Istituto Nazionale di Fisica Nucleare
Sezione di Padova

Dept. of Physics and Astronomy
University of Padova

AGATA-MUGAST-VAMOS Comissioning Analysis Report

Andrea Raggio

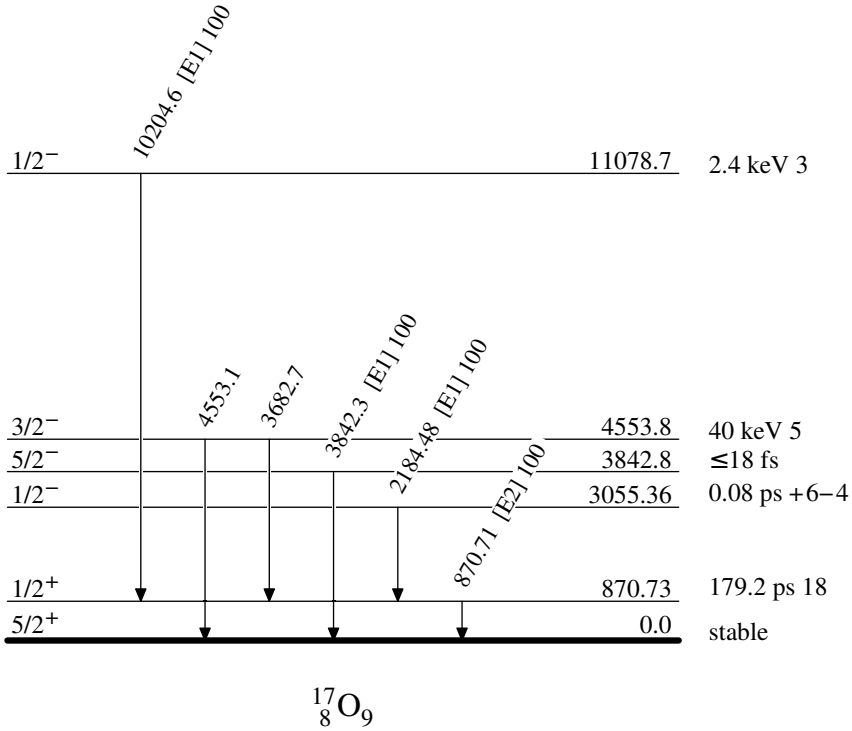
Master Student
Dept. of Physics and Astronomy
University of Padova

INFN-Sezione di Padova

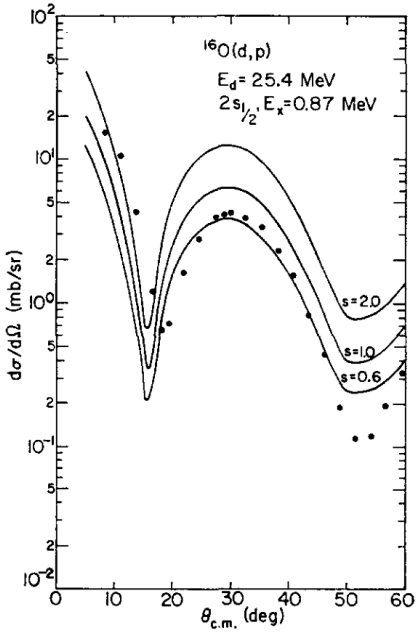
Reaction

$^{16}O(d,p)^{17}O$

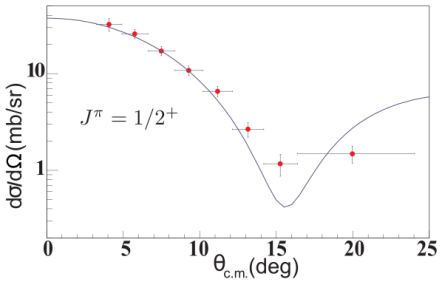
^{17}O level scheme



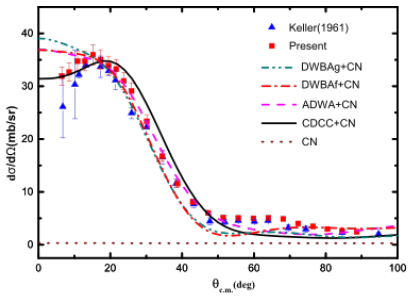
$^{17}_{8}O_{9}$



M.D. Cooper et al., NPA 218,249(1974)



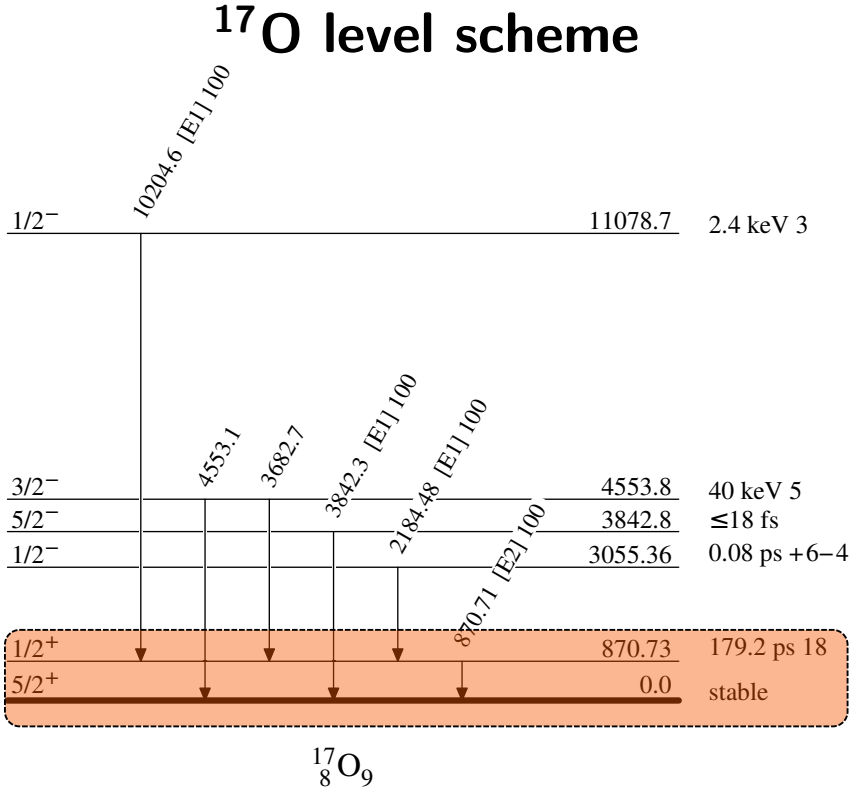
T. Al Kalanee et al., PRC 88, 034301 (2013)



T.L. Ma et al., Nuclear Physics A 986 (2019) 26-23

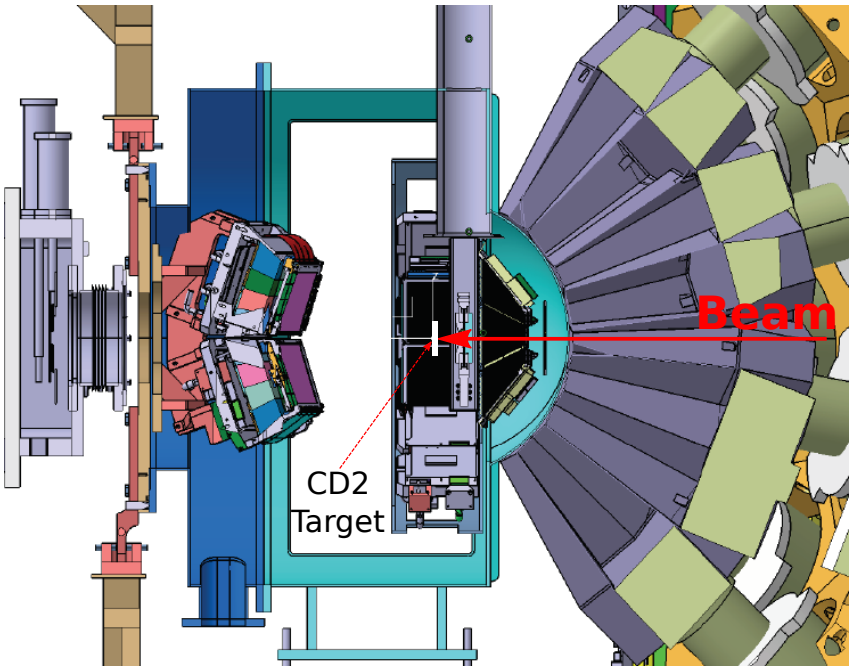
Reaction

$^{16}O(d,p)^{17}O$



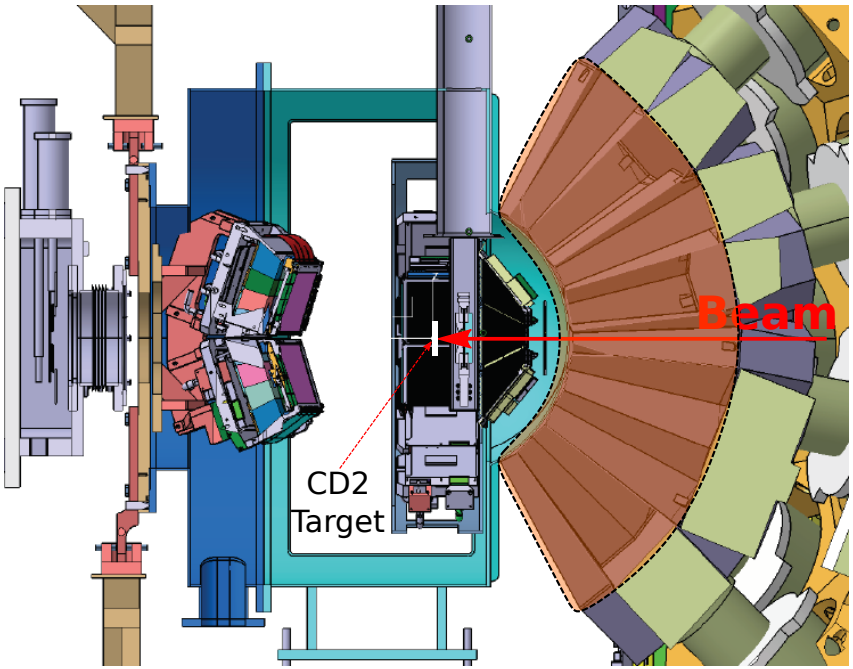
- → Angular distribution for transfer to g.s. and 1/2+ of ^{17}O
- → Proton-gamma coincidence for the 870 keV gamma decay
- → AGATA efficiency estimate.

Setup



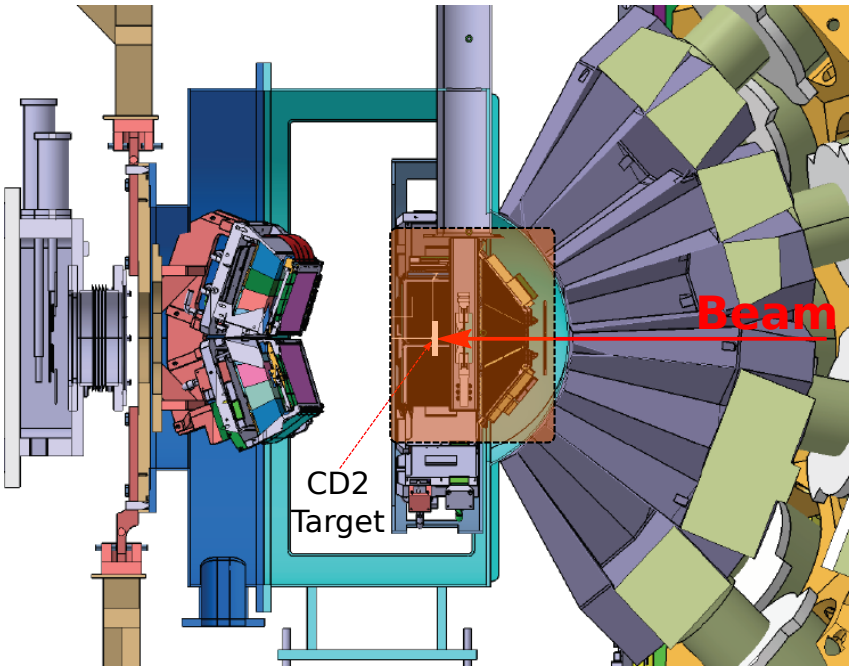
- ^{16}O beam on CD2 Target
  - → 6 MeV/u - 10^4pps
  - → 1 mg/cm^2
- AGATA - backward
  - → 37 crystal
- MUGAST - backward
  - → 5 trapezoidal DSSD
  - → 1 anular DSSD
  - → 2 square DSSD at 90°
- MUST2 - forward
  - → 4 Telescope
- VAMOS

Setup



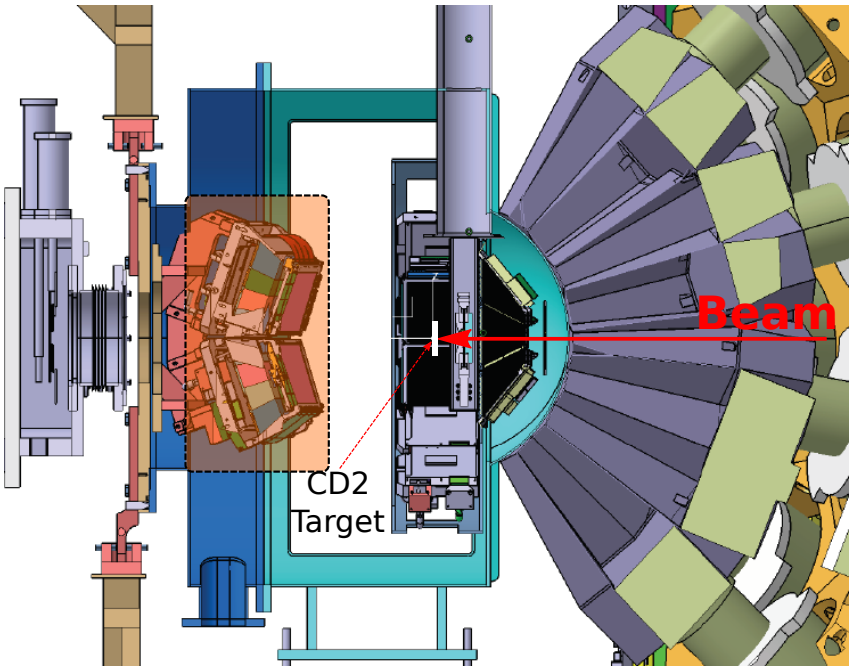
- ^{16}O beam on CD2 Target
  - → 6 MeV/u - 10^4pps
  - → 1 mg/cm^2
- AGATA - backward
  - → 37 crystal
- MUGAST - backward
  - → 5 trapezoidal DSSD
  - → 1 anular DSSD
  - → 2 square DSSD at 90°
- MUST2 - forward
  - → 4 Telescope
- VAMOS

Setup



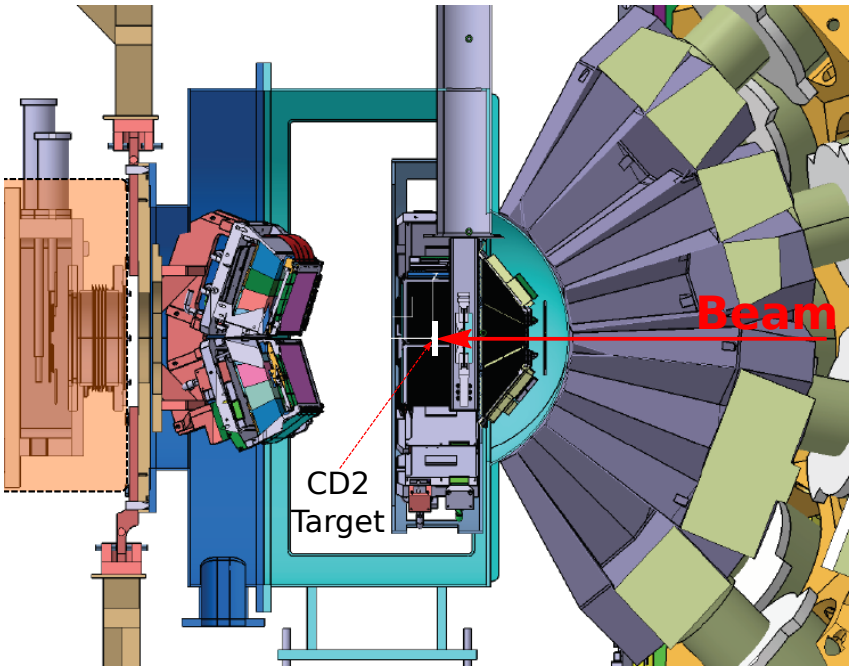
- ^{16}O beam on CD2 Target
  - → 6 MeV/u - 10^4pps
  - → 1 mg/cm^2
- AGATA - backward
  - → 37 crystal
- MUGAST - backward
  - → 5 trapezoidal DSSD
  - → 1 anular DSSD
  - → 2 square DSSD at 90°
- MUST2 - forward
  - → 4 Telescope
- VAMOS

Setup



- ^{16}O beam on CD2 Target
  - → 6 MeV/u - 10^4pps
  - → 1 mg/cm^2
- AGATA - backward
  - → 37 crystal
- MUGAST - backward
  - → 5 trapezoidal DSSD
  - → 1 anular DSSD
  - → 2 square DSSD at 90°
- MUST2 - forward
  - → 4 Telescope
- VAMOS

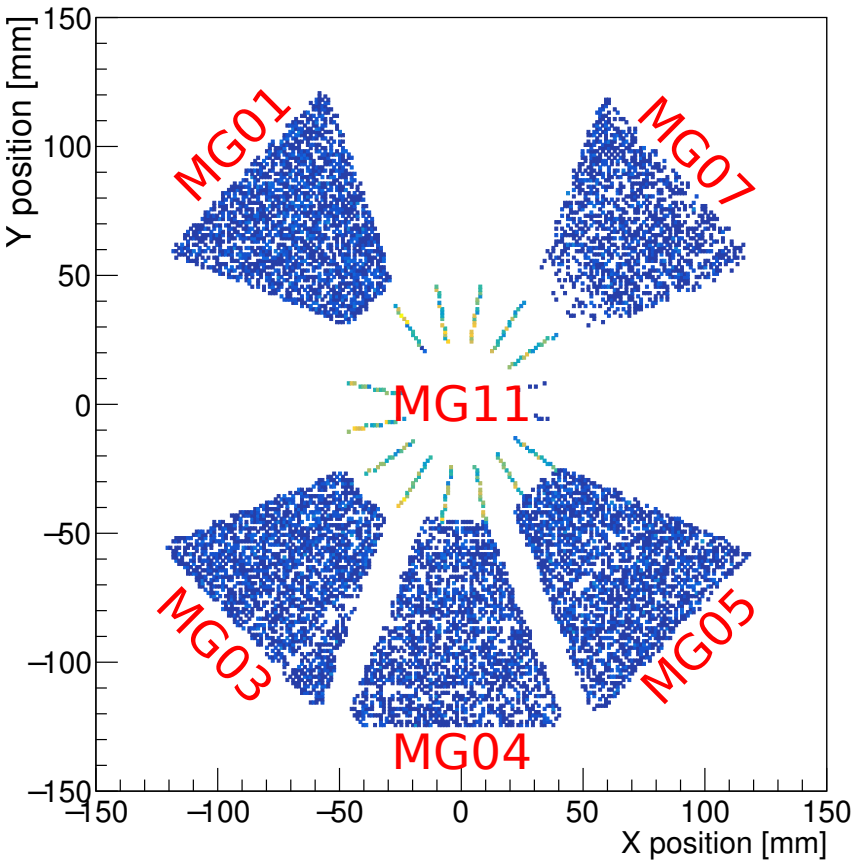
Setup

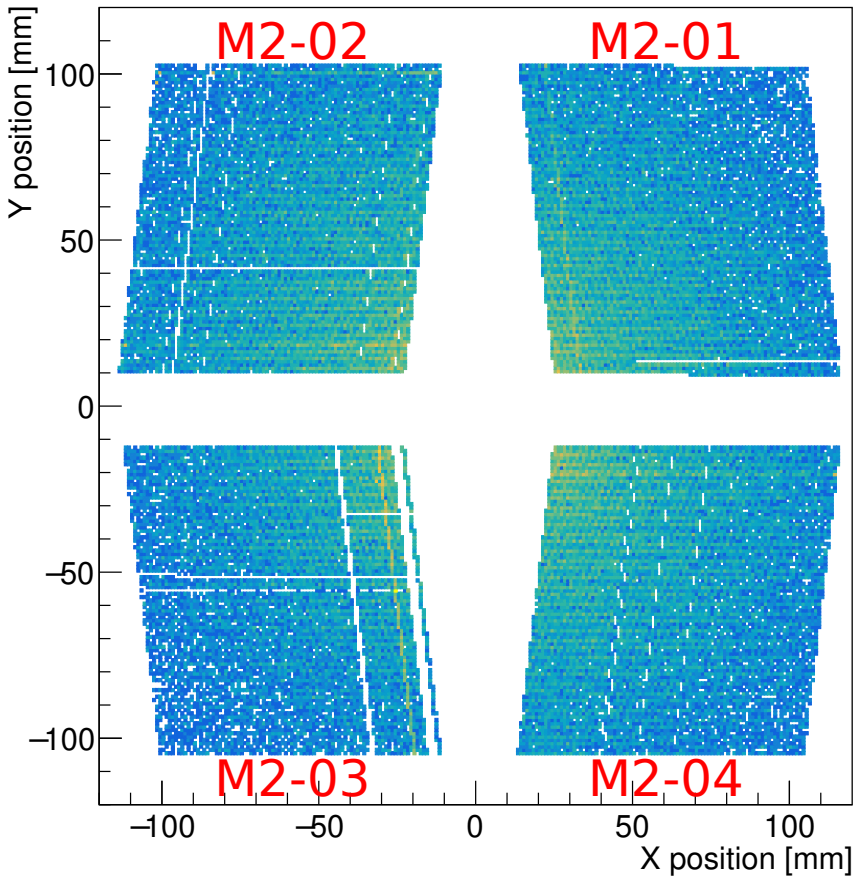


- ^{16}O beam on CD2 Target
  - → 6 MeV/u - 10^4pps
  - → 1 mg/cm^2
- AGATA - backward
  - → 37 crystal
- MUGAST - backward
  - → 5 trapezoidal DSSD
  - → 1 anular DSSD
  - → 2 square DSSD at 90°
- MUST2 - forward
  - → 4 Telescope
- VAMOS

Impact Matrix

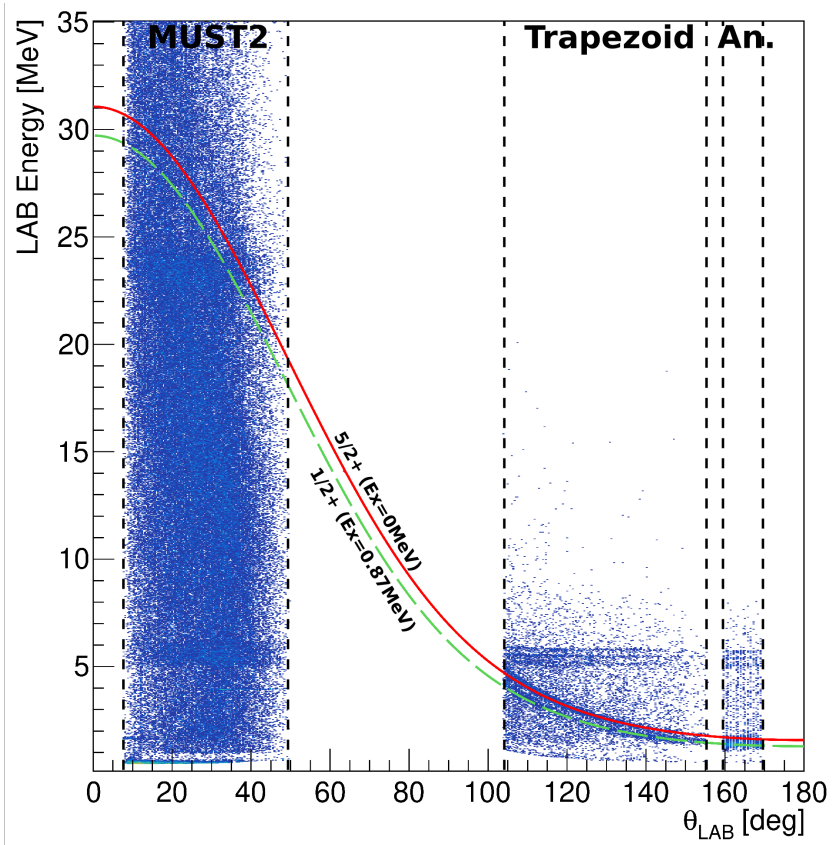
11 h. acquisition long at $\sim 4\ 10^4$ pps



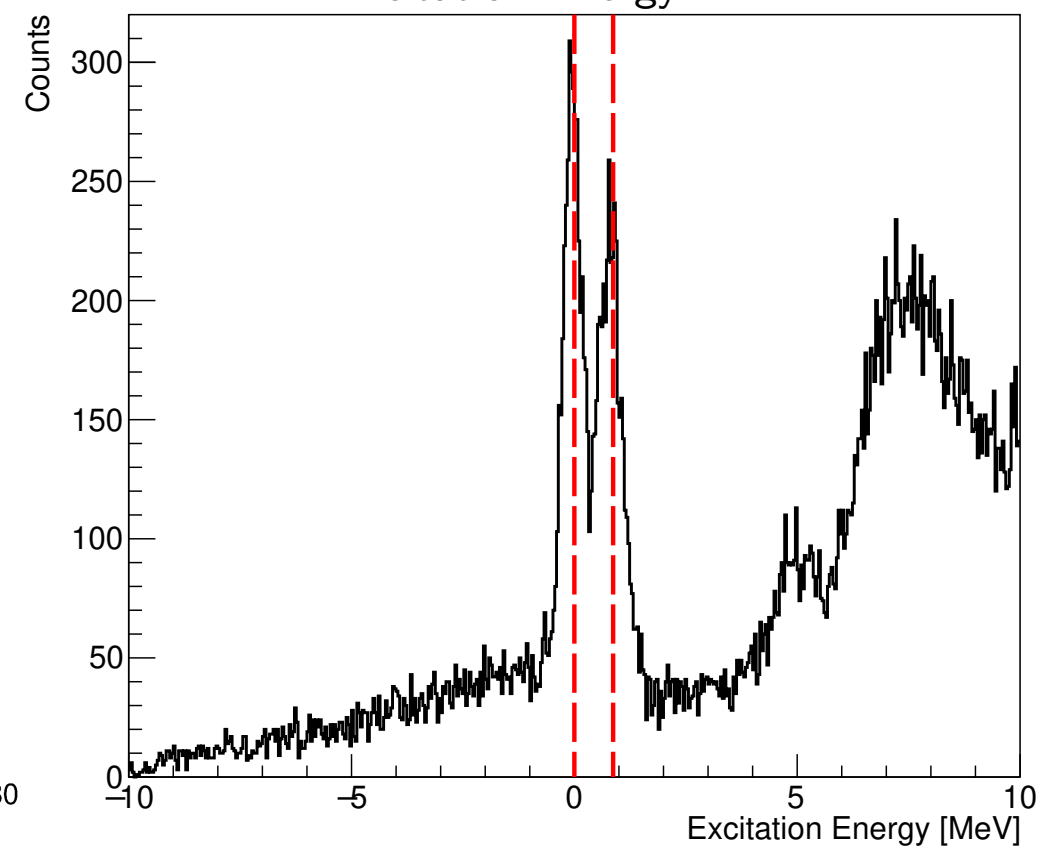


Kinematic Lines

No clear kinematic lines on MUST2

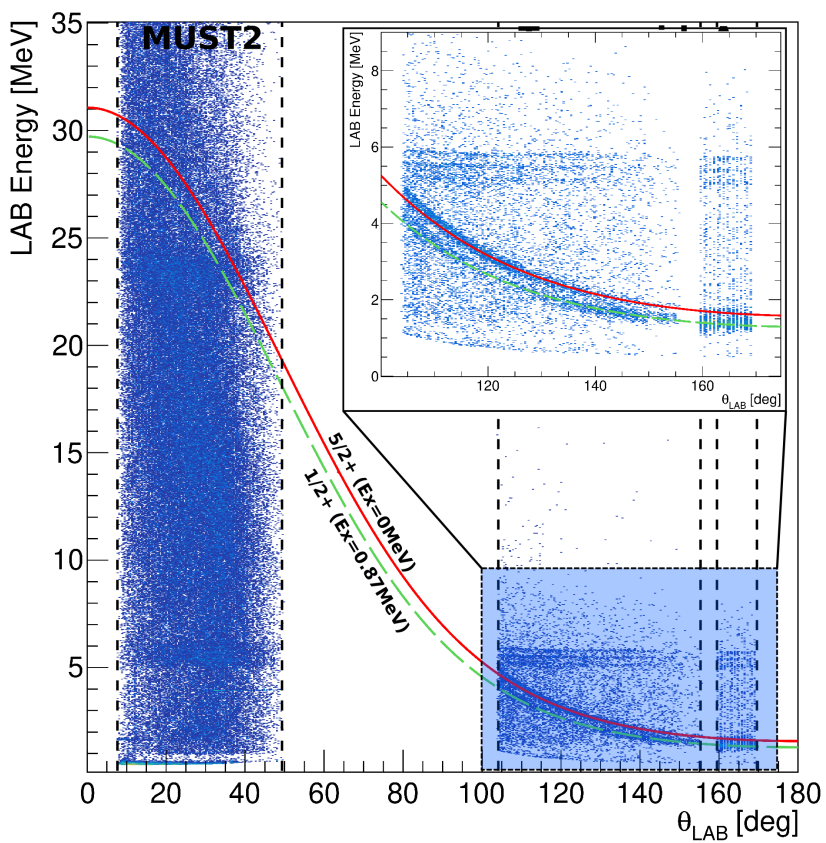


Excitation Energy

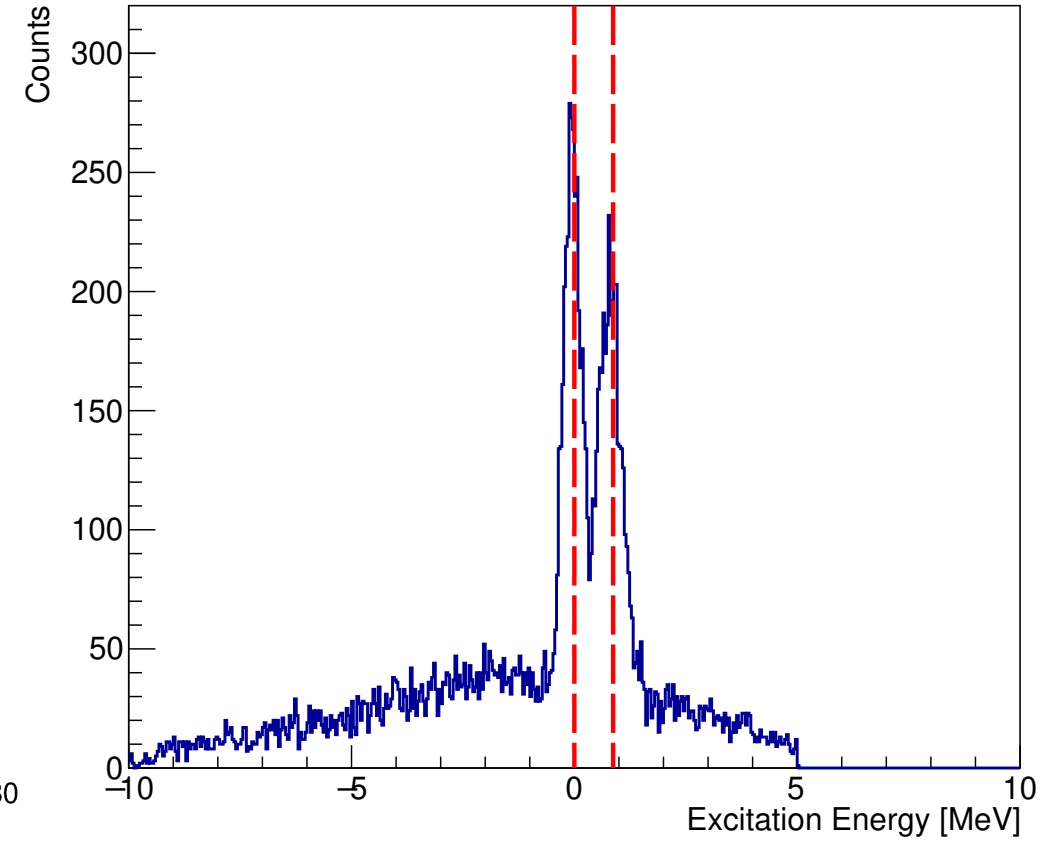


Kinematic Lines

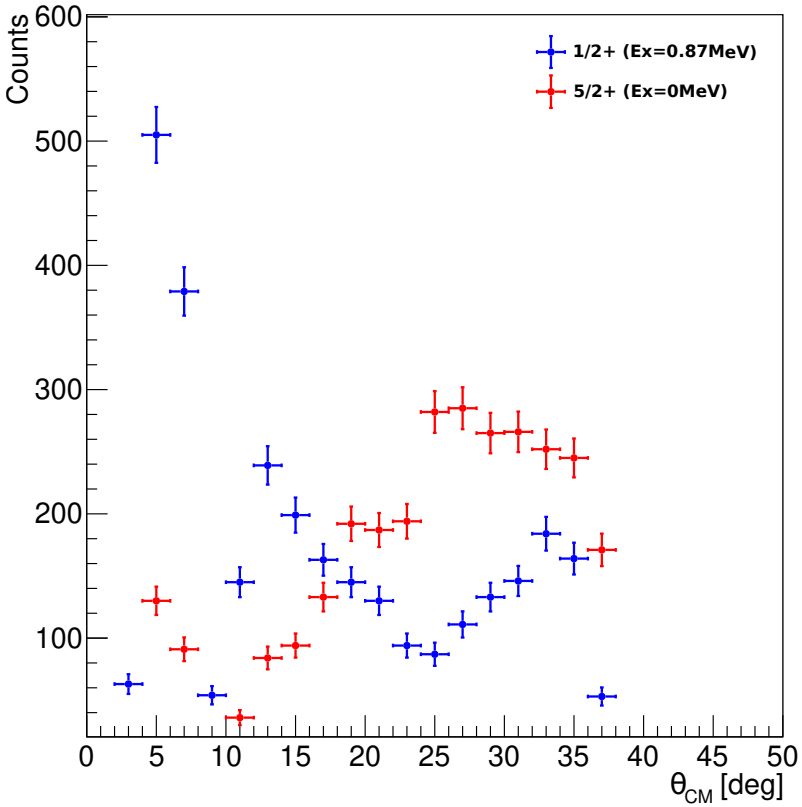
Selection of particle only on Mugast

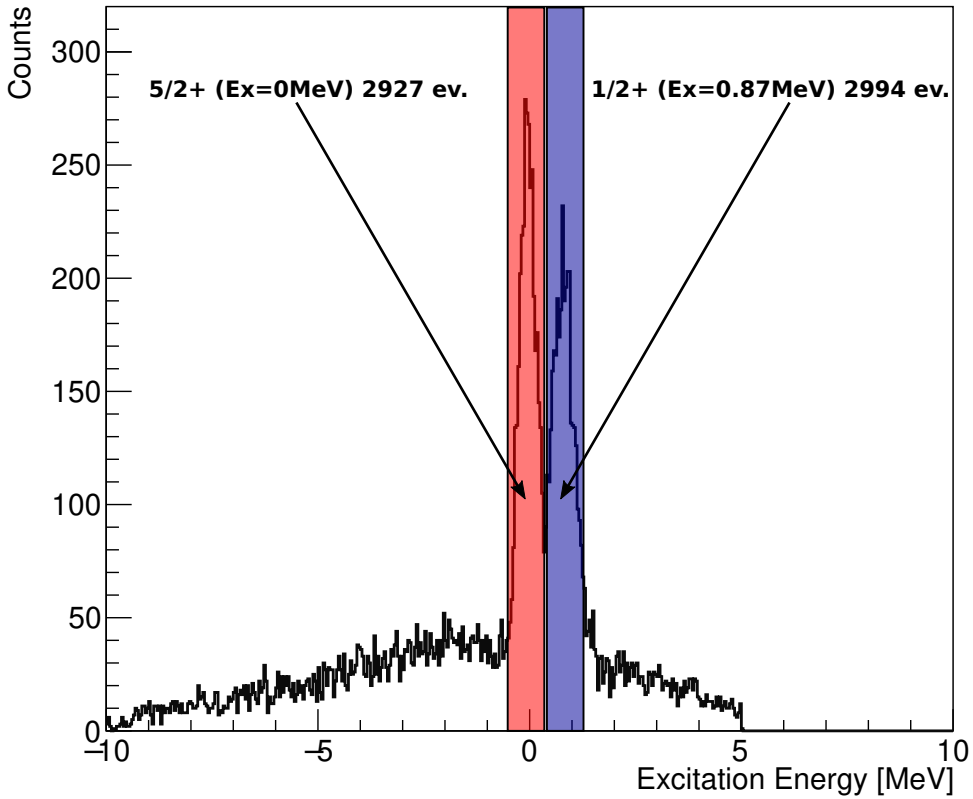


Excitation Energy



Angular Distribution





Differential Cross Section

Normalized with simulated angular efficiency

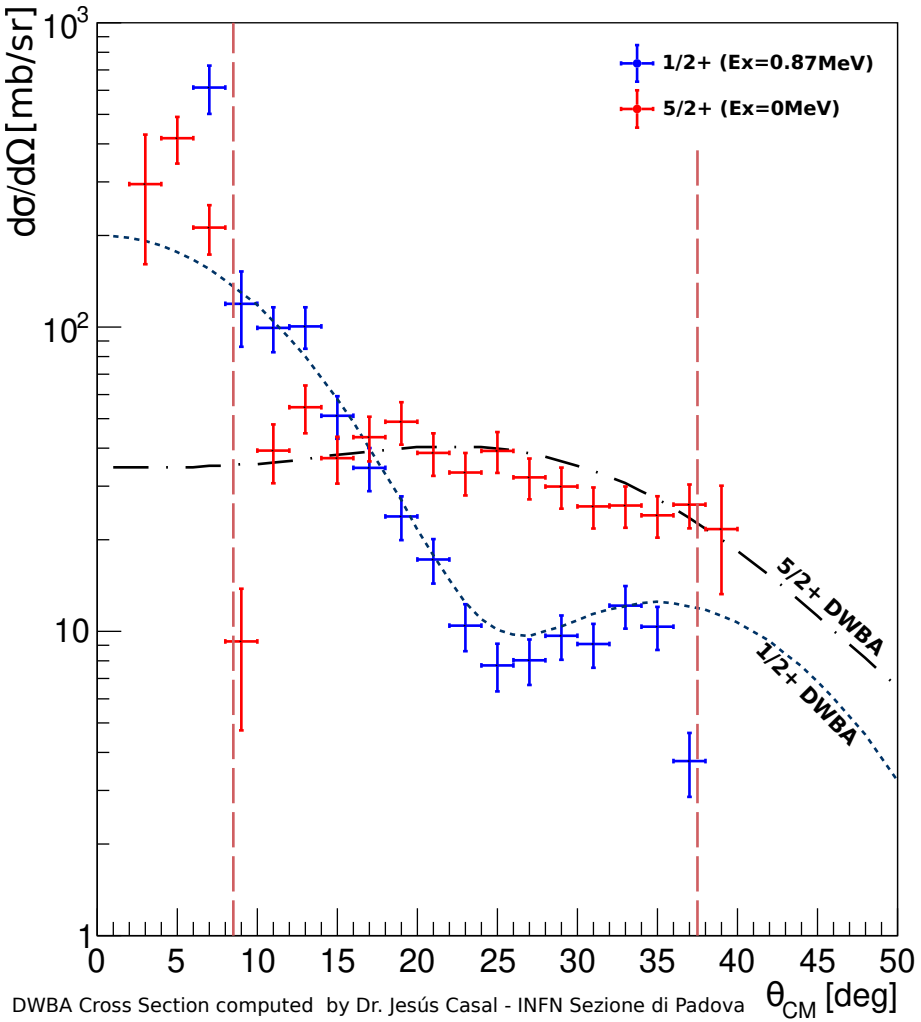
↓

Fit over the theoretical distribution

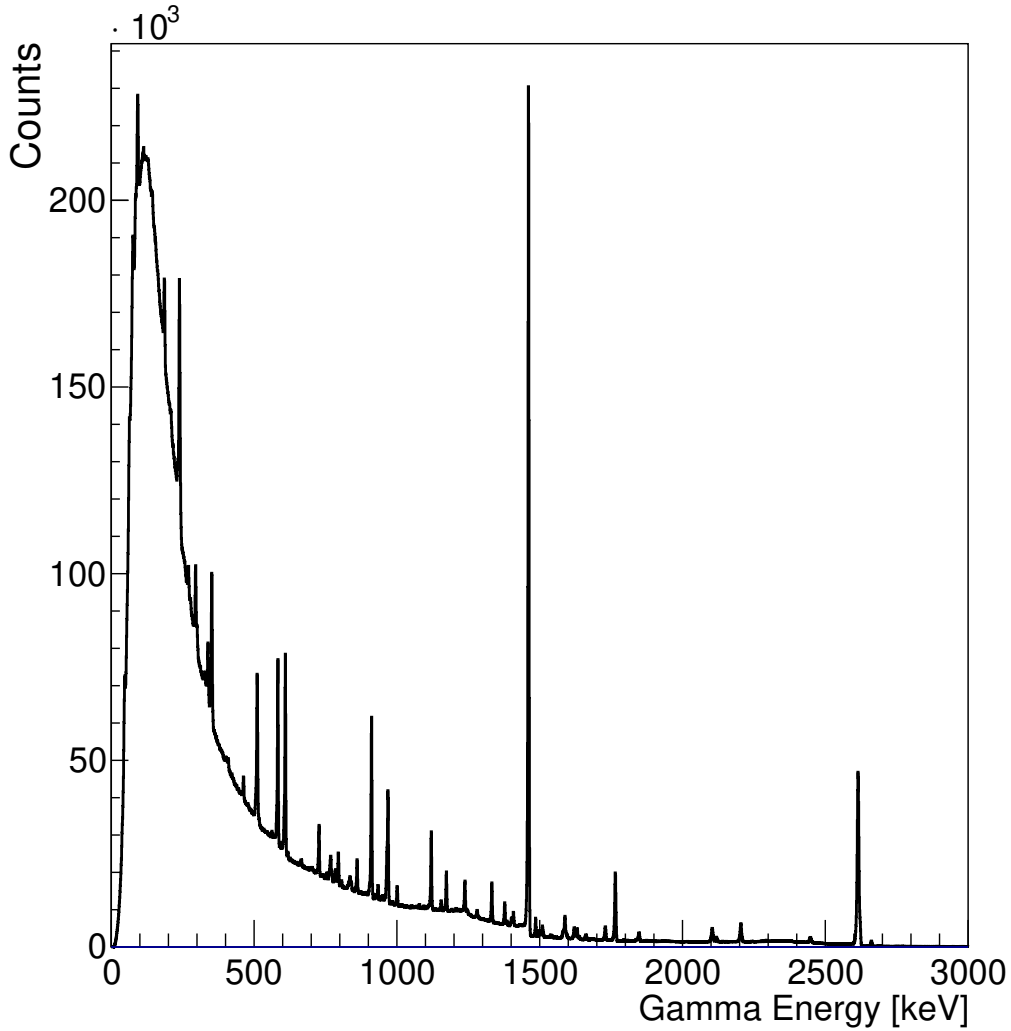
Efficiency normalization to be checked in the anular acceptance

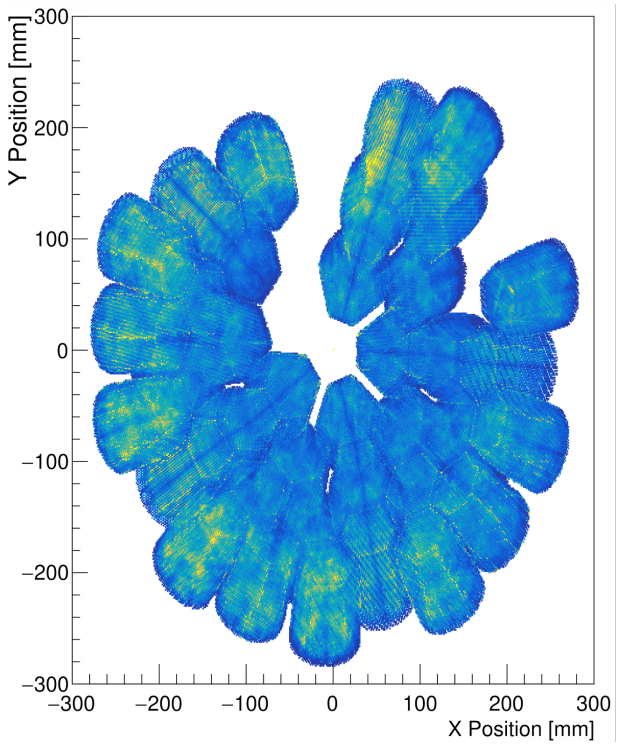
DWBA calculation from Jesus Casal
Università degli Studi di Padova
INFN Sezione di Padova

Optical potential from
An et al.,PRC 73.5 (2006)
Watson et al., PR 182.4 (1969)



Gamma Spectra

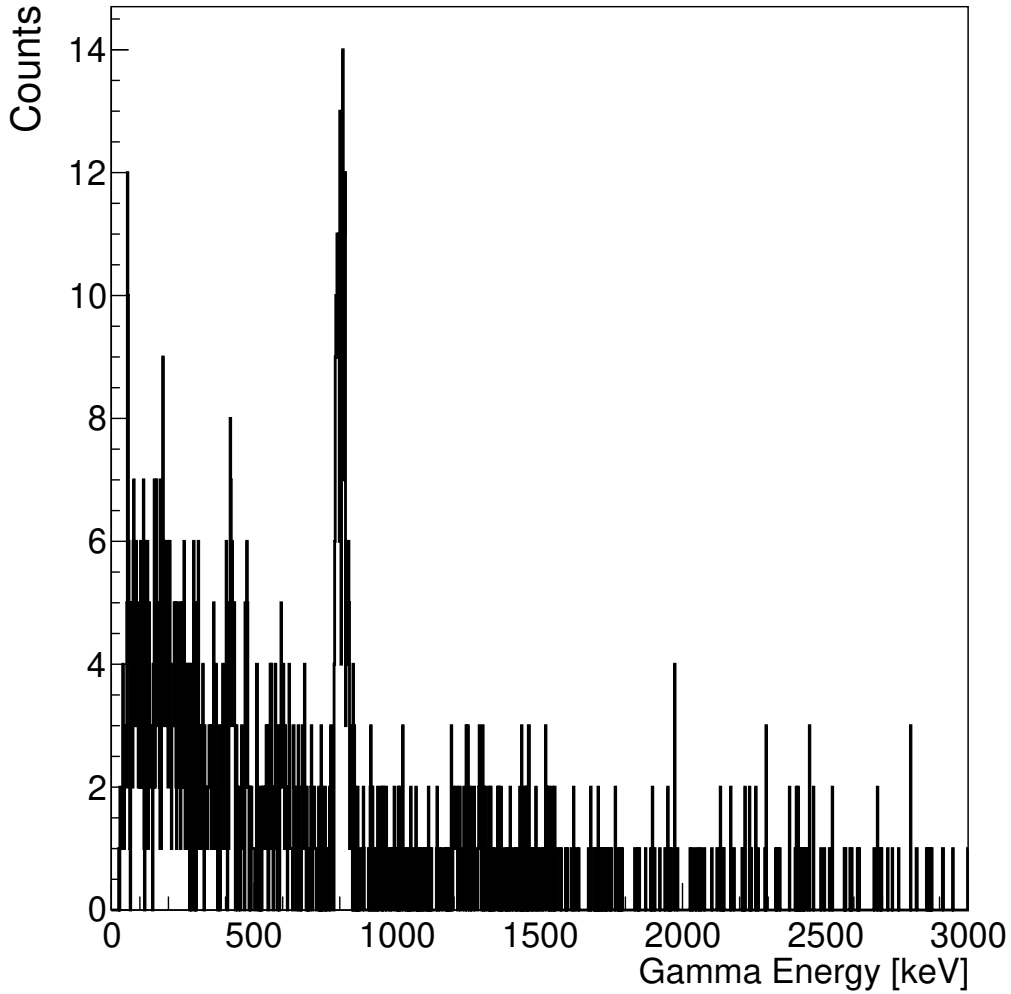




Gamma spectrum w/o gate.

$6.9\ 10^7$ ev.

Gamma Spectra

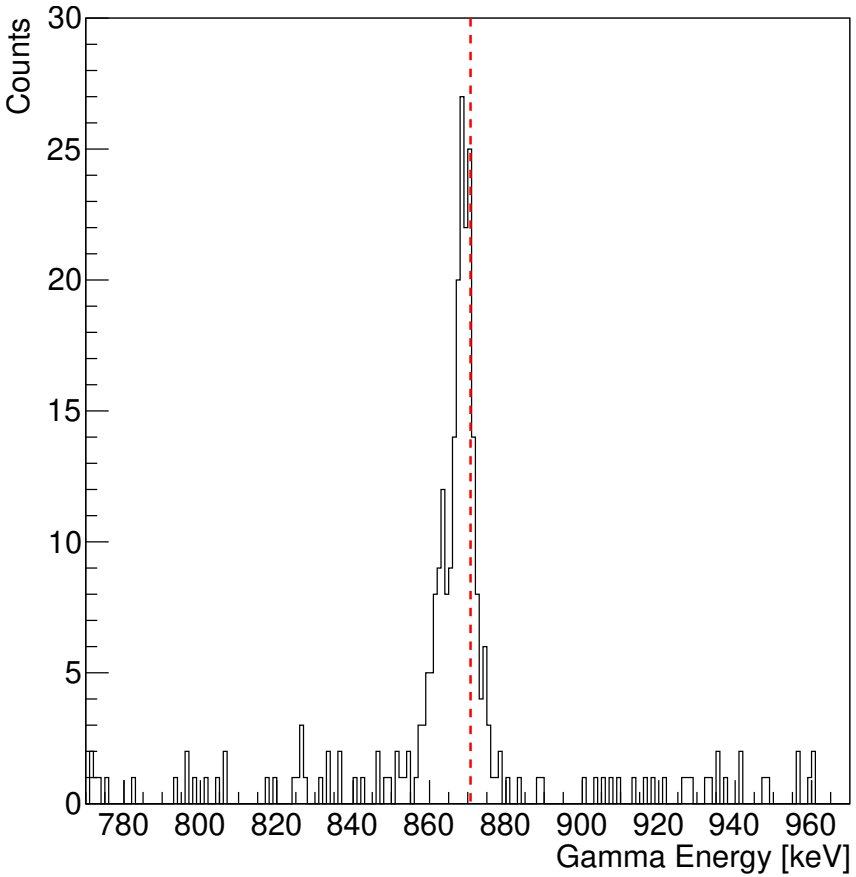


Proton gated spectrum.
1.6 10^3 ev.

↓

Doppler Correction Needed.

Doppler Correction

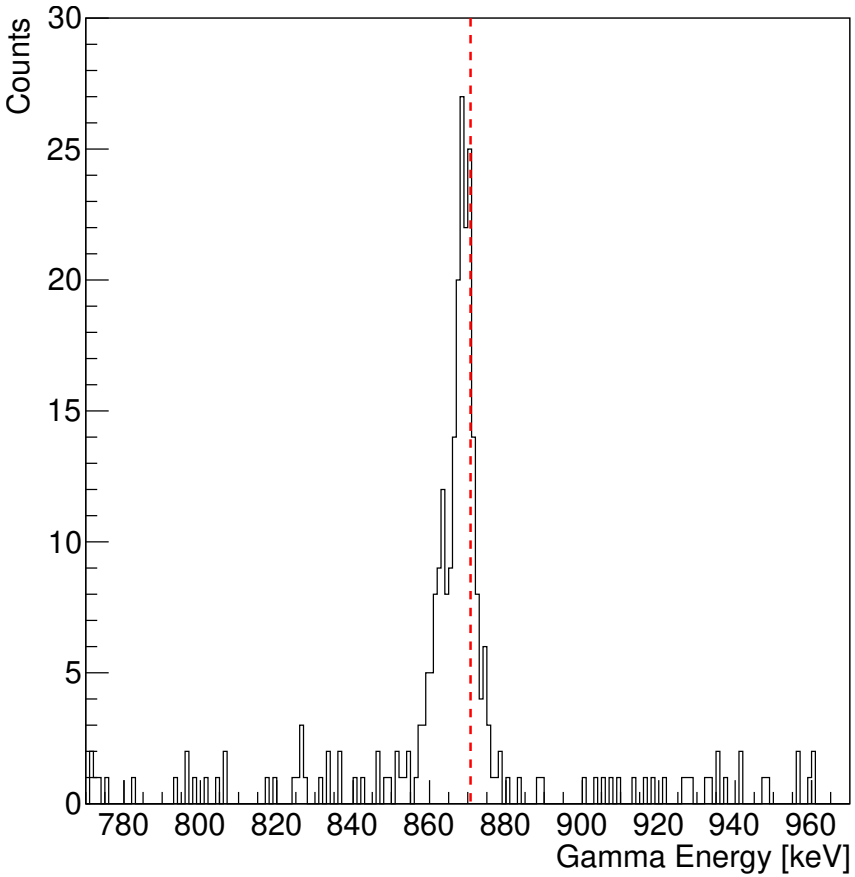


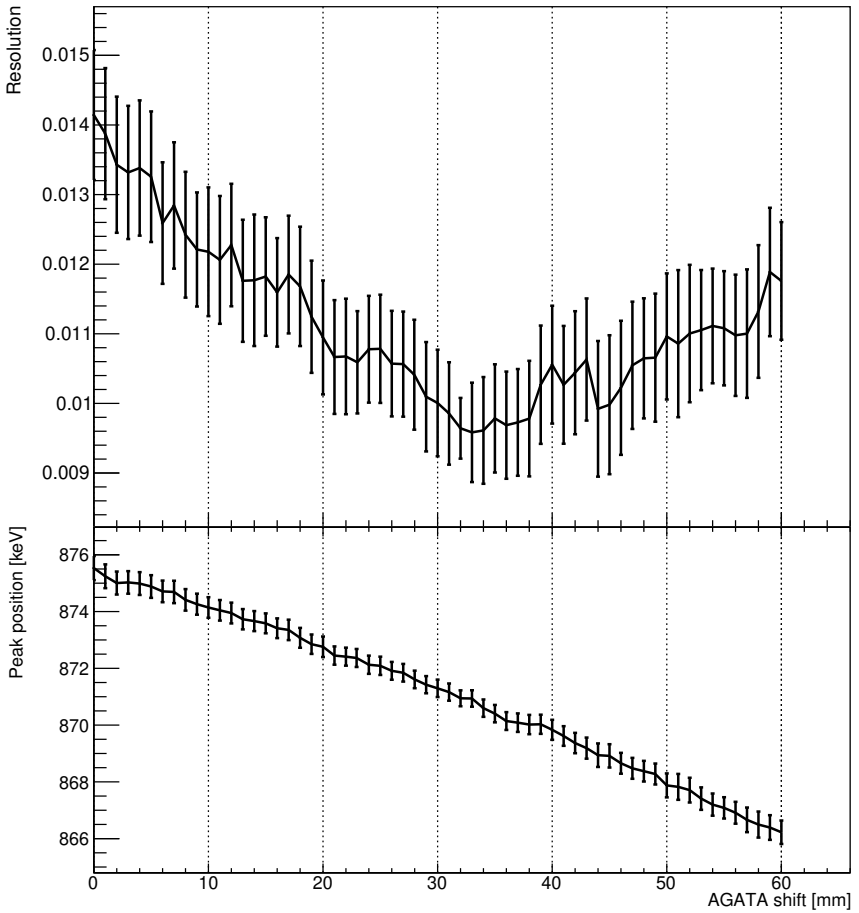
- Beta computation from proton direction
- First interaction from tracking (51 mm AGATA shift)

The peak is 1.8 keV shifted from 1/2+ state adopted energy.

Doppler Correction

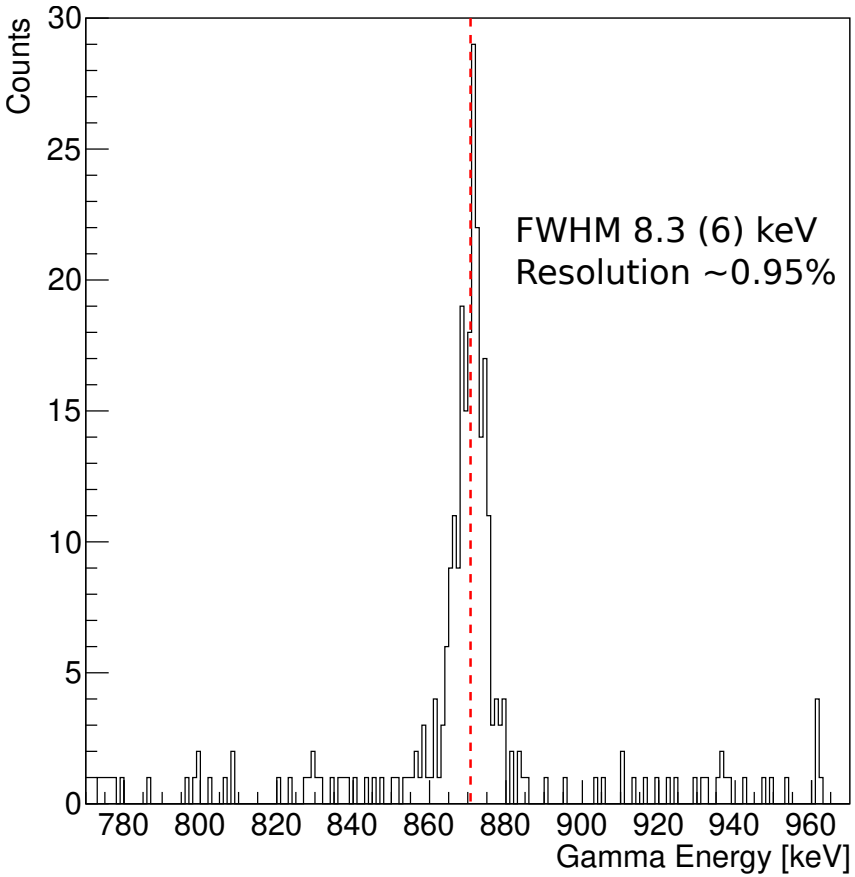
Minimization of resolution with scan over different shifts

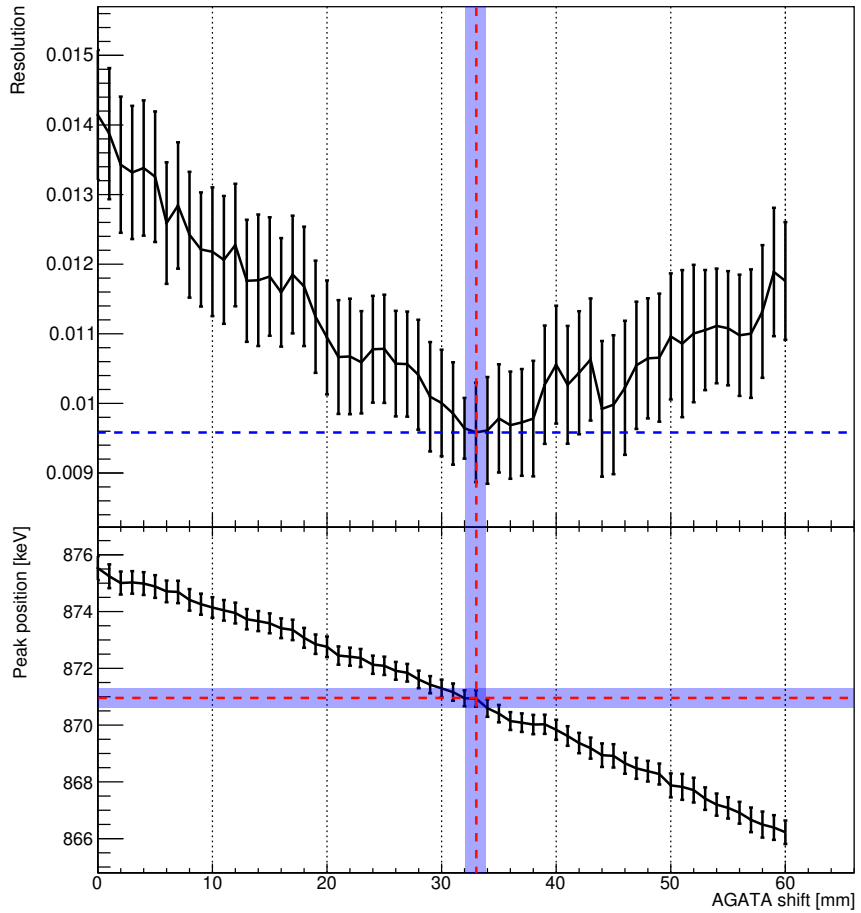




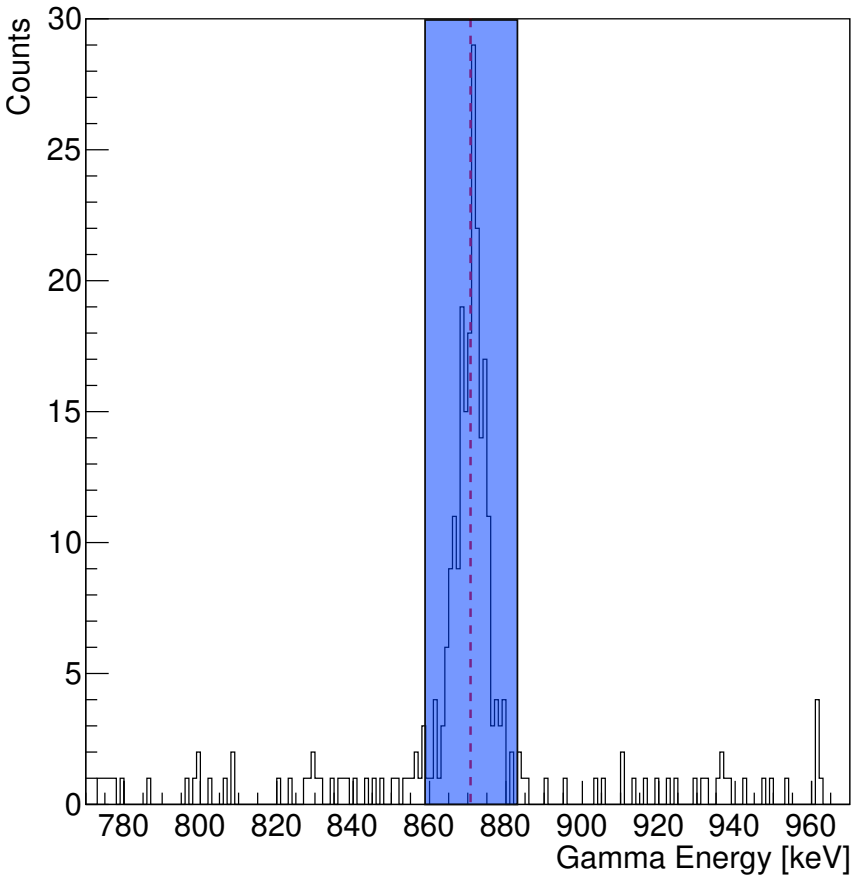
Doppler Correction

Best Resolution and Energy match with 33 mm shift





Deduced Efficiency



- 870 keV excitation peak integral (background removed)

$$\downarrow$$

2562 ± 50 protons

- 870 keV gamma peak integral (background removed)

$$\downarrow$$

Add Back $\rightarrow$ 177 ± 13 γ

Tracking $\rightarrow$ 160 ± 13 γ

Efficiency Estimate:

Add Back $\rightarrow$ 7.0 ± 0.5 %

Tracking $\rightarrow$ 6.3 ± 0.5 %

Summary

- Kinematic of the outgoing proton and ^{17}O (5/2+ and 1/2+) final levels selection from excitation energy.
- Angular distribution normalized and fitted to the theoretical differential cross section.
- Coincidence with AGATA and 870 keV peak doppler correction.
- AGATA efficiency estimate

Perspectives

- Investigation on mugast simulated angular efficiency.
- Check VAMOS performance.
- Investigation on AGATA resolution.

Acknowledgments

Thanks to AGATA+GRIT+VAMOS collaborations and
thank you for attention!