

(d,p) reaction study with MUGAST: enhanced setup

Adrien Matta ^a, W. Catford ^a

^aDepartment of Physics, University of Surrey

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Introduction

Aim of MUGAST

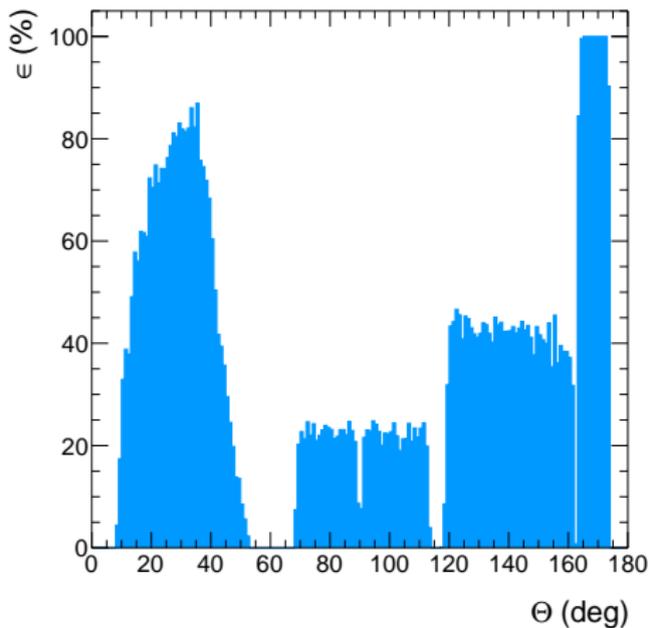
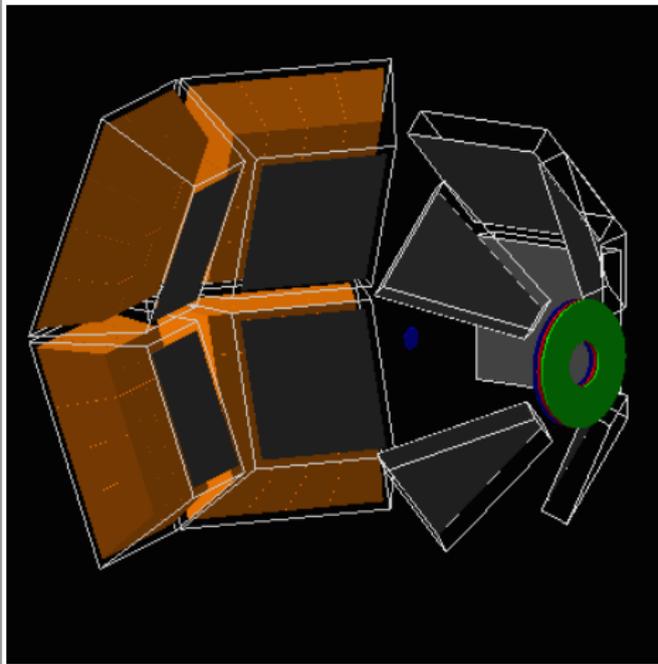
- Demonstrate GASPARD/HYDE/TRACE
- Show off particle- γ integration
- Take advantage of AGATA
- Take advantage of VAMOS

Pieces available for a setup

- MUST2: 4 Telescopes and 12 Electronic blocs
- GASPARD: 4 Trapezoidal Si
- Trace: 4 Rectangular Si
- Other: 1 S1 Annular Si

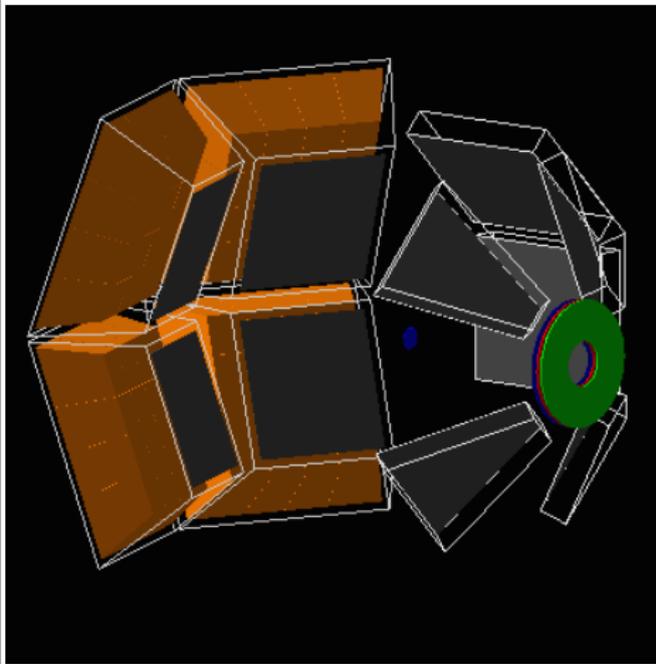
Introduction: Why a new setup?

Original Setup



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Original Setup

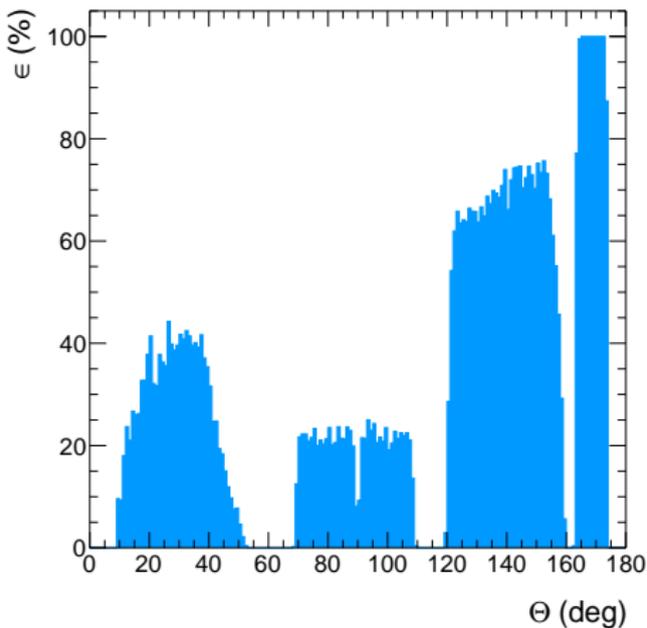
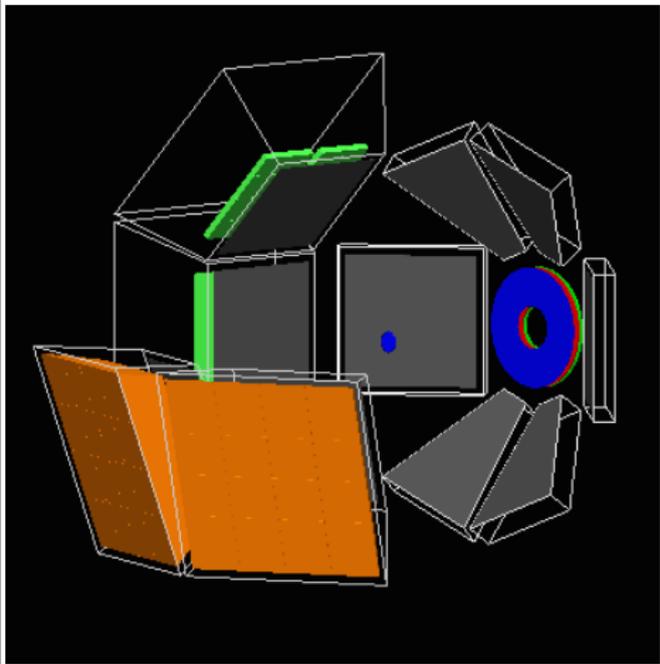


Stripping perspective:

- Good eff. forward (80%)
 - Insufficient eff. backward (40%)
 - Trace too thin for proton at 90 deg.
- (d,p) eff. at 90 deg is 0%
- elastic eff. at 90 deg is limited

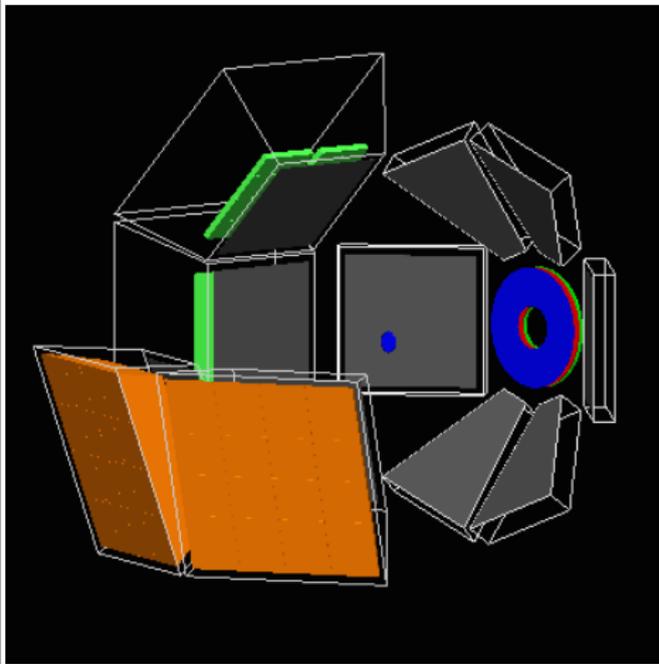
Introduction: New Setup

Enhanced Setup



Introduction: New Setup

Enhanced Setup

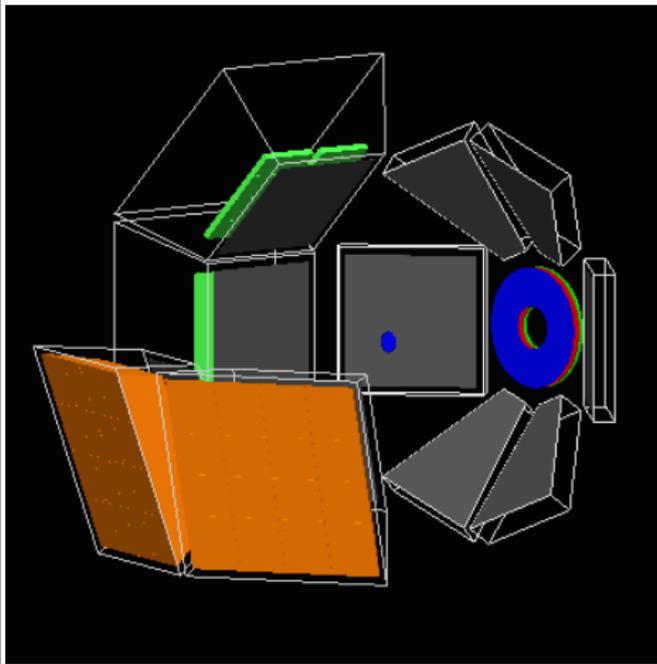


Stripping perspective:

- Reduced eff. forward (40%)
- Sufficient eff. backward (80%)
- Sufficient eff. for elastic (20%)
- Wide energy range and d/p Discr.
- SiLi good for proton at 90 deg
- Bigger range for angular distribution

Introduction: New Setup

Enhanced Setup



How to:

- Take the two trace detector to backward angle
- Reorganise the GASPARD Trapezoid
- Install Two MUST2 with Si(Li) at 90 deg.
- Leave space at 90 for Electronic Bloc
- Easy to reinstall 2 Telescope with CsI at Forward Angle

Simulation using NPTool



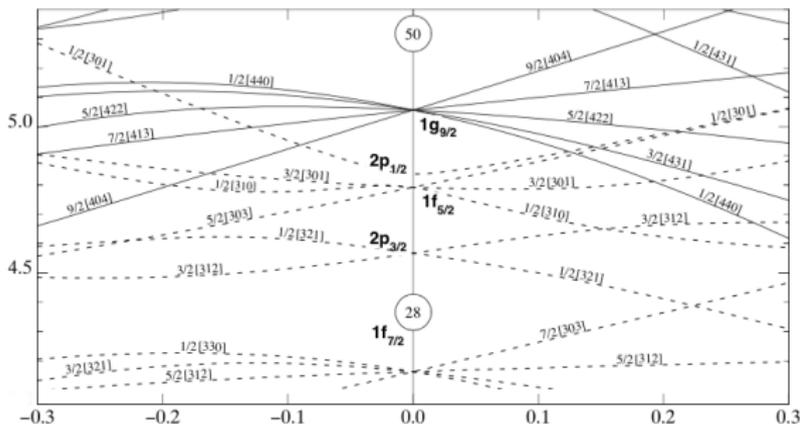
- web site :
<https://github.com/adrien-matta/nptool>
- Instructions to download and run the simulation on the page
- If you need more EventGenerator, contact at a.matta@surrey.ac.uk
- Old setup: use MUGAST.detector
- New setup: use MUGAST2.detector

^{75}Kr : Physics Case

Expected states

shell	ℓ	Ω	E (keV)
1g $9/2$	4	5/2	0
1g $9/2$	4	7/2	187
1f $5/2$	3	5/2	358
1g $9/2$	4	3/2	179
1g $9/2$	4	5/2	786
2p $1/2$	1	1/2	689

Deformation



Elbek and Thoron (1969)

Fingerprint methods

- Populate the SM component
- SF within a band give β

Shape coexistence

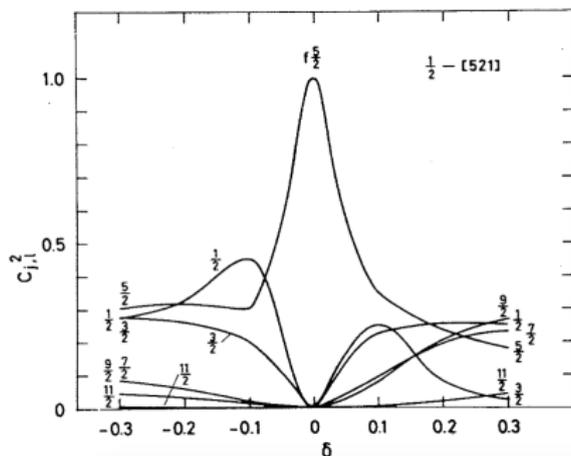
- Rotational band with $\beta = 0.4$
- Rotational band with $\beta = -0.2$

^{75}Kr : Physics Case

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Shape coexistence

- Rotational band with $\beta = 0.4$
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^{75}Kr : Beam time

Beam intensity and Target

- ^{74}Kr at 4 AMeV 3.10^4 pps
 - CD_2 target of $2 \text{ mg}\cdot\text{cm}^2$
 - VAMOS Eff: 80%
 - AGATA Eff: 7% (23.5 cm)
- NB: AGATA demonstrator only

Count rate per day

shell	ℓ	σ	N_R
1g9/2	4	6 mb	2600
1g9/2	4	6 mb	2600
1g9/2	3	3 mb	1300
1g9/2	4	6 mb	2600
1g9/2	4	6 mb	2600
2p1/2	1	5 mb	2200

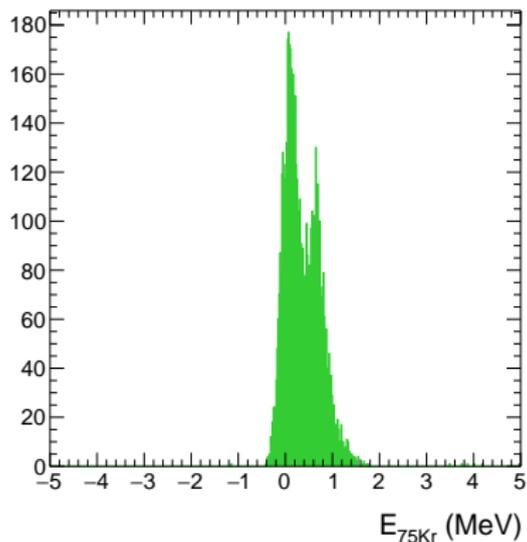
counts assume: $S=0.5$

Beam time

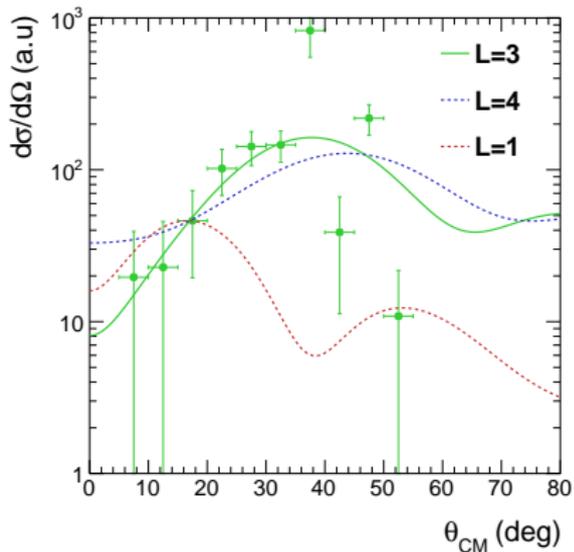
7 days of counting minimum. Requesting 10 days.

^{75}Kr : MUGAST

Excitation Energy



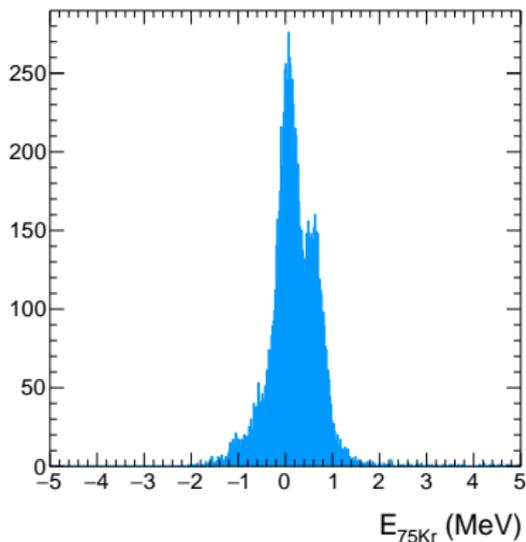
Differential Cross Section



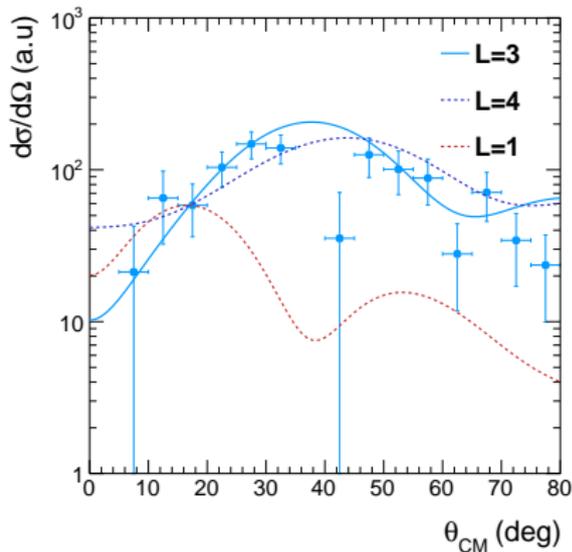
Gamma gated count for 1st ex. state count : 82

^{75}Kr : MUGAST2

Excitation Energy



Differential Cross Section

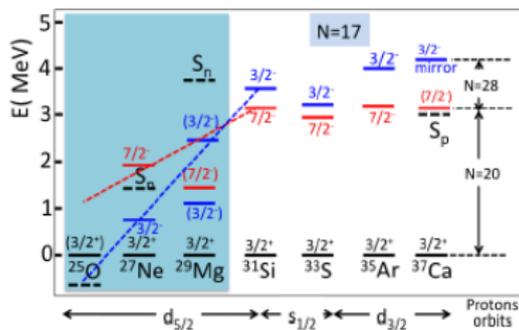


Gamma gated count for 1st ex state count : 144

^{29}Mg : Island of Inversion

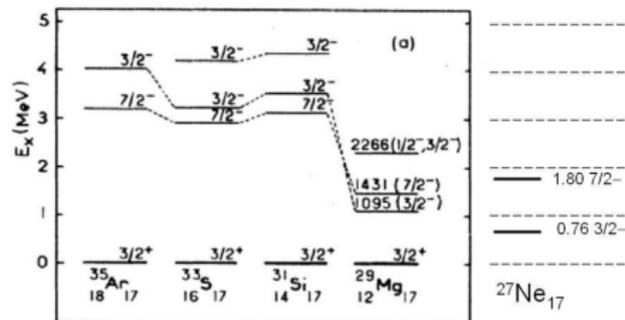
Closure of $N=20$

Gap evolution between $1s_0d$ and $0f_1p$



O.Sorlin, INPC 2013 proceeding.

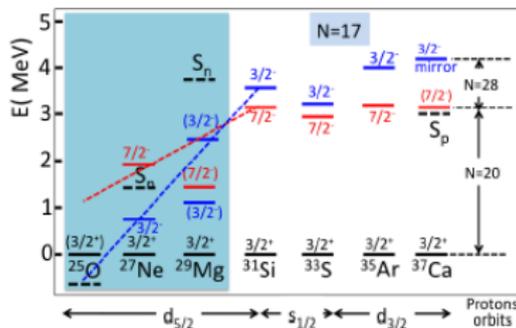
Level Scheme



^{29}Mg : Island of Inversion

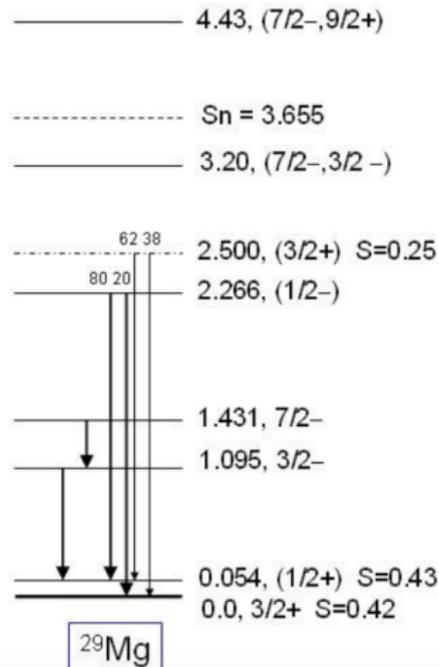
Closure of $N=20$

Gap evolution between $1s_0d$ and $0f_1p$



O.Sorlin, INPC 2013 proceeding.

Level Scheme



^{29}Mg : Beam time

Beam intensity and Target

- ^{28}Mg at 10 AMeV 1.10^5 pps
 - CD_2 target of $2 \text{ mg}\cdot\text{cm}^2$
 - VAMOS Eff: 80%
 - AGATA Eff: 7% (23.5 cm)
- NB: AGATA demonstrator only

Count rate per day

shell	E	ℓ	σ	N_R
1d3/2	0	2	7 mb	3200
2p3/2	1.1	1	4 mb	3000
1f7/2	1.4	3	6 mb	4400
2f1/2	2.3	3	6 mb	4400
1f7/2	4.4	3	6 mb	4400
1g9/2	4.4	4	2 mb	1500

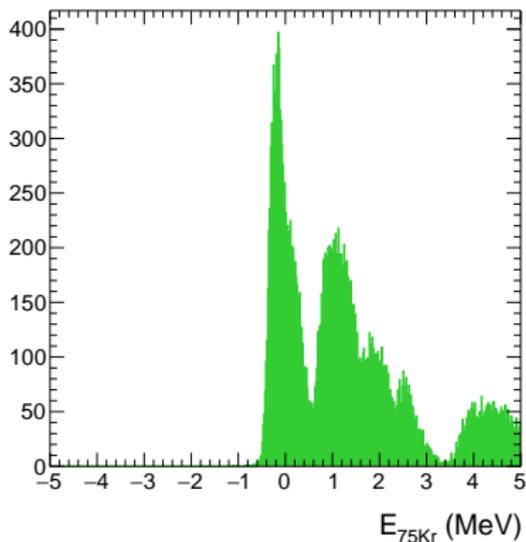
counts assume: $S=0.5$

Beam time

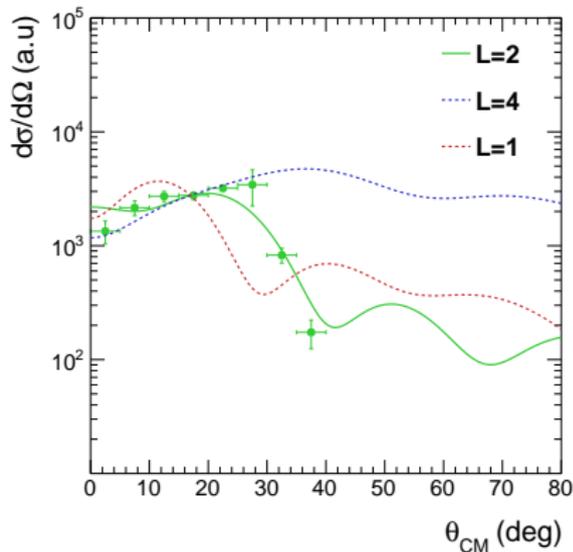
7 days of counting minimum. Requesting 10 days.

^{29}Mg : MUGAST

Excitation Energy



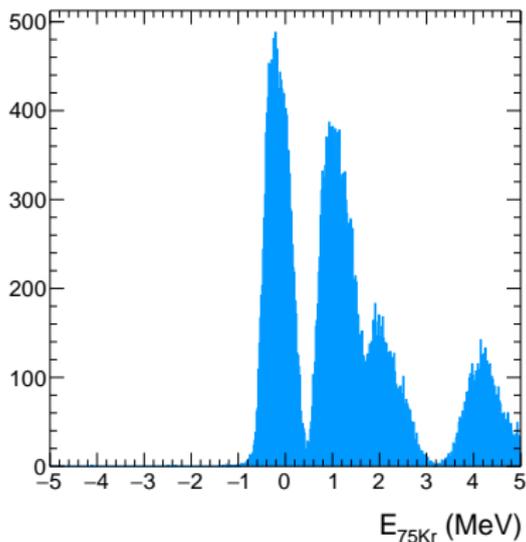
Differential Cross Section



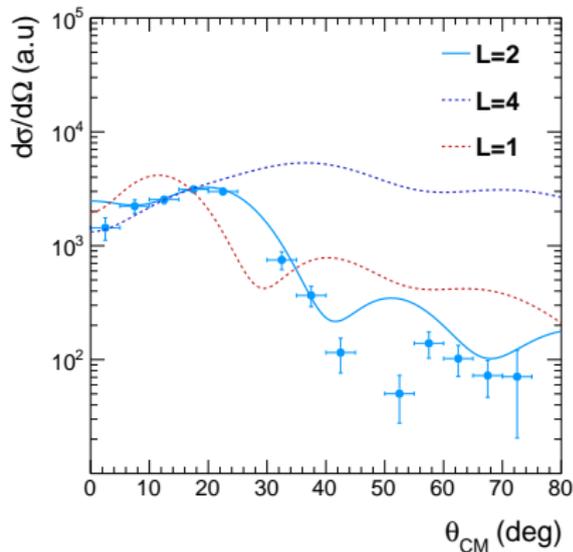
Gamma gated count for 1st ex. state count : 779

^{29}Mg : MUGAST2

Excitation Energy



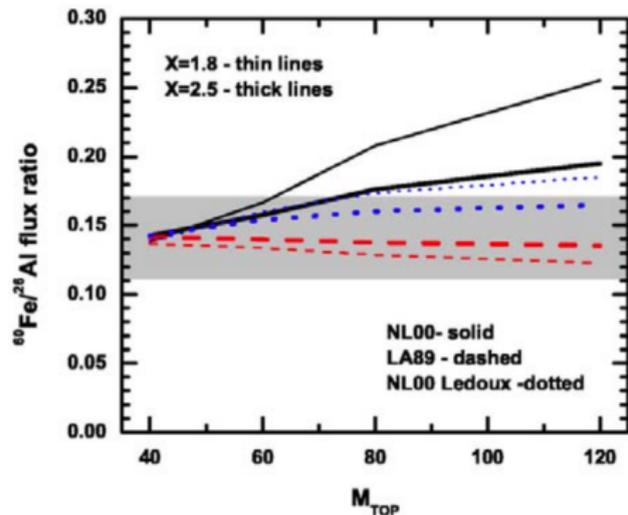
Differential Cross Section



Gamma gated count for 1st ex state count : 1217

^{61}Fe : Stellar nucleosynthesis

Production model

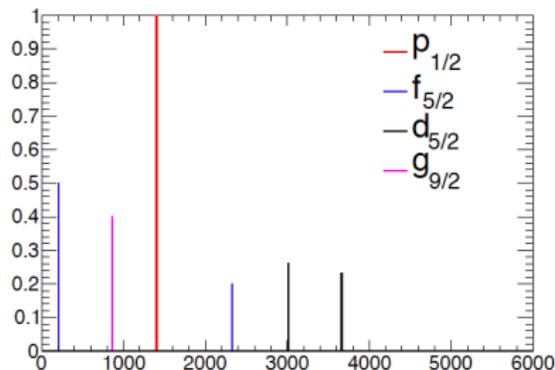


Limongi/Chieffi, *Astroph. Jour.*, Vol. 647(2006)

Experiment done on LISE before

- Higher energy
- Poor Gamma Statistic
- Background

Strength of (d,p) state



S. Giron thesis (2011)

^{61}Fe : Beam time

Beam and Target

- ^{60}Fe at 9 AMeV
 - $1.7 \cdot 10^5$ pps
 - CD_2 target of $2 \text{ mg}\cdot\text{cm}^2$
 - VAMOS Eff: 80%
 - AGATA Eff: 7%
(23.5 cm)
- NB: AGATA
demonstrator only

Count rate per day

shell	E	ℓ	σ	N_R
1f5/2	207	3	1 mb	2518
1g9/2	861	4	3 mb	7554
1f5/2	1245	2	1 mb	2518
2p1/2	1401	1	6 mb	15108
1d5/2	~ 3000	2	8 mb	20144
1d5/2	~ 3500	2	8 mb	20144

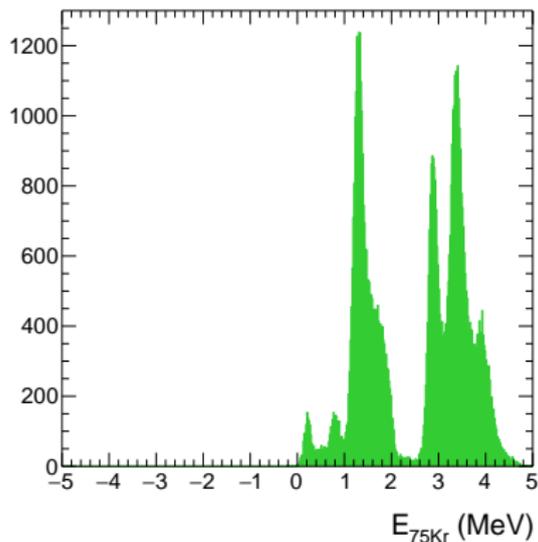
counts assume: $S=0.5$

Beam time

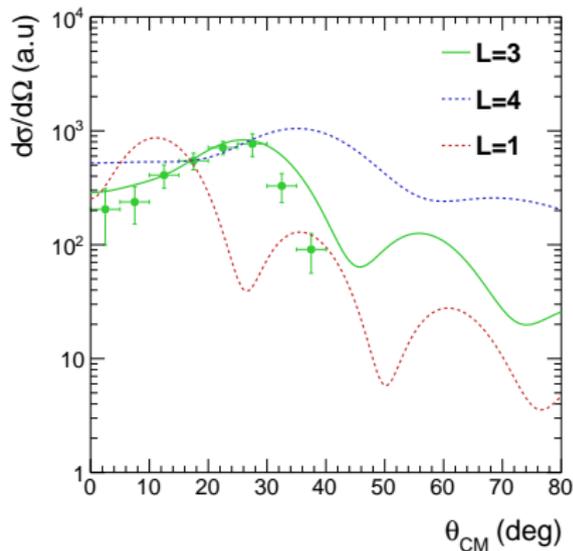
7 days of counting minimum. Requesting 10 days.

^{61}Fe : MUGAST

Excitation Energy



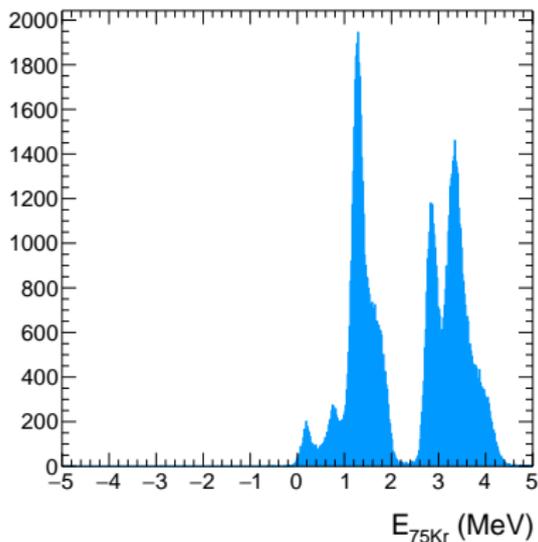
Differential Cross Section



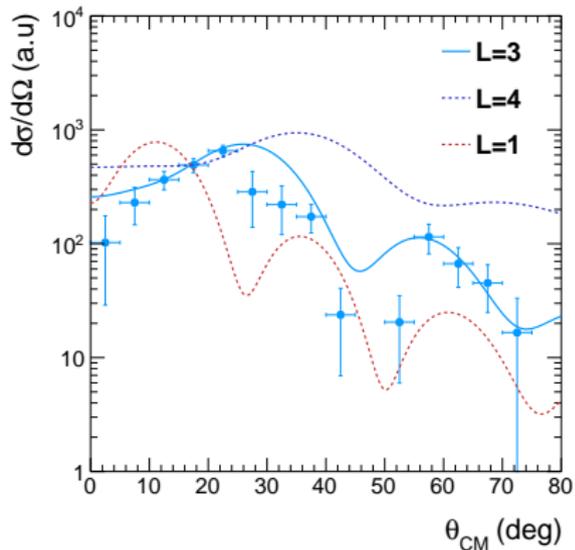
Gamma gated count for 1st ex. state count : 180

^{61}Fe : MUGAST2

Excitation Energy



Differential Cross Section



Gamma gated count for 1st ex state count : 246