UPPSALA
UNIVERSITET

NSG

AGATA
ADVANCED GAMMA
TRACKING ARRAY

Uppsala

Position resolution measurement based on results of commissioning experiment #1

Pär-Anders Söderström

Nuclear Structure Group
Department of Physics and Astronomy
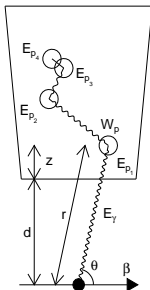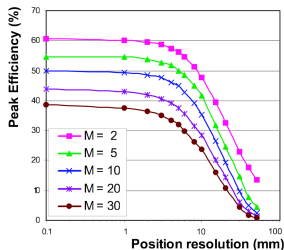Uppsala University

10th AGATA Week: LYON
2010-11-24

Outline

Position Resolution

UPPSALA
UNIVERSITET

**Position resolution
measurement based
on results of
commissioning
experiment #1**

P.-A. Söderström

Position Resolution

New Strategy

Commisioning

Results

- Width of γ-ray peak proportional to position resolution

$$W_{E_{\gamma 0}}^2 = a^2 + b^2 \left(\frac{p}{r}\right)^2$$

-

$$W_{\text{tot}}^2 = W_{\text{int}}^2 + W_{\text{rec}}^2 + W_{\Delta\theta}^2$$

- Maximize b (or E_γ, β and $\sin\theta$) to increase this effect
- Old strategy to measure $W_{E_{\gamma 0}}^2$ and compare to Monte Carlo simulations of the experiment

UPPSALA
UNIVERSITET

Position resolution
measurement based
on results of
commissioning
experiment #1

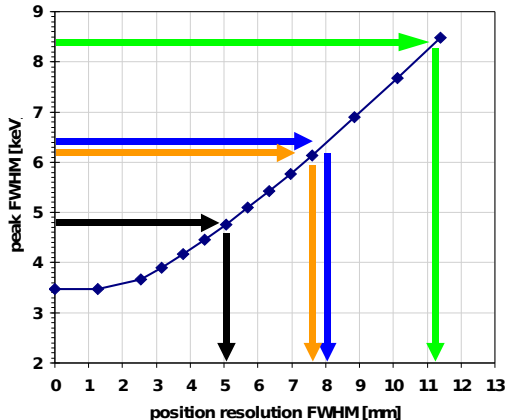P.-A. Söderström

Position Resolution

New Strategy

Commisioning

Results

Old Strategy

Performance of different PSA algorithms

Recursive Subtraction

Matrix Method

Miniball Algorithm

Grid Search

peak FWHM [keV] (vertical axis, 2 to 9)

position resolution FWHM [mm] (horizontal axis, 0 to 13)

Simulations

- New Monte Carlo model-independent method

$$p^2 = \frac{1}{k^2} \left(\Delta E_{\text{close}}^2 - \Delta E_{\text{far}}^2 \right) \left(\frac{1}{d_{\text{close}}^2} - \frac{1}{d_{\text{far}}^2} \right)^{-1}$$

See PhD Thesis by F. Recchia

$s = $ `mgt` smearing

UPPSALA
UNIVERSITET

Position resolution
measurement based
on results of
commissioning
experiment #1
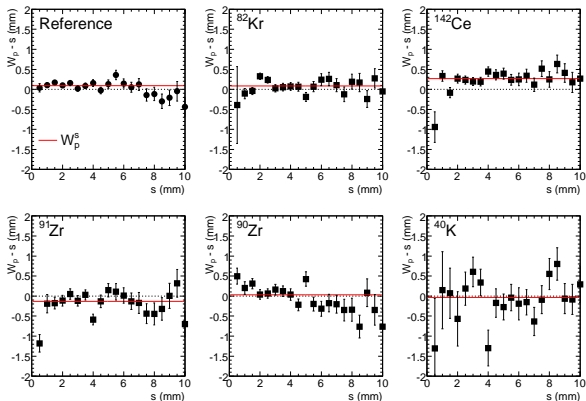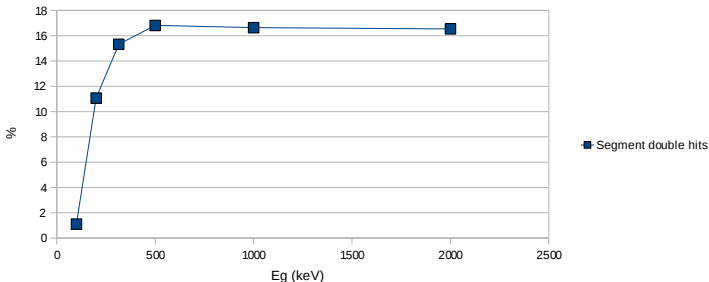
P.-A. Söderström

Position Resolution
New Strategy
Commisioning
Results

UPPSALA
UNIVERSITET

Position resolution
measurement based
on results of
commissioning
experiment #1

P.-A. Söderström

Position Resolution
New Strategy
Commisioning
Results

Commissioning experiment

- Commisioning experiment in March 2009
- ^{30}Si beam at 70 MeV, target 0.2 mg/cm^2 ^{12}C, ^{30}Si(^{12}C, np)^{40}K
- One AGATA triple cluster, no ancillary detectors
- Two datasets at 55 mm (650 Mevents) , one dataset at 235 mm (280 Mevents)
- JASS PSA basis, no double hits in the same segment
- NARVAL emulator and `mgt` tracking code

UPPSALA
UNIVERSITET

Position resolution
measurement based
on results of
commissioning
experiment #1

P.-A. Söderström

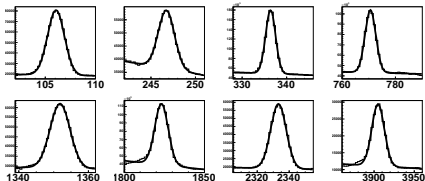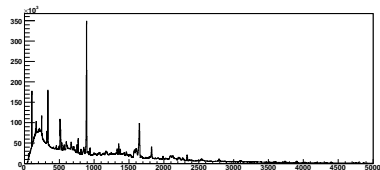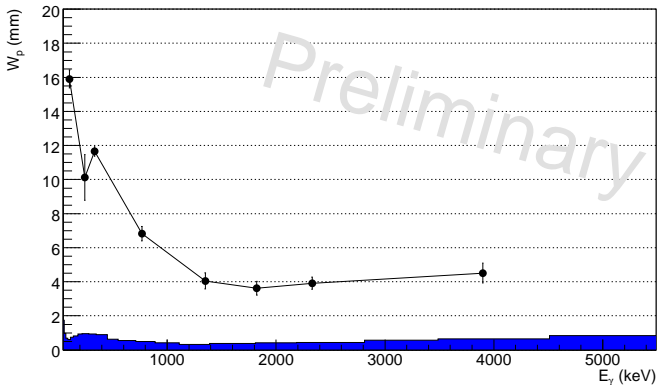Position Resolution

New Strategy

Commisioning

Results

Commissioning experiment

E_γ	FWHM (close)	FWHM (far)
106	2.22	1.98
246	2.34	2.15
336	3.18	2.63
770	5.27	4.73
1352	7.13	6.73
1826	10.4	9.85
2333	12.0	11.4
3905	19.4	18.4

- ^{40}K: 336 keV, 770 keV, 1352 keV, 1826 keV, 2333 keV
- ^{38}Ar: 106 keV
- ^{41}K: 246 keV
- ^{40}Ca: 3905 keV

Position resolution vs. γ-ray energy

- Previous experiments only evaluate a single point
- More complete picture as a function of energy
- Systematic uncertainties estimated in the blue histogram

Position resolution vs. interaction mode

- Photoelectric events (blue)
- Compton events (red)
- Worse resolution for Compton, probably due to interaction point energy

UPPSALA
UNIVERSITET

Position resolution
measurement based
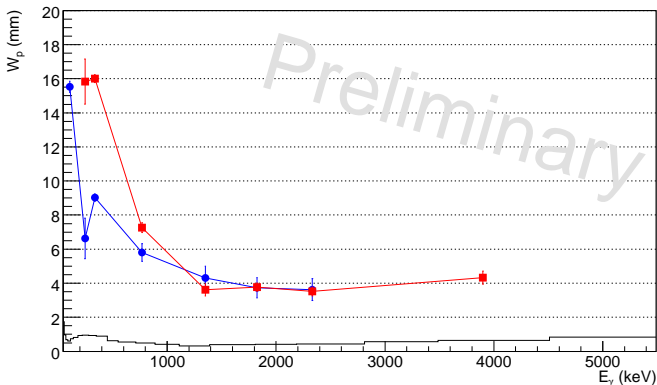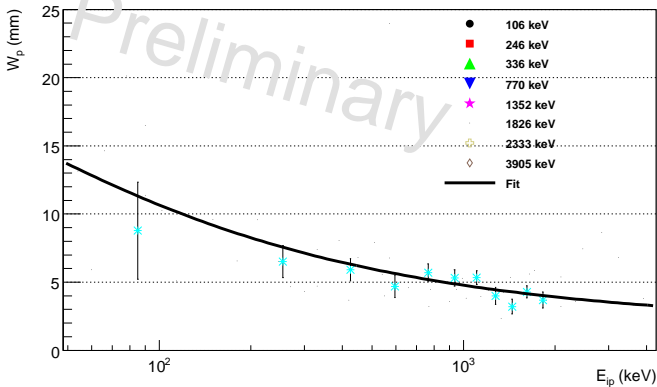on results of
commissioning
experiment #1

P.-A. Söderström

Position Resolution
New Strategy
Commisioning
Results

Position resolution vs. interaction-point energy

- Position resolution as a function of interaction point energy
- 1826 keV γ-ray energy
- Fitted function as:

$$W_p(E) = s_0 + s_1 \sqrt{\frac{100}{s_2 + E}}$$

Preliminary Results

- Position resolution as a function of interaction point energy
- All γ-ray energies
- Fitted function as:

$$W_p(E) = s_0 + s_1 \sqrt{\frac{100}{s_2 + E}}$$

Summary

UPPSALA
UNIVERSITET

Position resolution
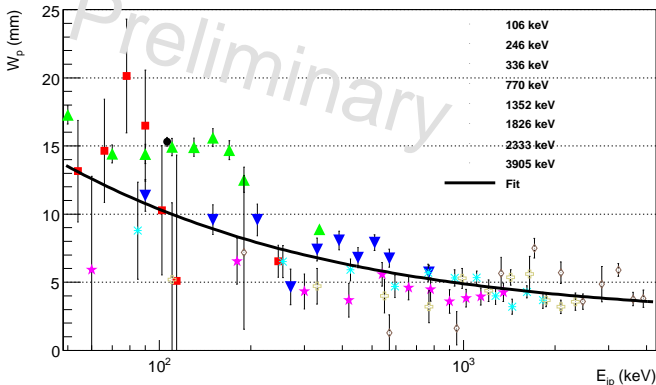measurement based
on results of
commissioning
experiment #1

P.-A. Söderström

Position Resolution
New Strategy
Commisioning
Results

- New MC-model independent method to measure position resolution
- Simulations show the method works even for non-optimal reactions
- From experimental data we get a position resolution of 3.5-4 mm above 1 MeV
- To do: Analyze to get position resolution as a function of interaction depth