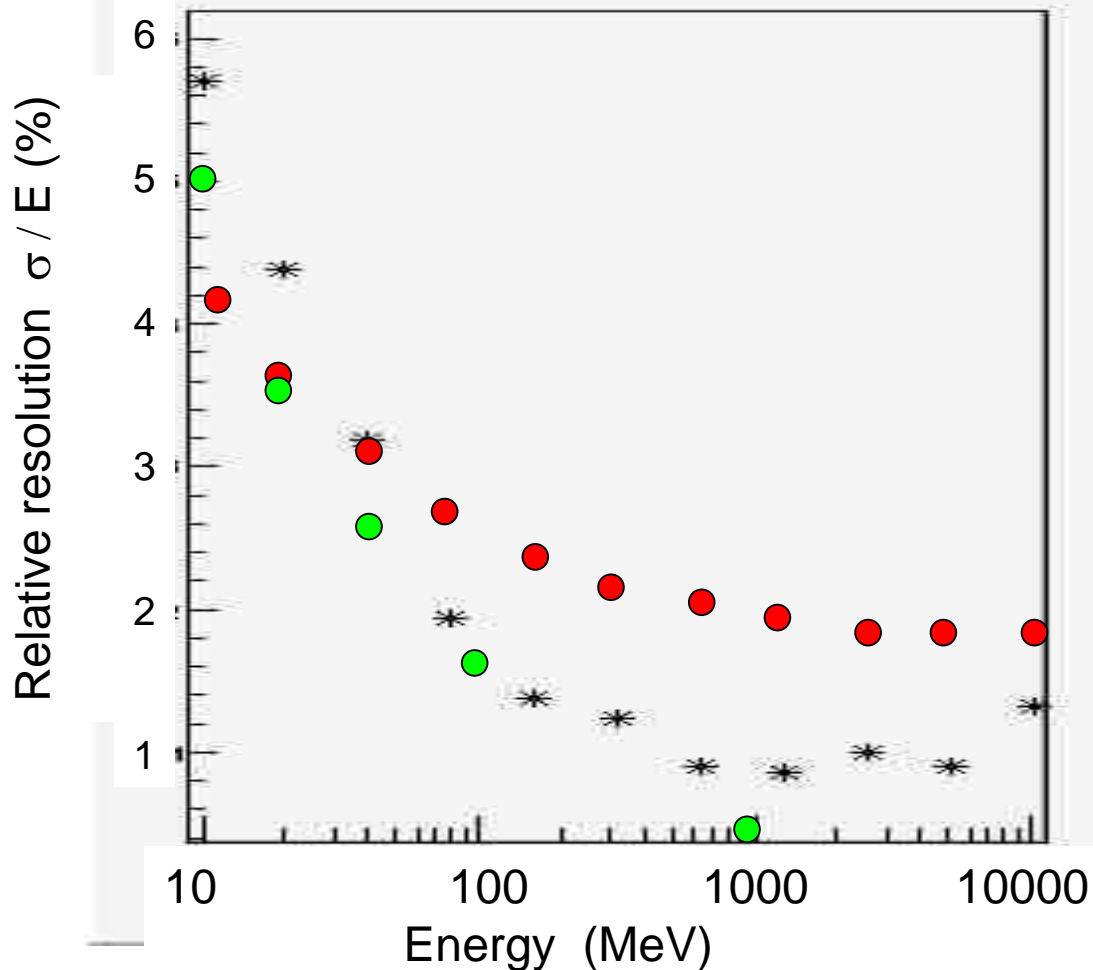
# Contribution to energy resolution from

(1) energy leakage (GEANT4) from 20 cm PWO

(from María Marteinsdóttir)

(2) Light yield fluctuations ● crystal type 2

(3) Poisson statistics (● 40 photo electrons per MeV)



# To do

- Investigate measures to make the light yield uniform
  - Modifying PWO surface
  - Modifying reflective wrapping