

# Measurement of the non-linearity of LAB: results and conclusions

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# Motivation

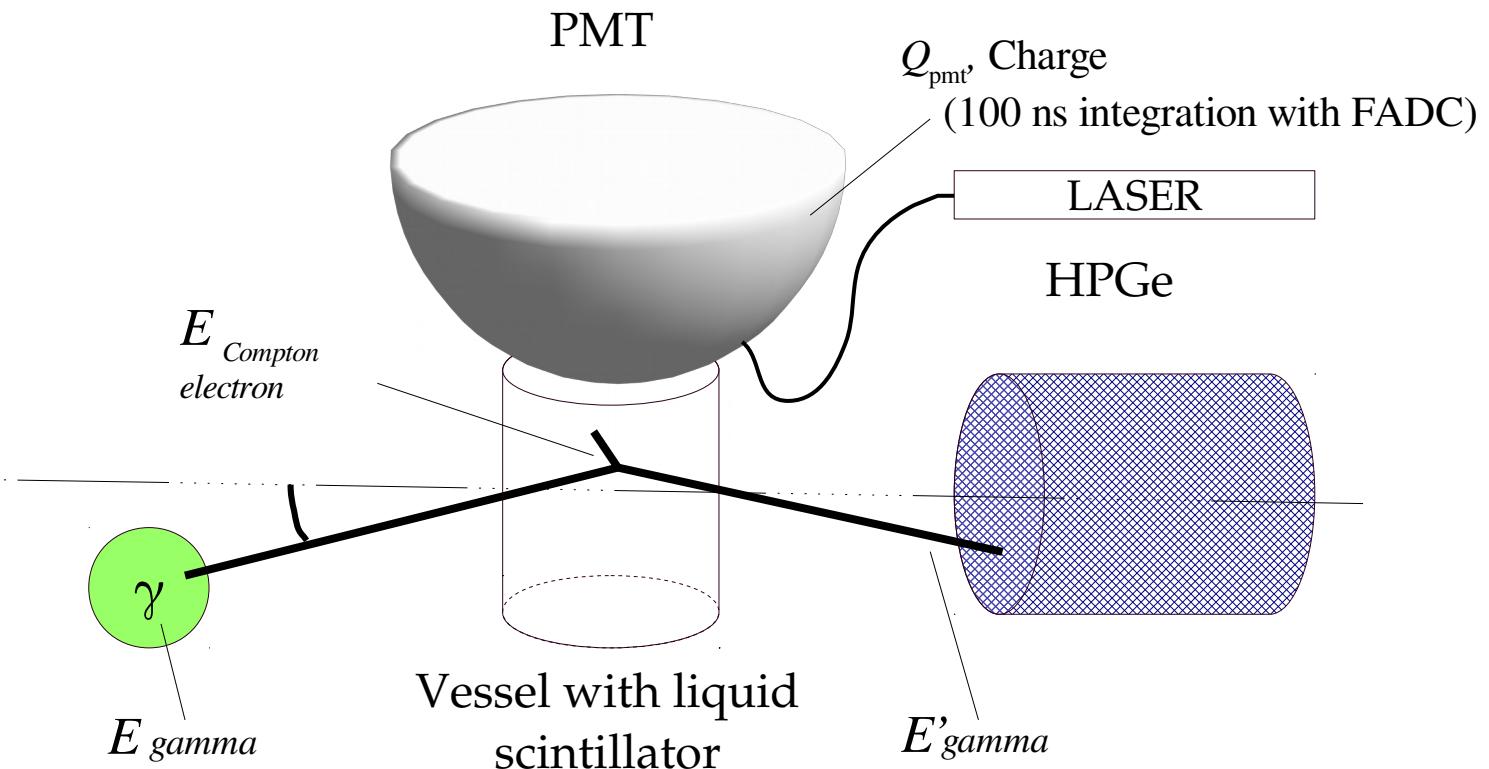
**Energy resolution and linearity of the energy scale** are the main characteristics of scintillator detector; for JUNO the detector response has **challenging requirements for neutrino Mass Hierarchy determination**:

- uncertainty on non-linearity < 1%
- energy resolution 3% for 1 MeV

Complementary measurement of the non-linearity: small-scale, independent from calibrations, measurement of the ionization quenching

Plus, insights on *intrinsic energy resolution* measurement

# Compton coincidence technique



$$E_{\text{electron}} = E_{\text{gamma}} - E'_{\text{gamma}}$$

$Q_{\text{pmt}}$  vs  $E_{\text{electron}}$

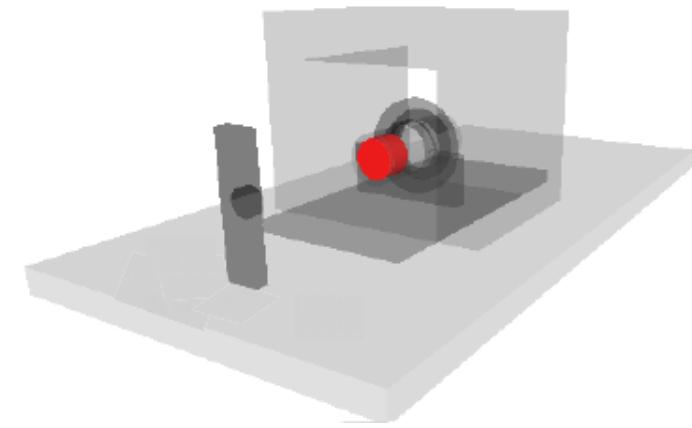
non-linearity  
energy resolution

# What was done

→ Experimental setup



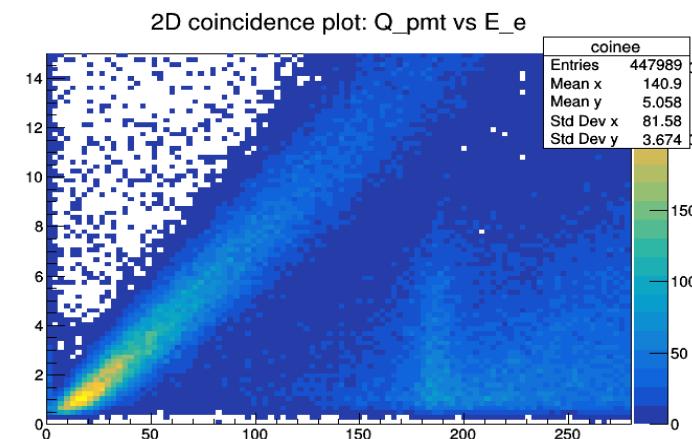
→ Monte Carlo code



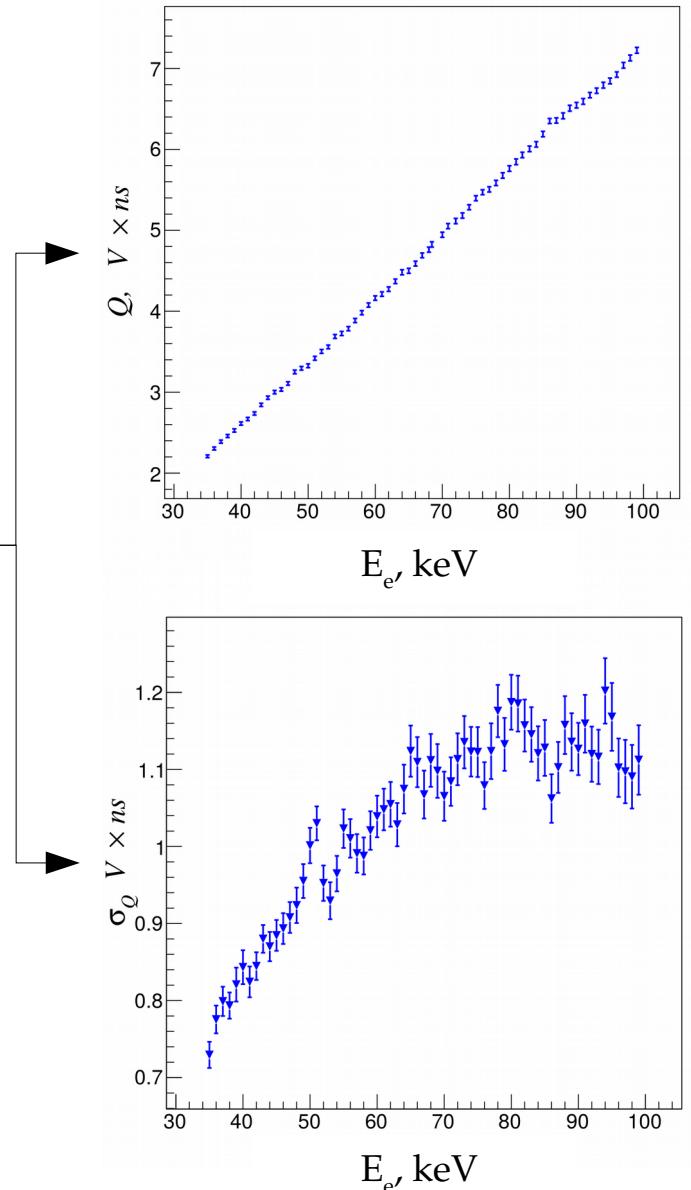
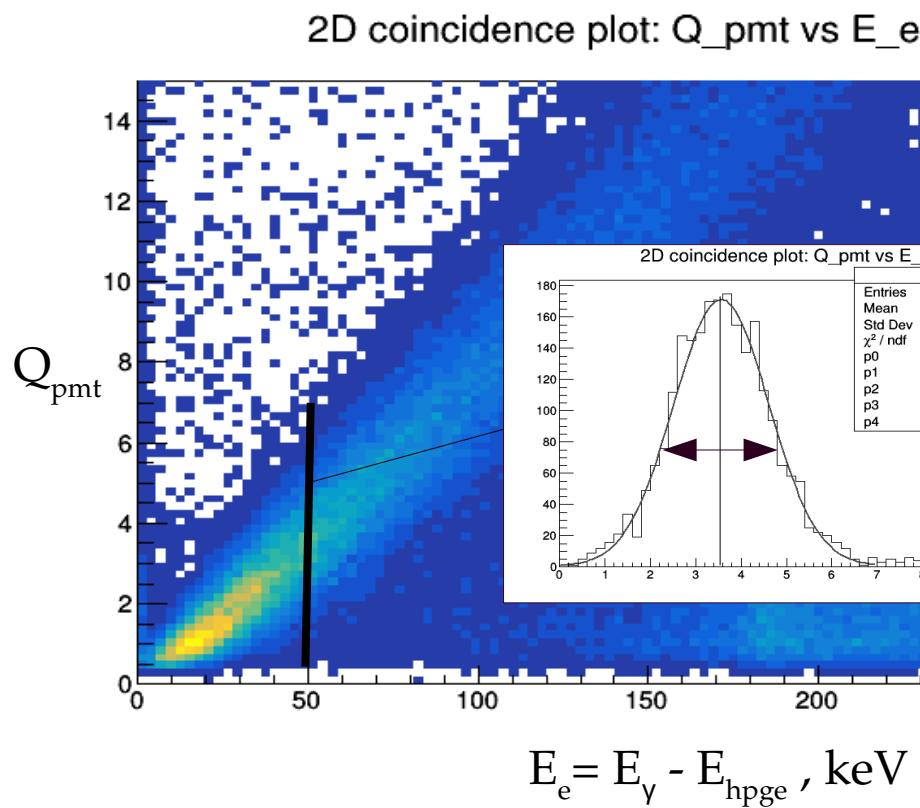
→ Data acquired

- $kB$  extracted (ionization quenching constant)
- intrinsic energy resolution

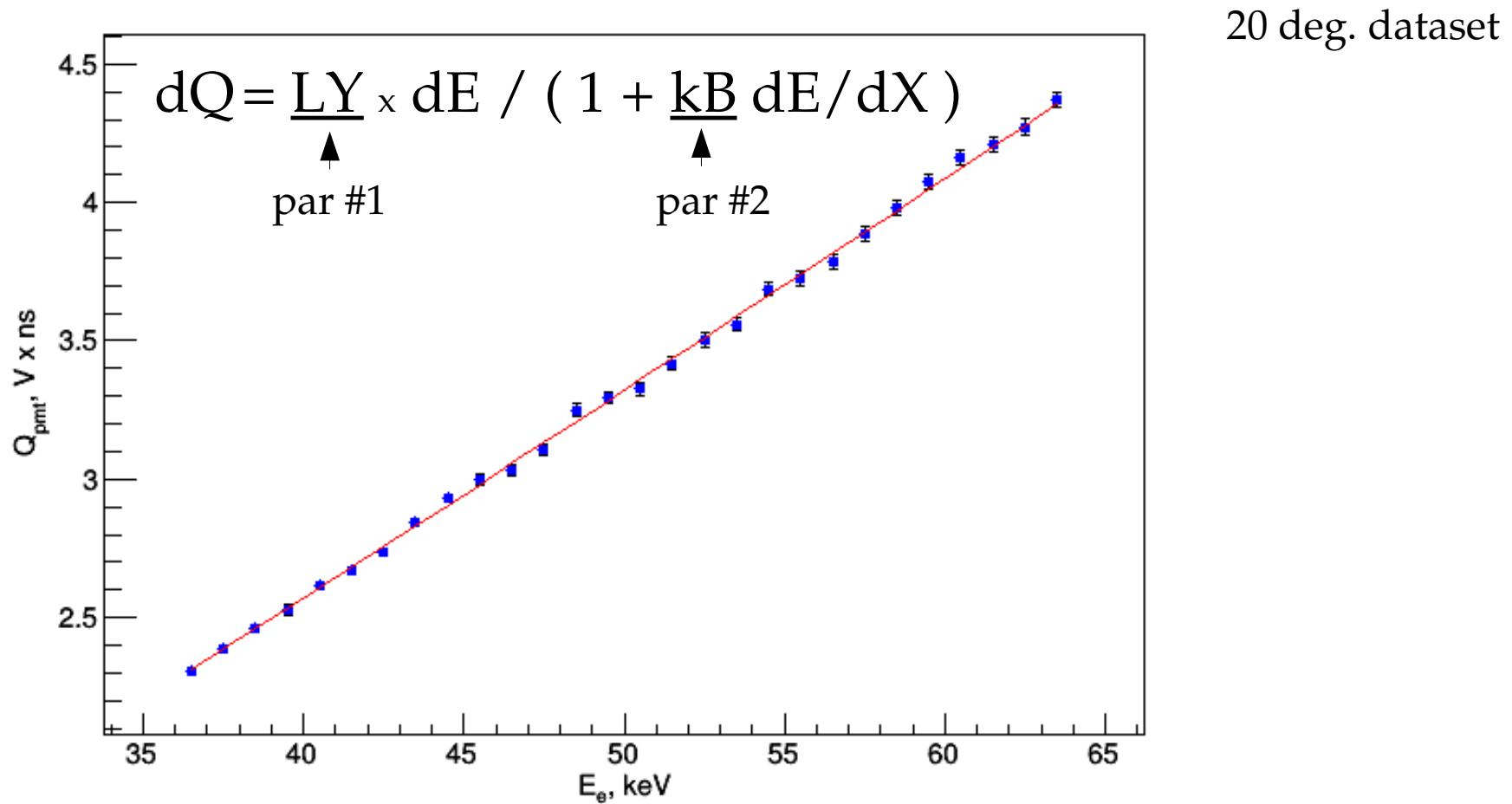
→ Current results are documented  
(doctoral thesis)



# Dataset analysis



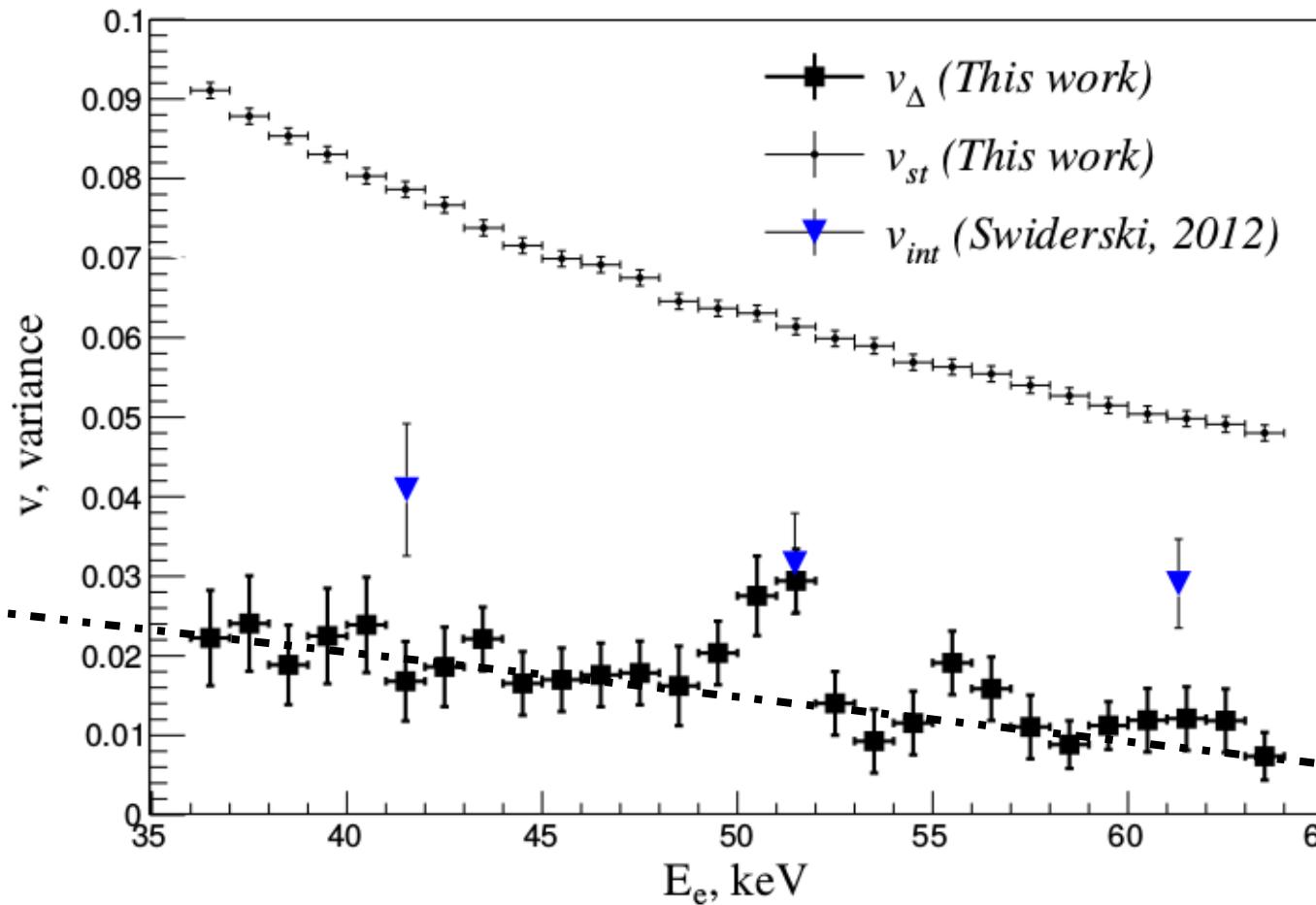
# Ionization quenching



the fit + systematic effect from slicing ( $\pm 0.5$  keV shift of HPGe energy scale)

$$kB = 0.0196 \pm 0.0019(\text{stat}) \pm 0.0024 \text{ (syst)} \text{ cm/MeV}$$

# Intrinsic energy resolution



JUNO energy  
resolution  
(statistical term)  
**It is not a fit  
of the  
experimental  
points!**

$v_{int} \approx v_{\Delta}$ , if the light collection variation term is negligible

- The effect of intrinsic energy resolution is comparable with JUNO statistical term, therefore it may have a big impact on the resolution of the detector.
- To make a definite conclusion the assumption of the negligible light collection variation term should be verified (very difficult with our setup).

# Steps to complete the measurement

- a) Improve analysis of the data  $kB$  extraction from the data:
- b) Using the existing Monte Carlo code, produce the exact dataset for 20 and 30 deg
- c) **Profound results discussion (publishable?)**
- d) Comparison/discussion with other groups
- e) Publish

5-6 people subgroup from JUNO Italy: profound results validation and publication preparation



Thank you for your attention!