PARIS — PHOTON ARRAY FOR STUDIES WITH RADIOACTIVE ION AND STABLE BEAMS

Status Report from the GEANT4 simulation WG

O. Stézowski, on behalf of the group

Paris Week, Strasbourg 12-14 January, 2011

PARIS — PHOTON ARRAY FOR STUDIES WITH RADIOACTIVE ION AND STABLE BEAMS

Spectroscopy

- high resolution e
- ‘low’ multiplicity
- ...

PARIS

LaBr3 + ?

Calorimeter

- ‘low’ resolution e
- high multiplicity (+ resolution)
- GDR
- ...

E : 0 ☛ 40 MeV, efficiency as greater as possible !

List of requirements

List of requirements related to the different physics cases to be addressed at PARIS

Physics Case	Recoil mass	v/c [%]	E_g range [MeV]	DE_g/E_g [%]	DE_{sum}/E_{sum} [%]	DM_g	W coverage	DT [ns]	Ancillaries	Comments
Jacobi transition	40-150	<10	0.1-30	4	<5	4	2p-4p	<1	AGATA HI det.	High eff. Beam rej.
Shape Phase Diagram	160-180	<10	0.1-30	6	<5	4	2p-4p	<1	HI det.	High eff. Differential method Beam rej.
Hot GDR in n-rich nuclei	120-140	<11	0.1-30	6	<8	4	2p-4p	<1	HI det.	Beam re.
Isospin mixing	60-100	<7	5-30	6	-	-	4p	<1	HI det.	High eff. Beam rej.
Reaction dynamics	160-220	<7	0.1-25	6-8	<8	4	2p	<1	n-det. FF det.	Complex coupling
Collectivity vs. multi-fragmentation	120-200	<8	5-30	5	-	-	2p	<1	LCP det. HI det.	Complex coupling
Radiative capture	20-30	<3	1-30	<4	5	-	4p	<1	HI det.	High eff.
Multiple Coulex	40-60	<7	2-6	5	-	-	2p	<5	AGATA CD det.	Complex coupling
Astrophysics	16-90	0.1	0.1-6	6	5	-	4p	<1	Outer PARIS shell as active shield	High eff. Back-ground
Shell structure at intermediate energies (SISSI/LISE)	16-40	20-40	0.5-4	3	-	-	3p	<<1	SPEG or VAMOS	High eff. Low I_{beam} g-g coinc
Shell structure at low energies (separator part of S^3)	30-150	10-15	0.3-3	3	-	-	3p	<<1	Spectrometer part of S^3	High eff. Low I_{beam} g-g coinc
Relativistic Coulex	40-60	50-60	1-4	4	-	-	Forward 3p	<<1	AGATA HI analyzer	Ang. Distr. Lorentz boost

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Hot GD [illegible] n[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	2p-4p	<1	HI det.	Beam re.
Isospi[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	4p	<1	HI det.	High eff. Beam rej.
Reactio[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	2p	<1	n-det. FF det.	Complex coupling
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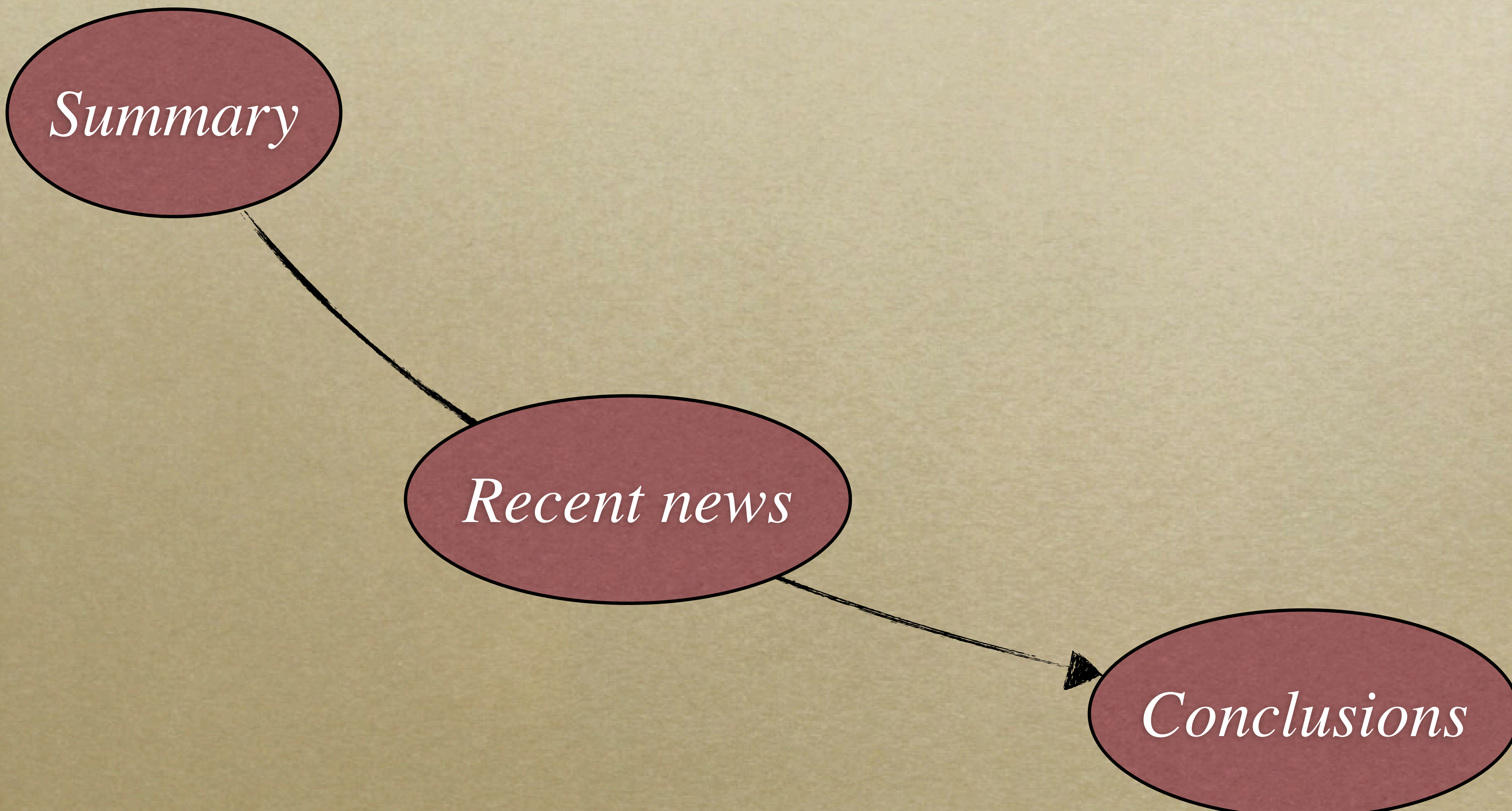
Not design for high recoil velocity

In this report



In this report

Summary

General Studies (package G4,EGS)

mainly efficiency @ multiplicity 1

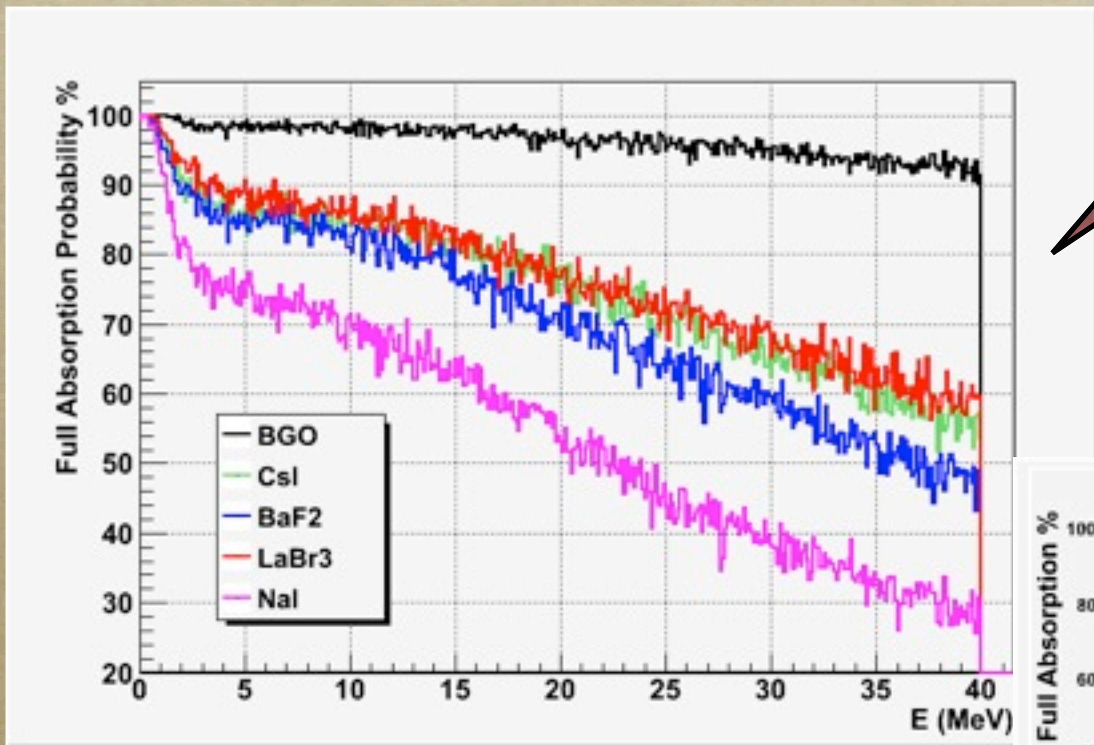
Recent news

Conclusions

http://paris.ifj.edu.pl/documents/sim/

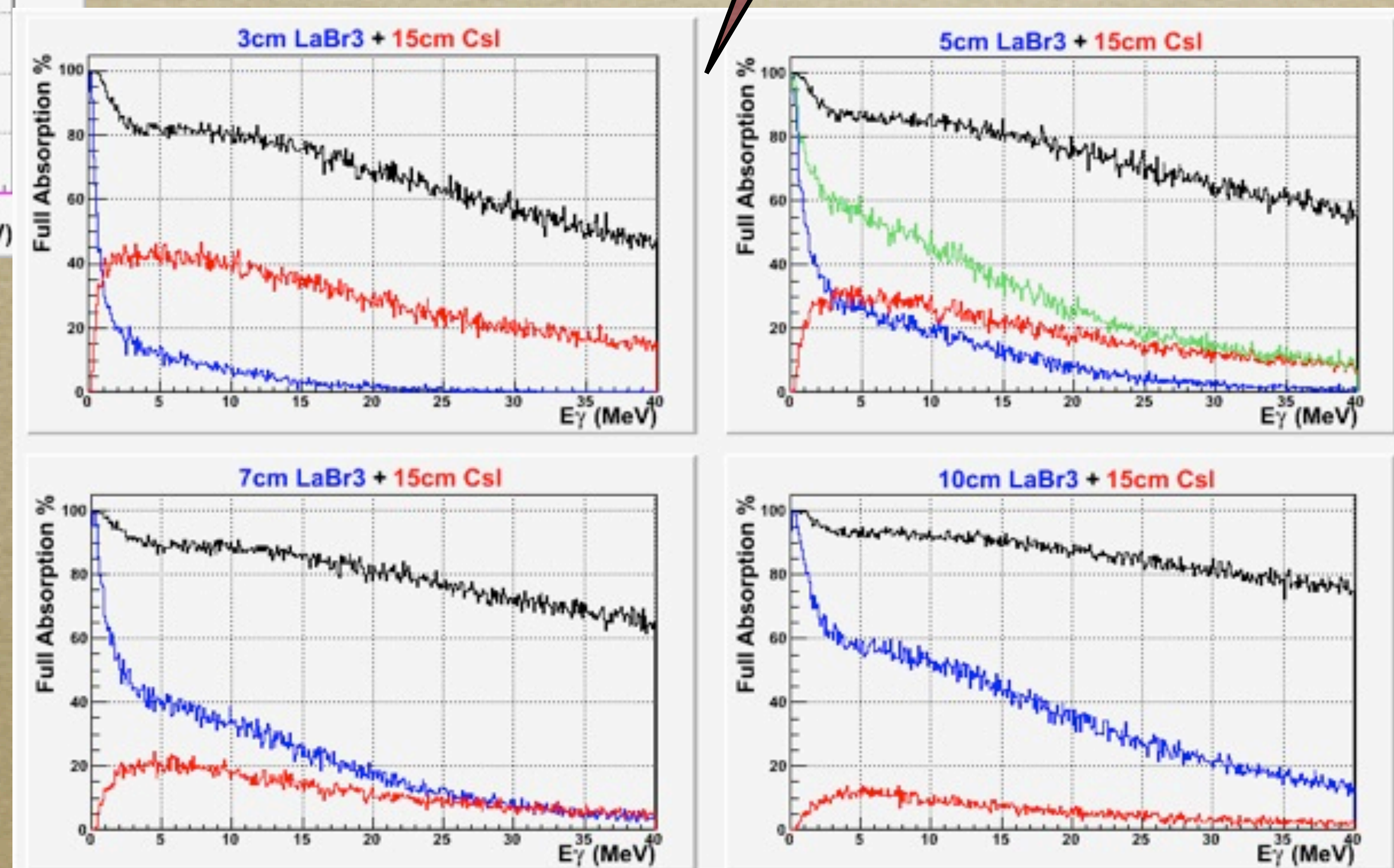
Summary

What we have learned



Full sphere

2 concentric spheres



Two shells : OK

(+ reconstruction)

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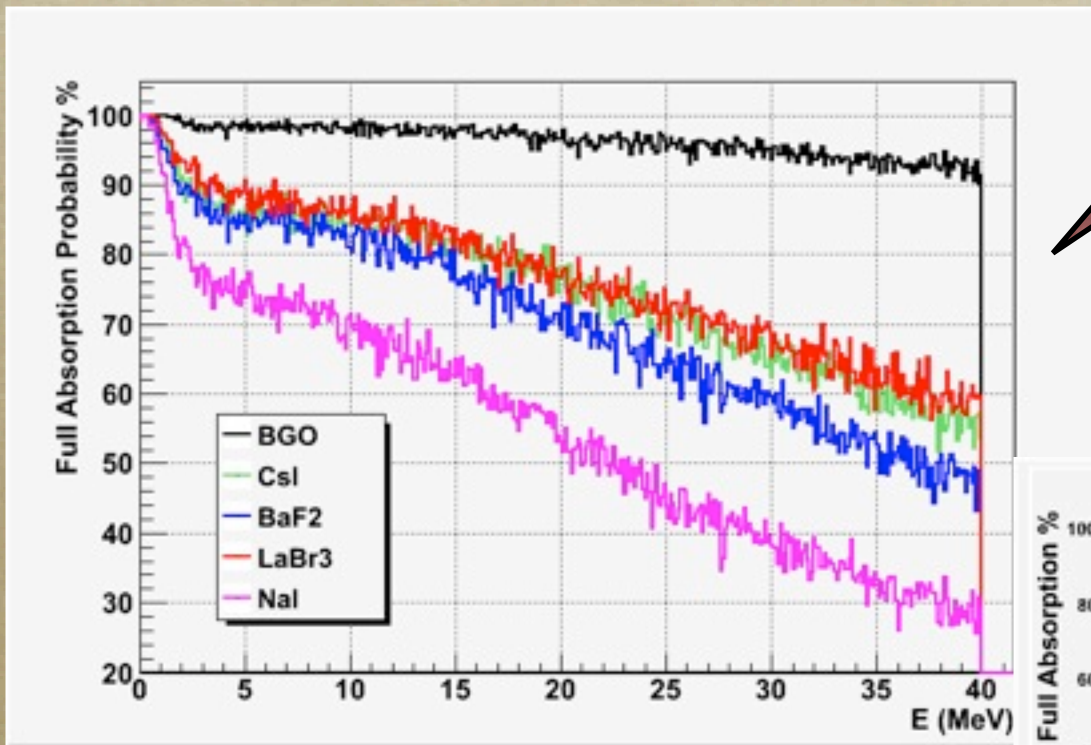

Full sphere

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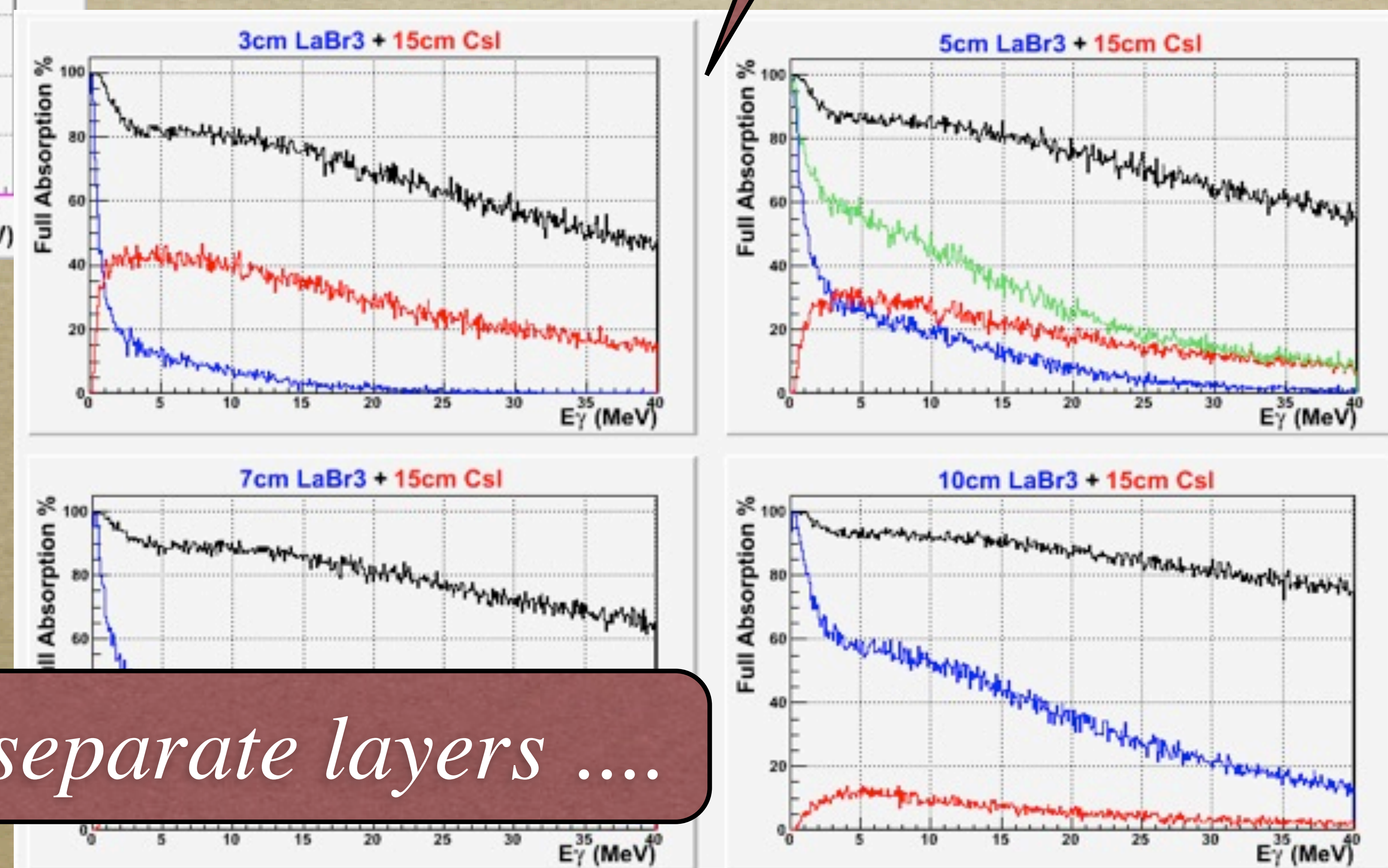

Two shells : OK

(+ reconstruction)

more required if two separate layers ....

Summary

What we have learned

- *Absorption (mean free path)*
  - *Energy resolution (Doppler)*
    - *Pileup*

☛ *Give limits for the segmentation ≃100*

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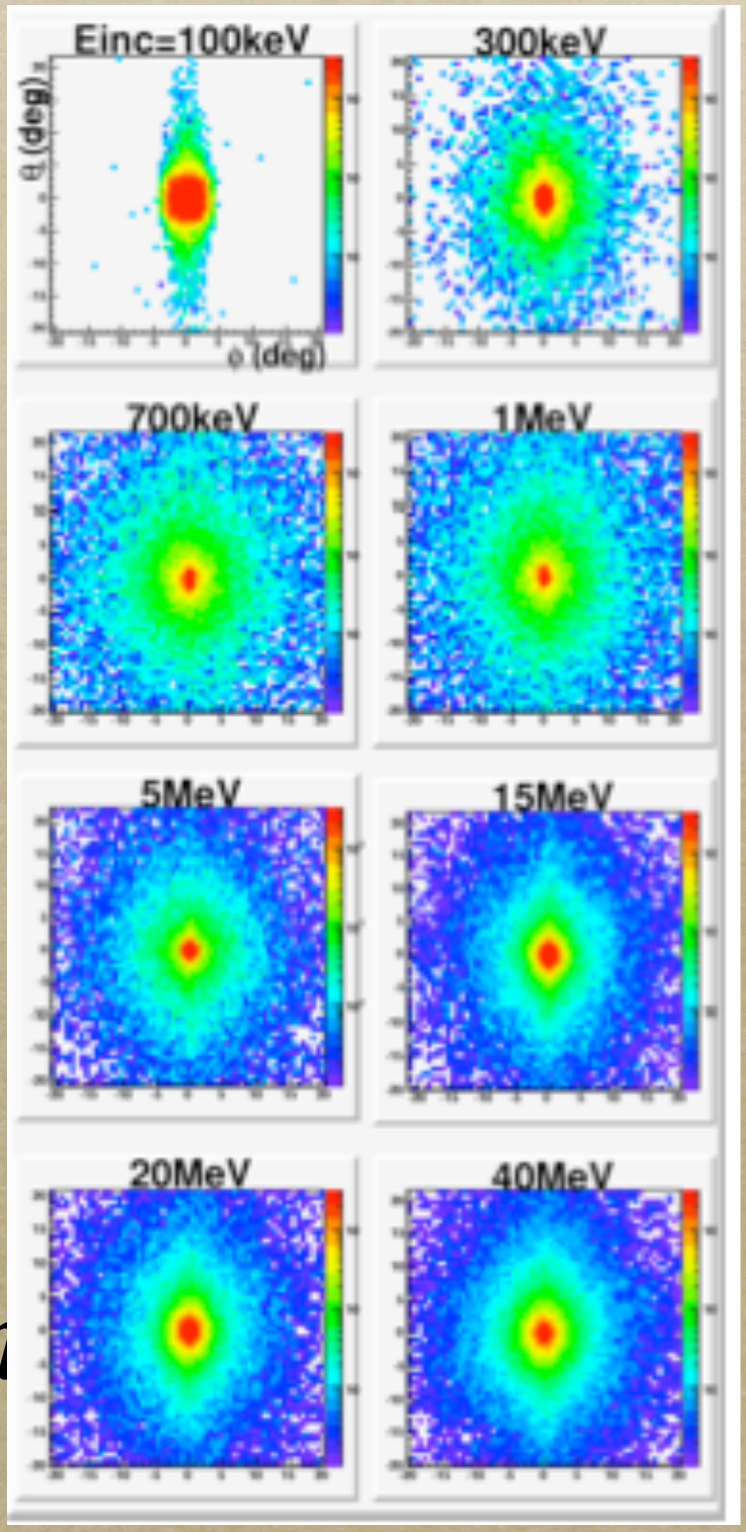

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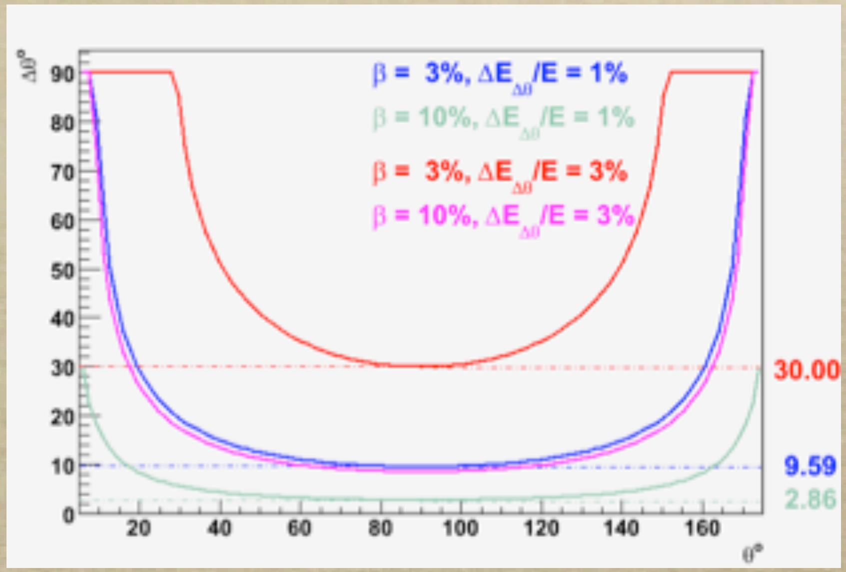

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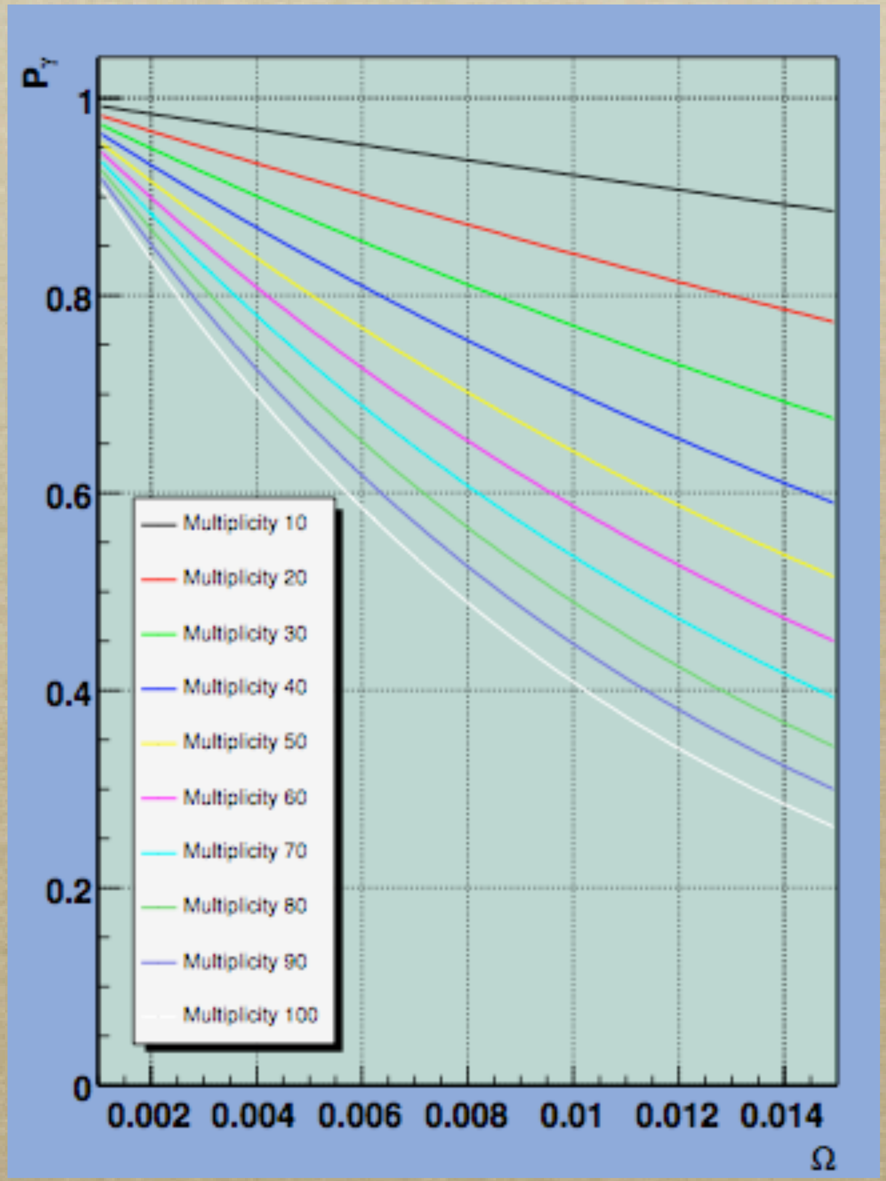

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Summary

What we have learned

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    - *Pileup*

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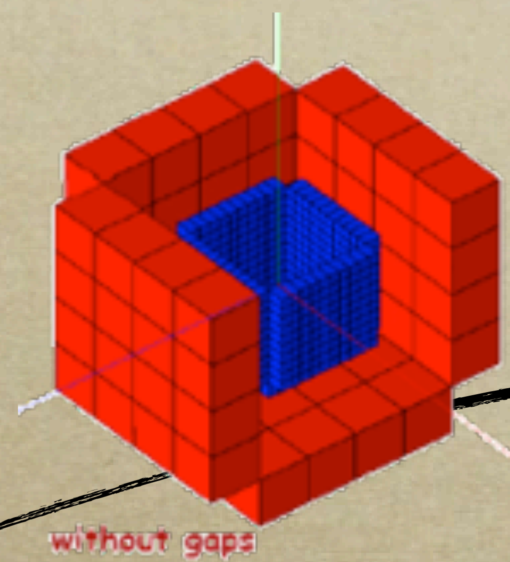
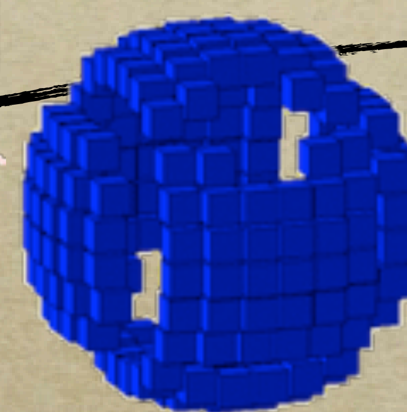
Summary

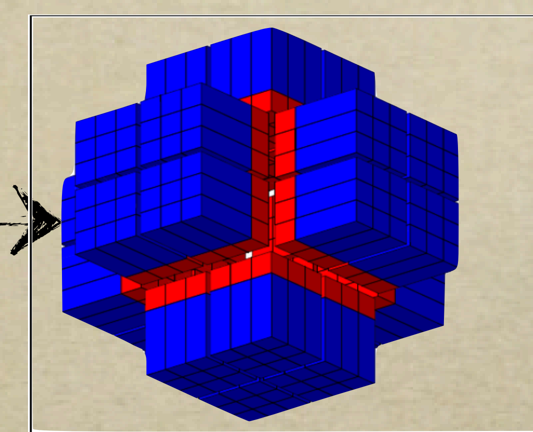
Several geometries studied

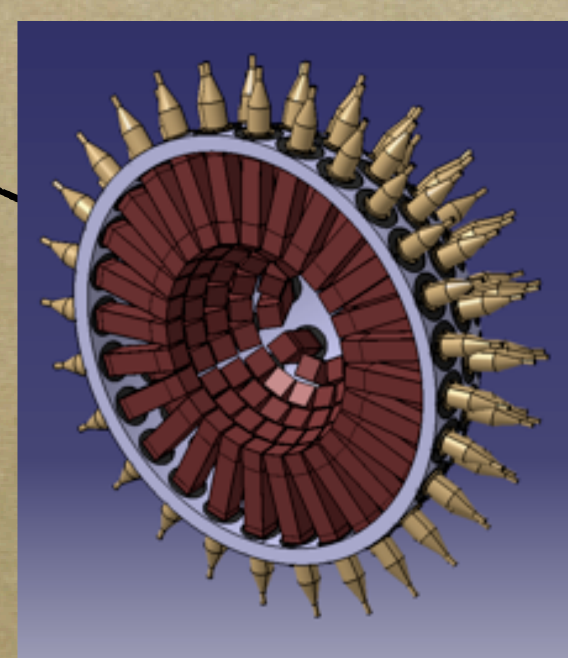
'Ideal'

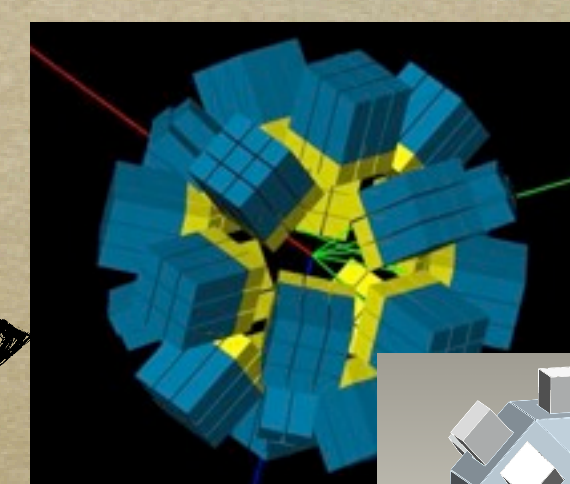


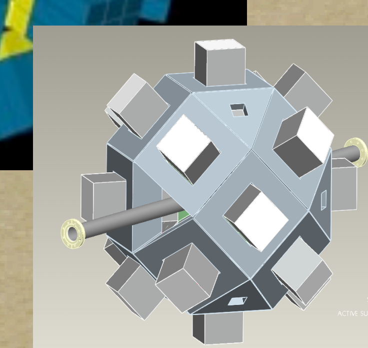


'cubic'-like





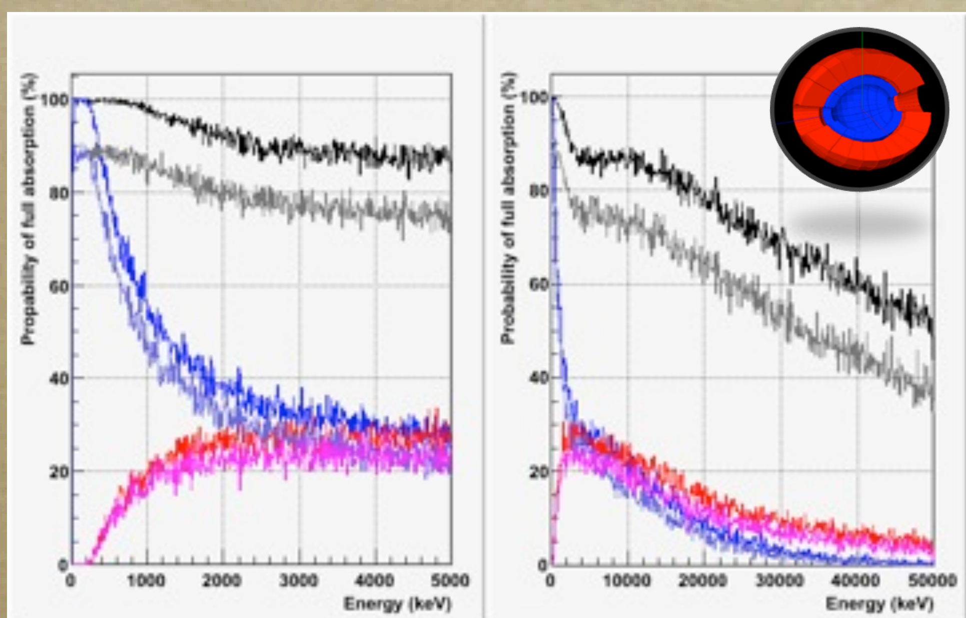


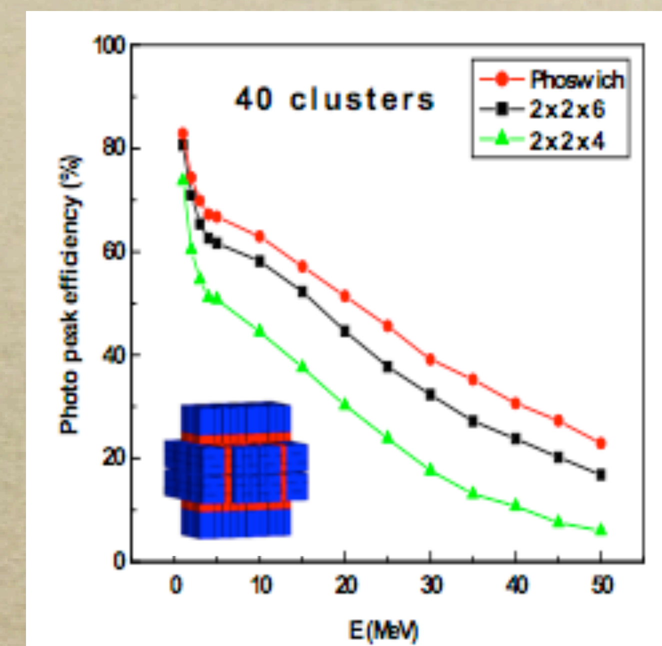


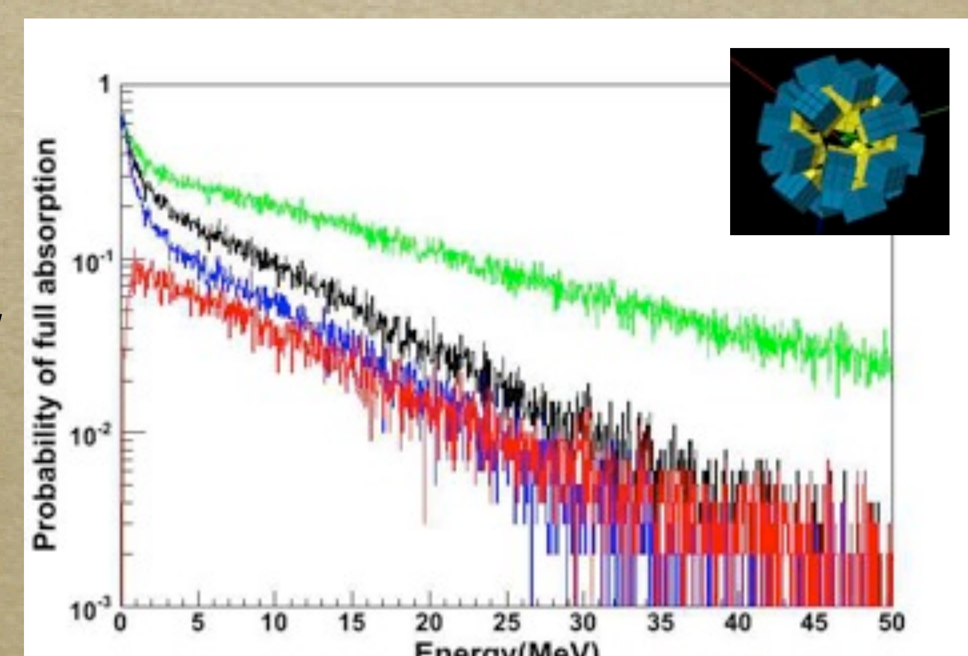
'radial'-like

Summary

Several geometries studied



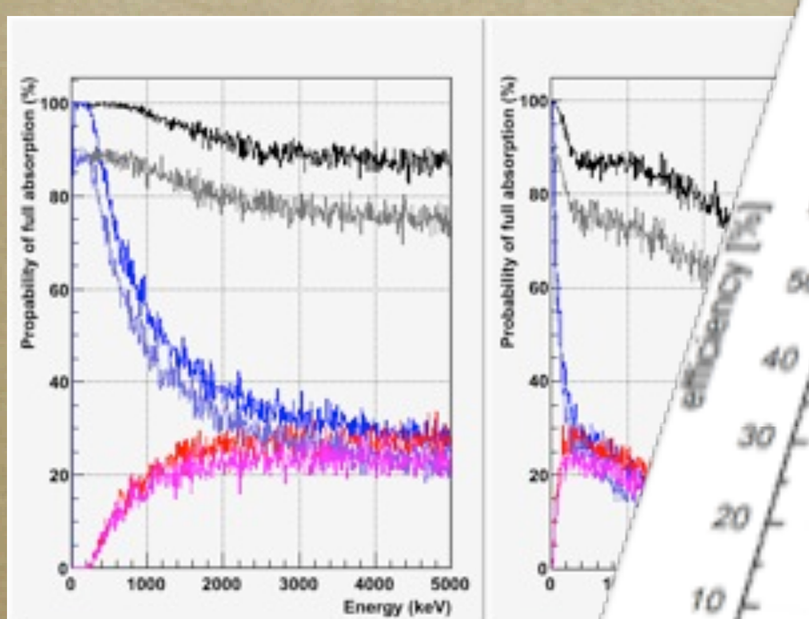


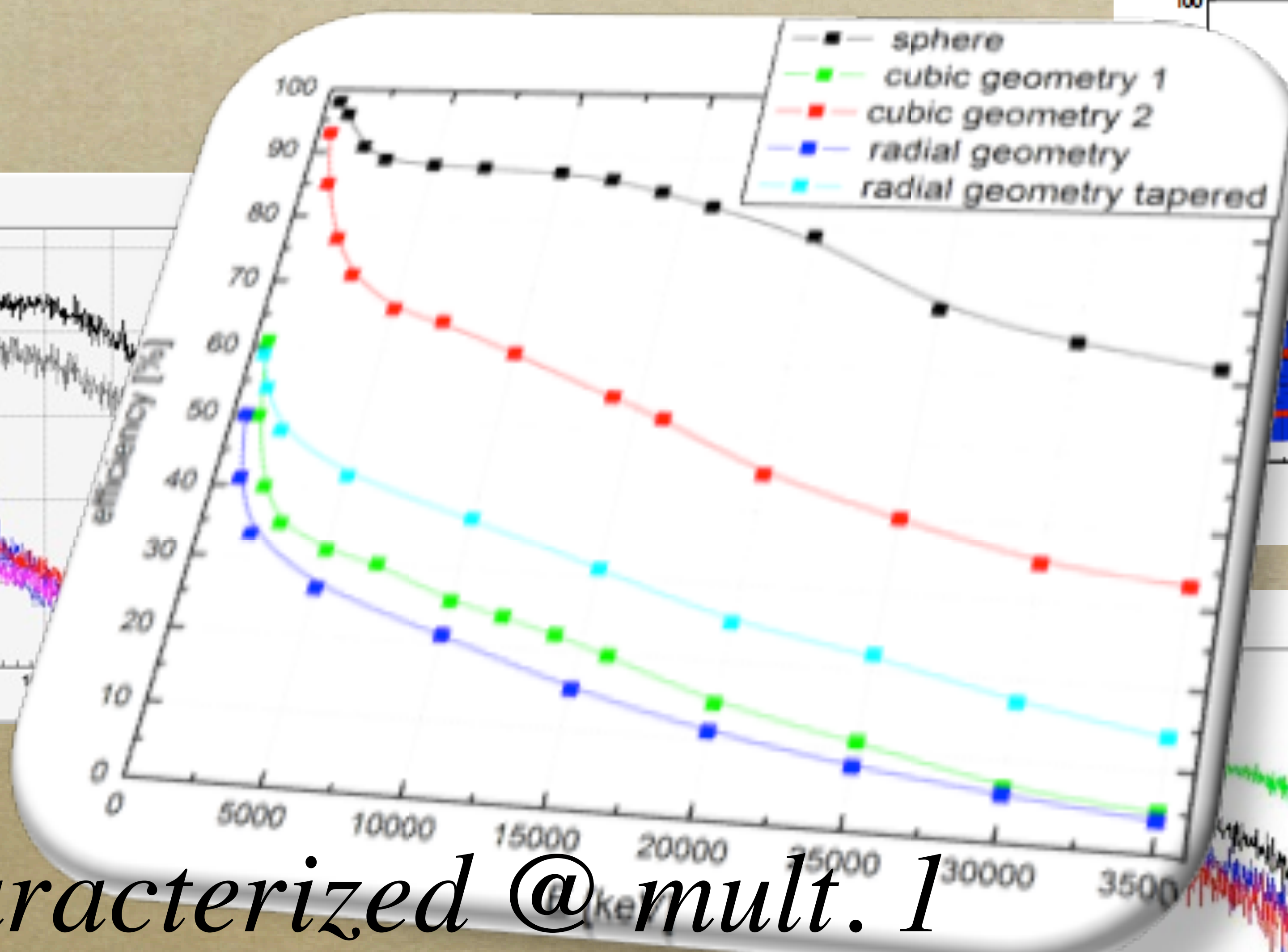


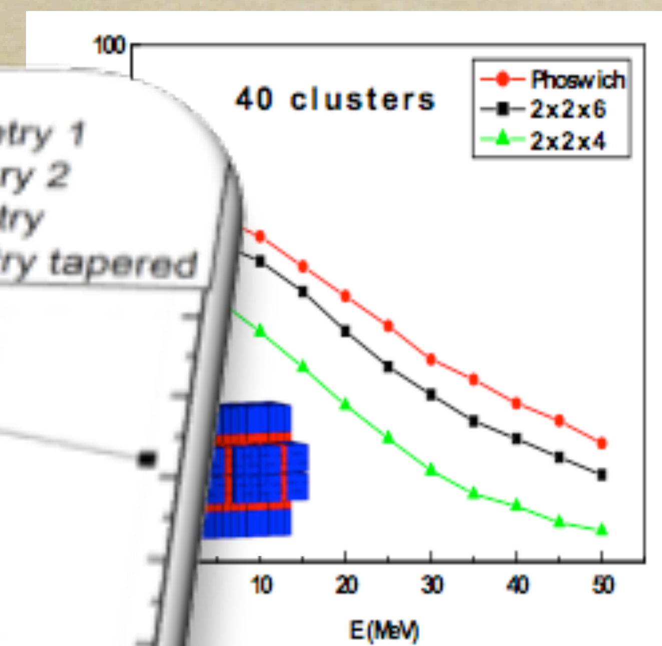
Mainly characterized @ mult. 1
(+ general studies)

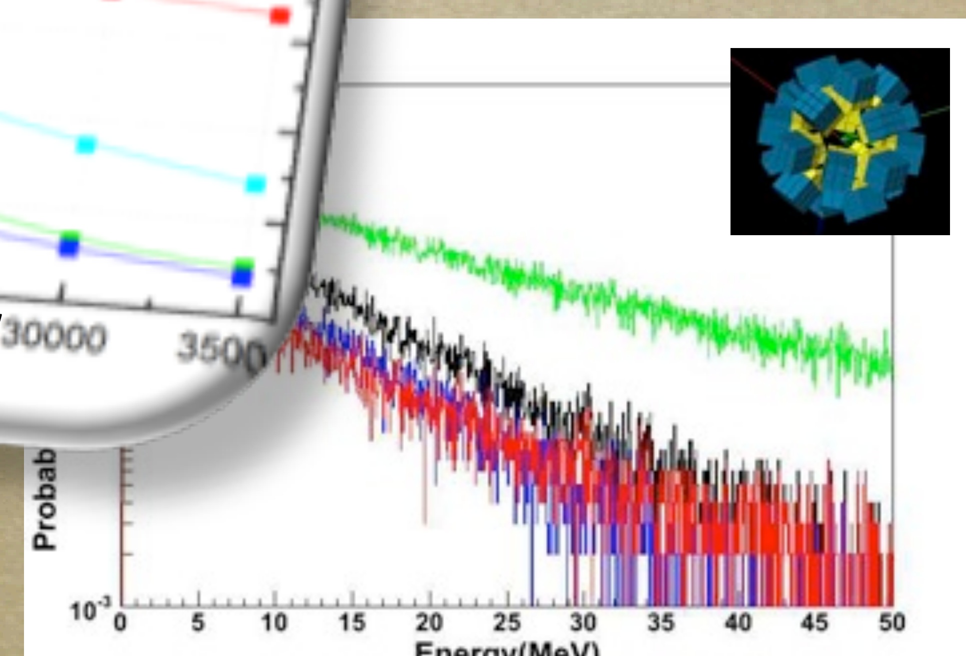
Several geometries studied

Summary









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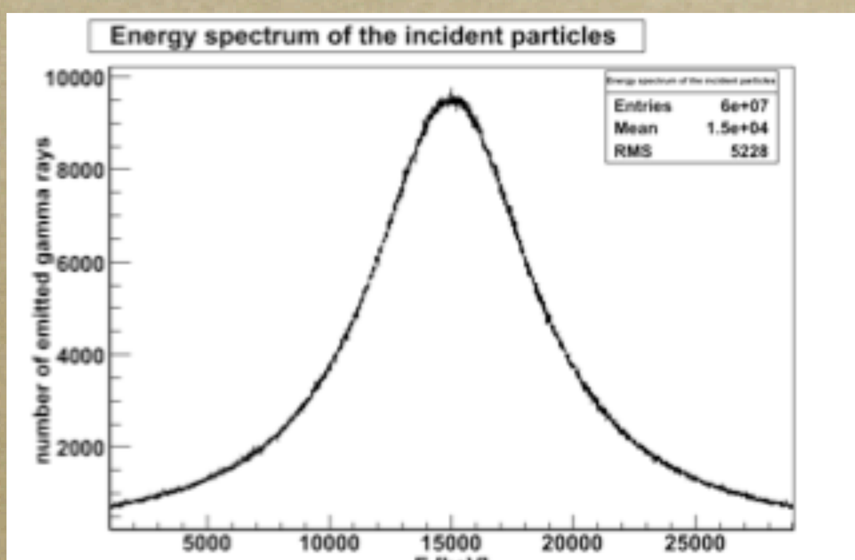
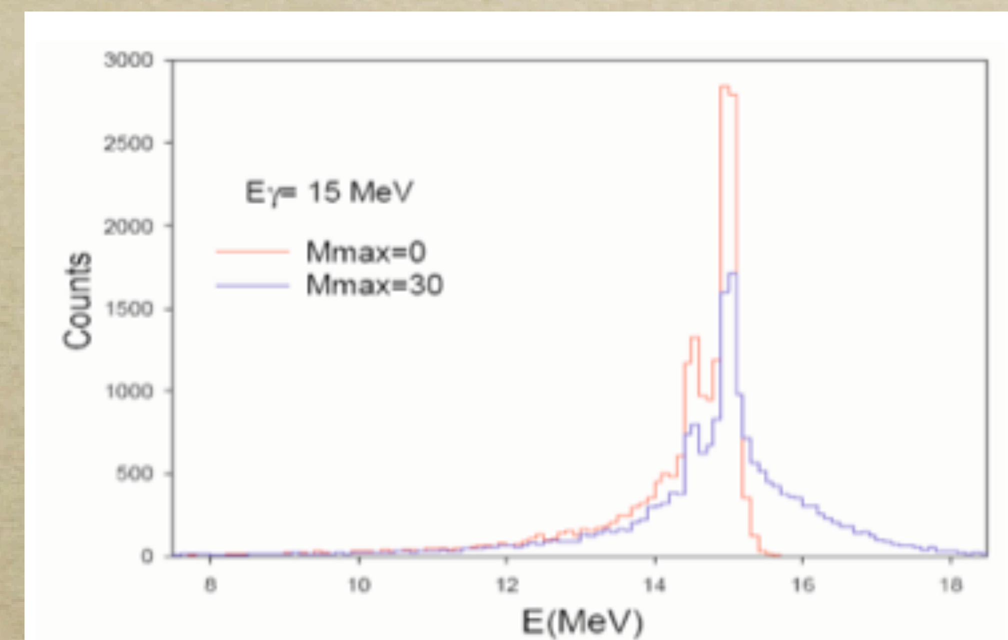
Summary

GDR line and FWHM

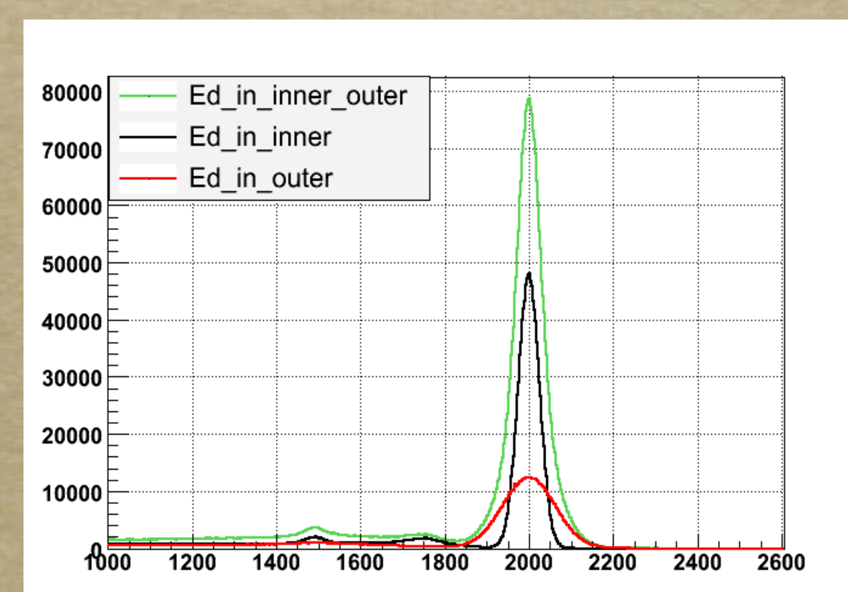
Deformations of the GDR shapes

(with cascades of low energy γ-rays)





FWHM in case of adding signals in materials ☛
(LaBr3+CsI)



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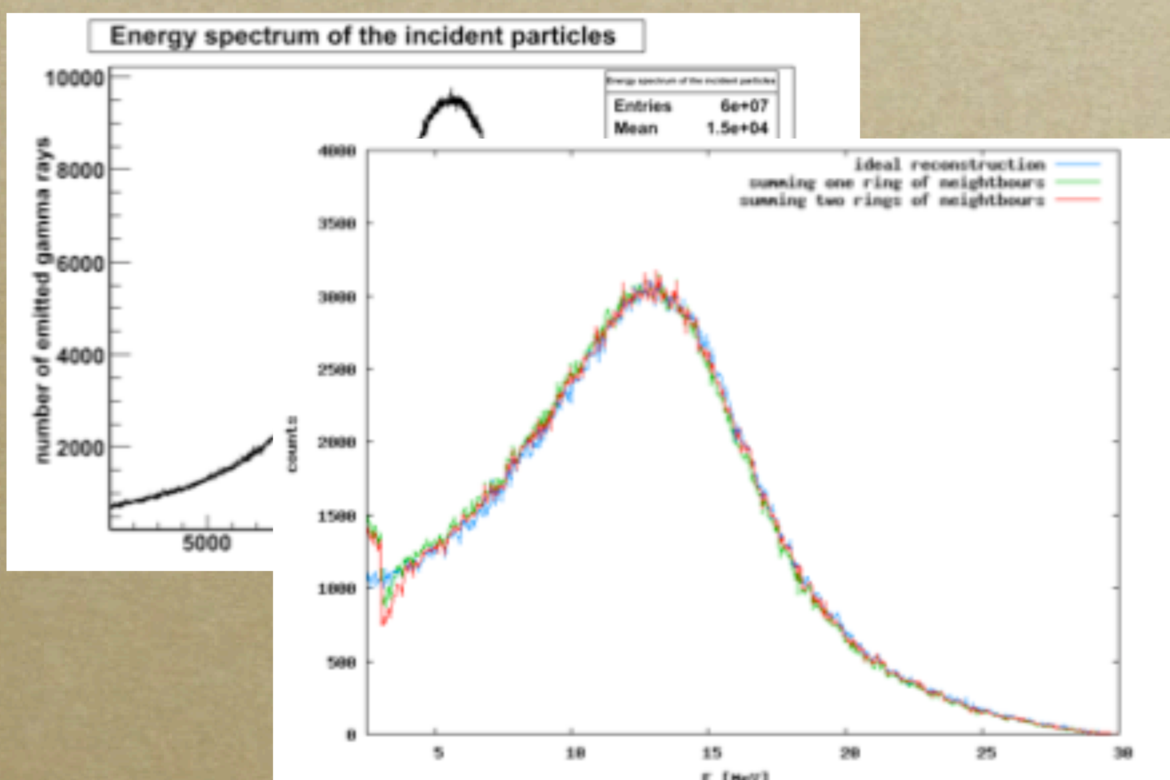

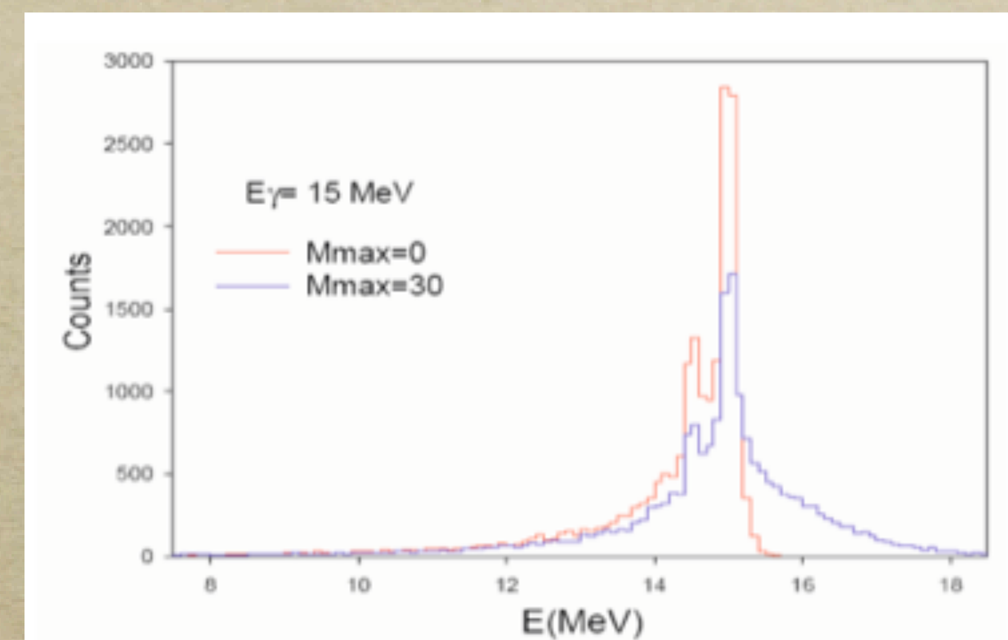

FWHM in case of adding signals in materials ☛

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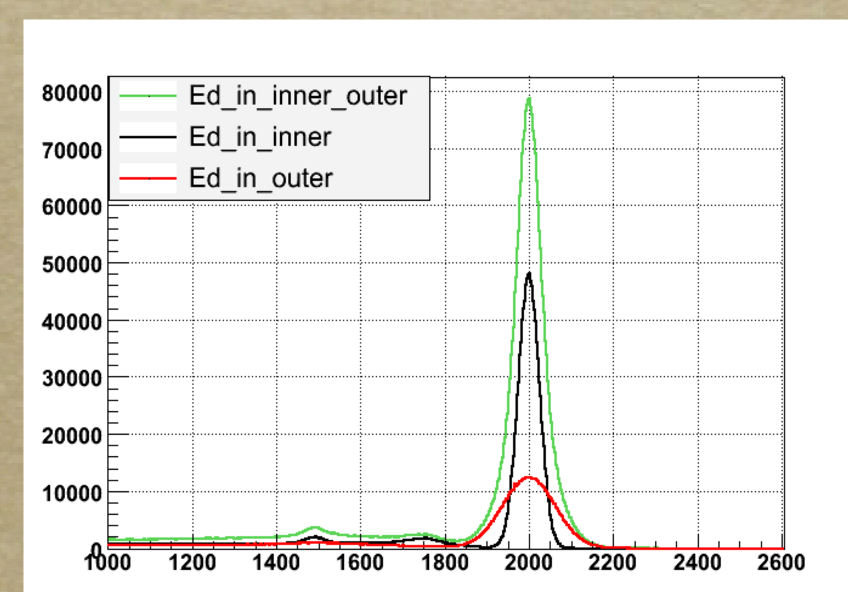

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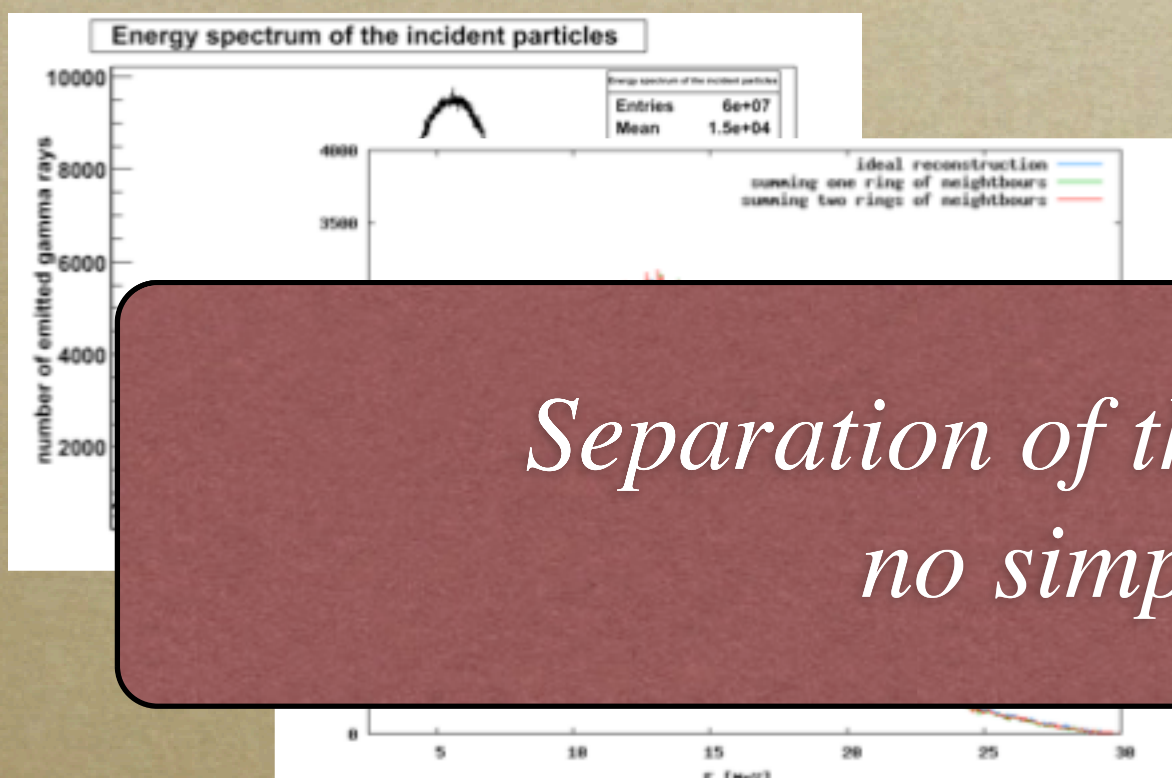

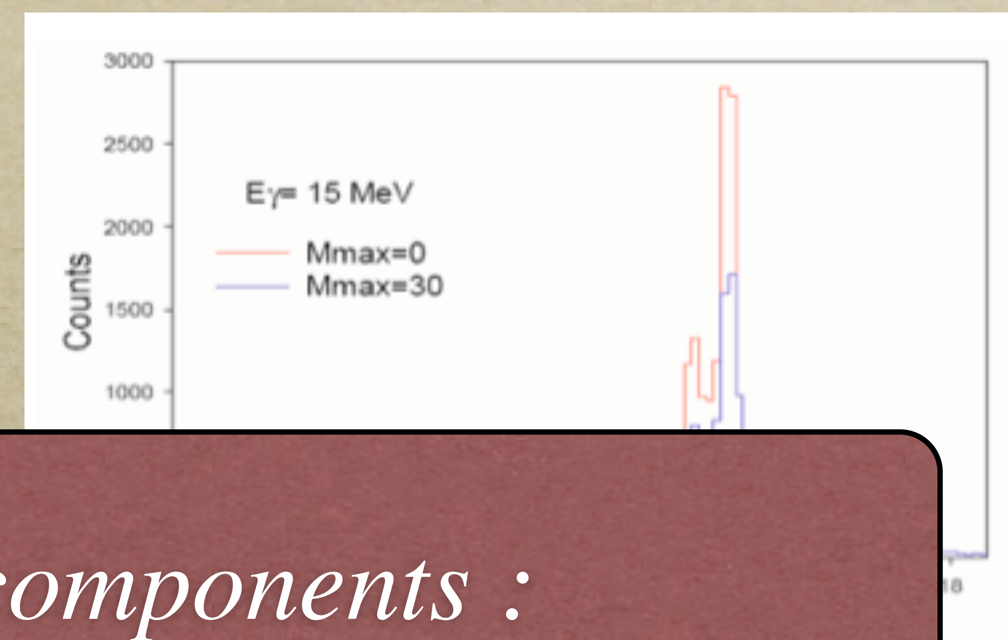

Separation of the two components :
no simple treatment

FWHM in case of adding signals in materials ☛
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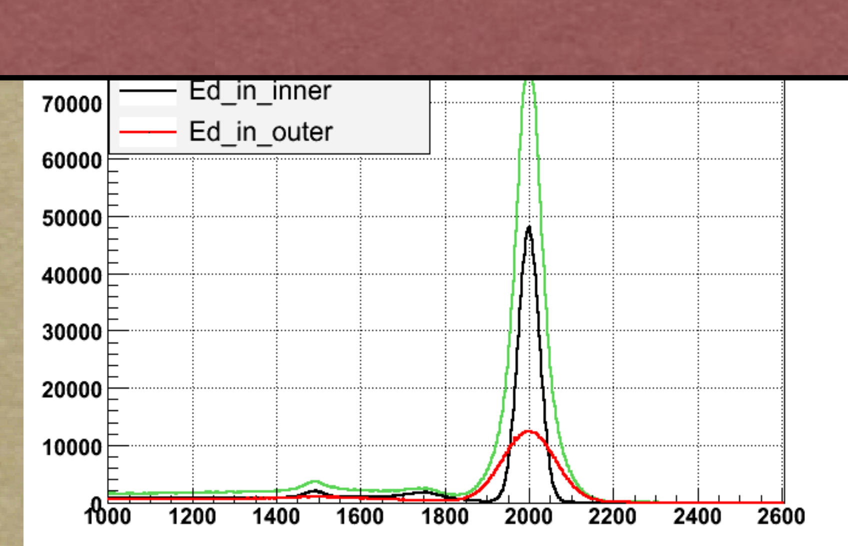
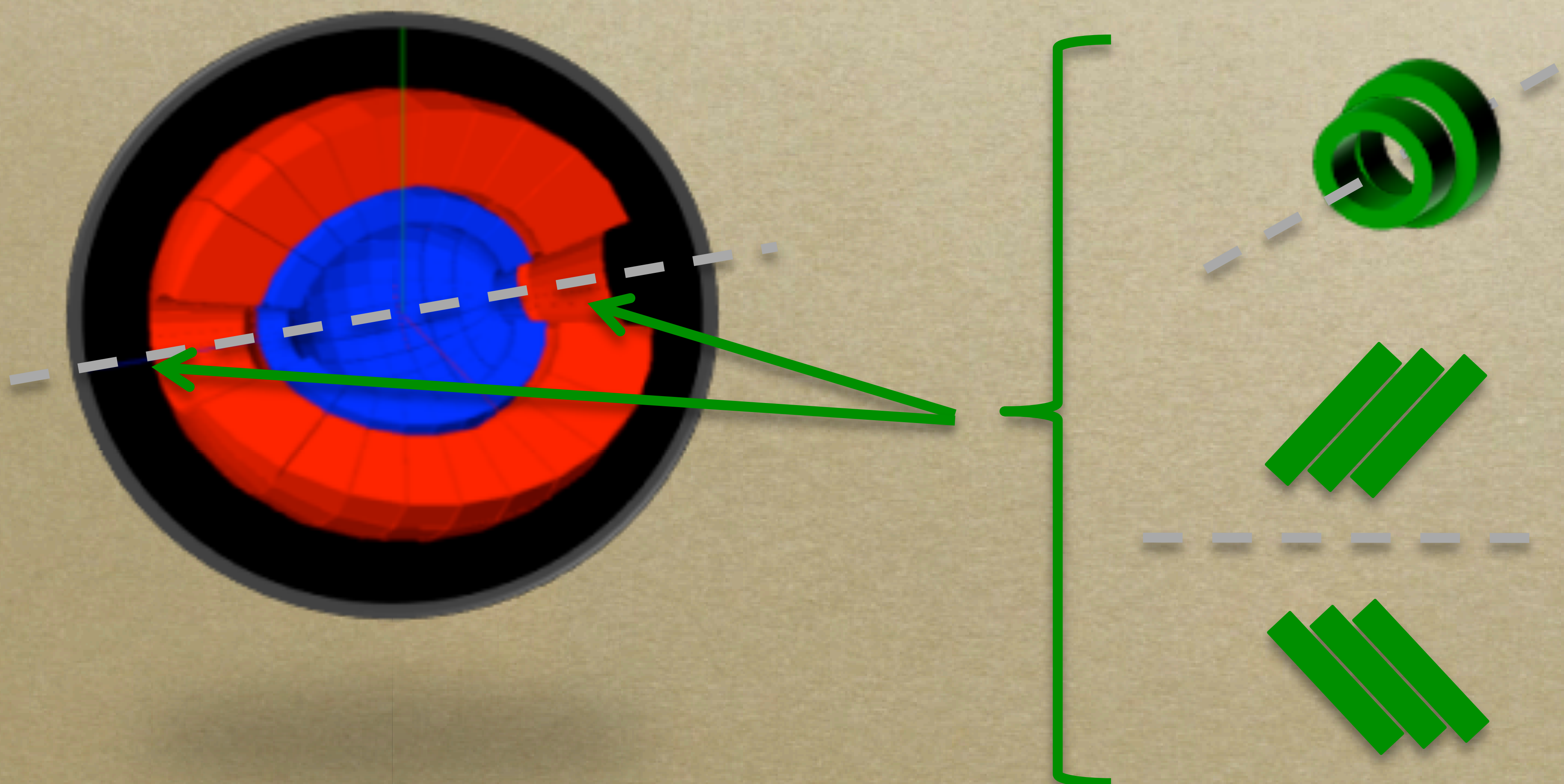


Summary

Sum-Spin spectrometer

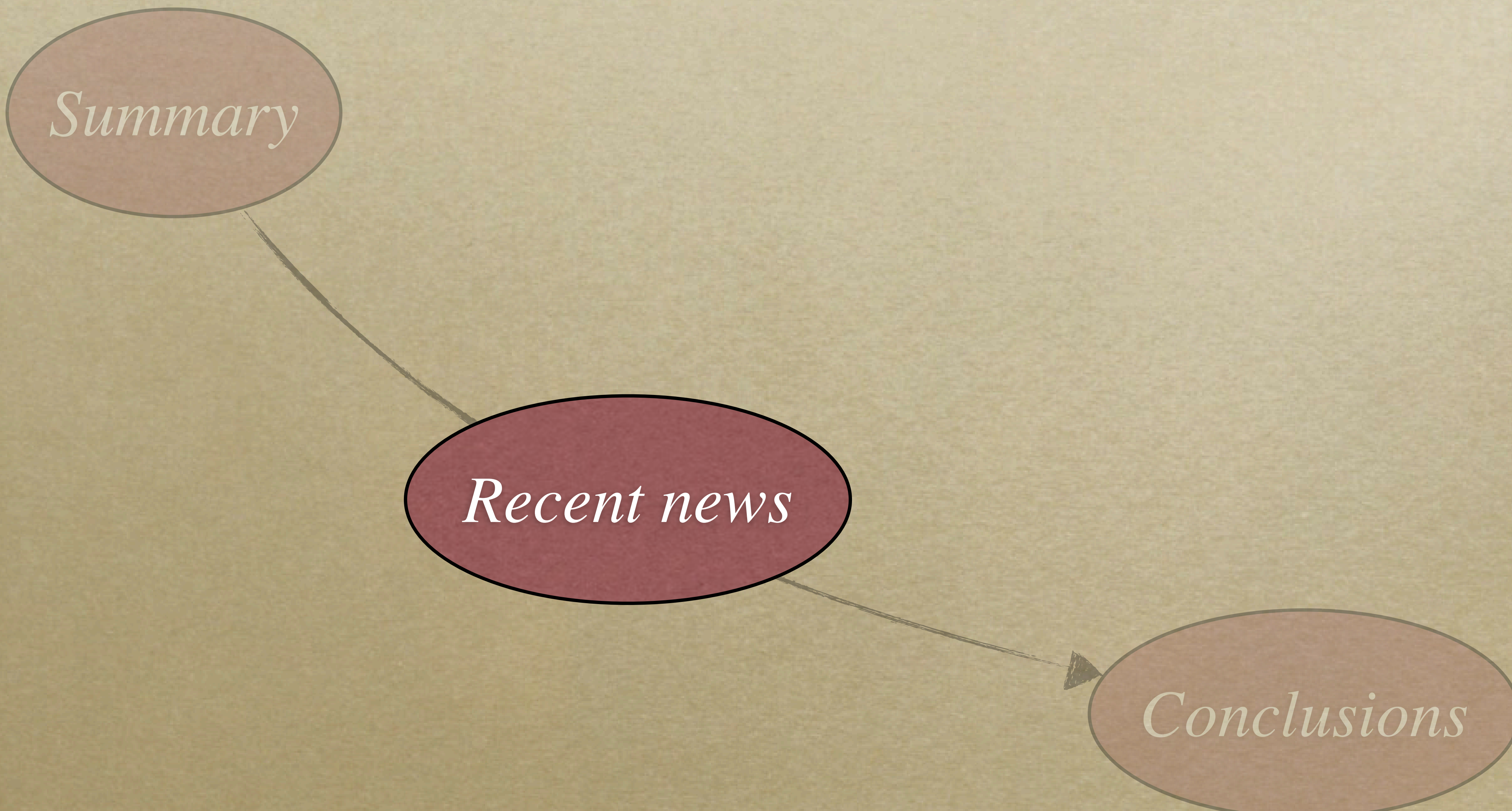
To keep 'good' resolution in {H,K}*

(sum energy, multiplicity of the cascade)



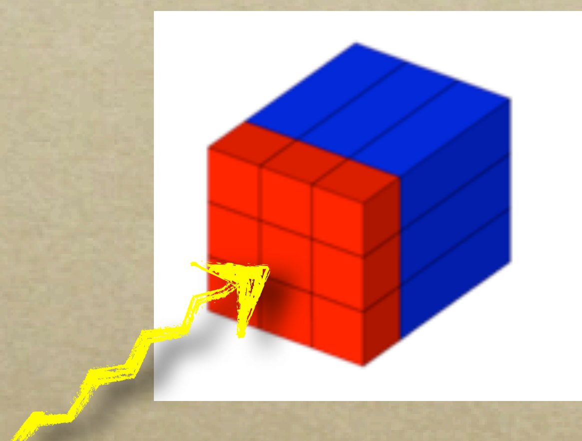
** regarding the various PARIS physics cases*

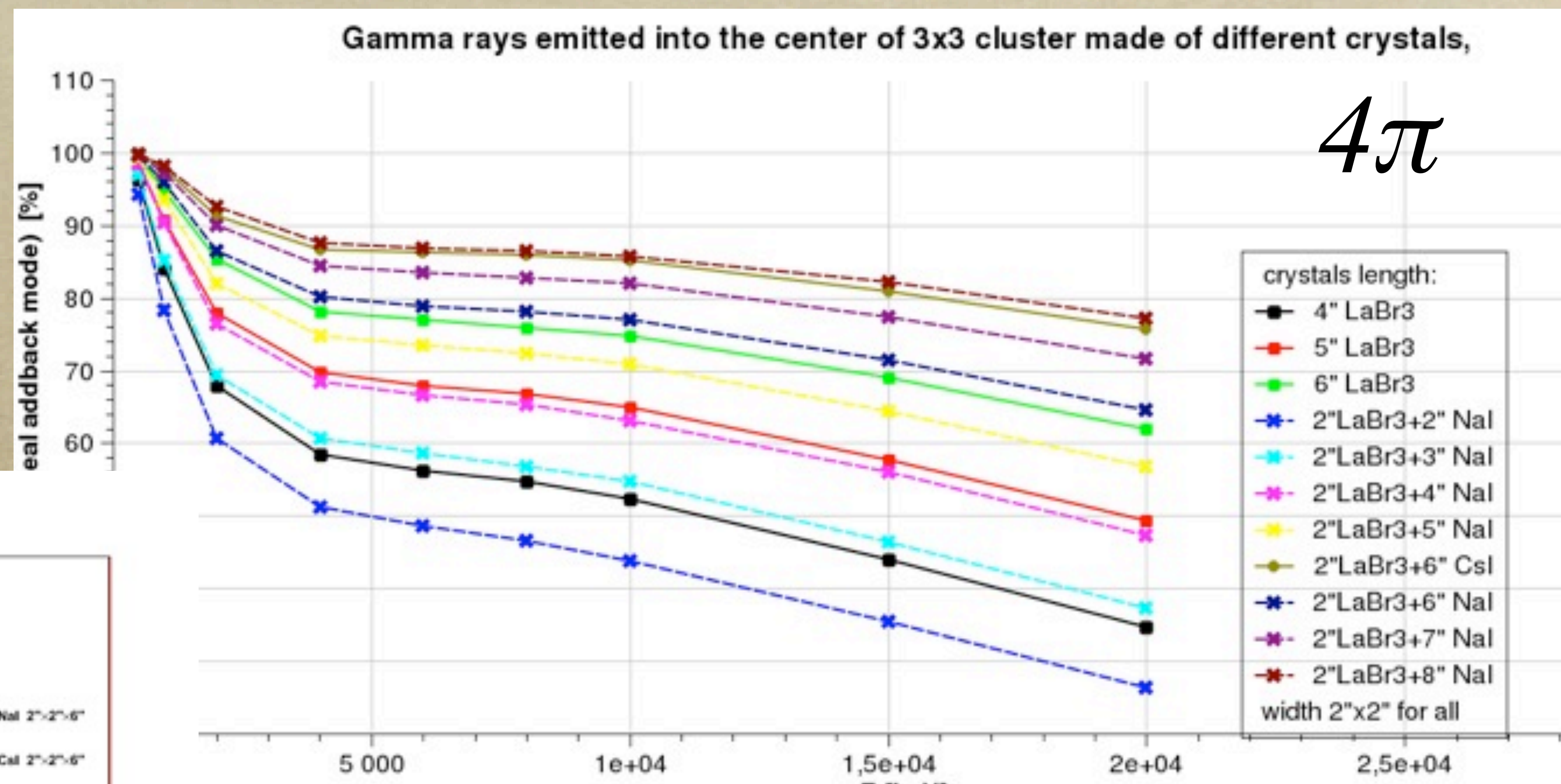
In this report

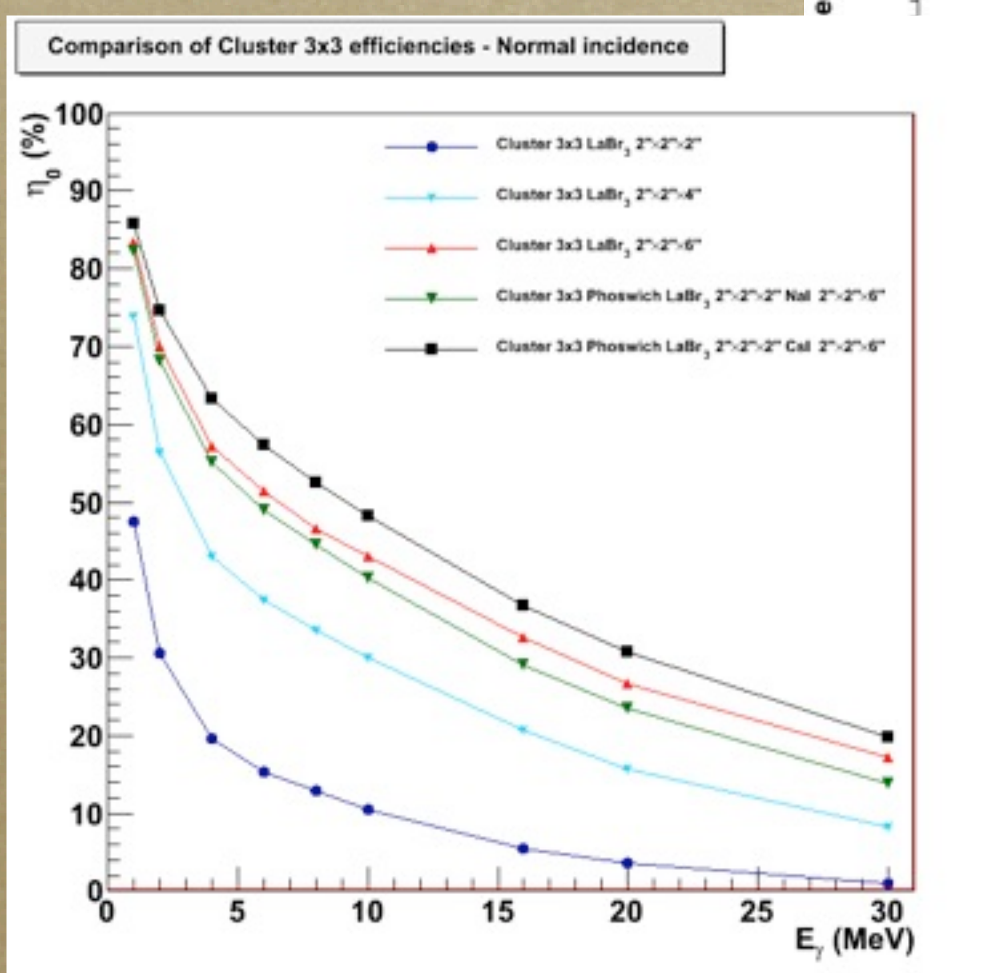


Recent news

Why ε @ mult. 1 is not enough ?







@ 20 MeV

Thomas :

2"LaBr3 + 6"NaI < 6" LaBr3

Michal :

2"LaBr3 + 6"NaI > 6" LaBr3

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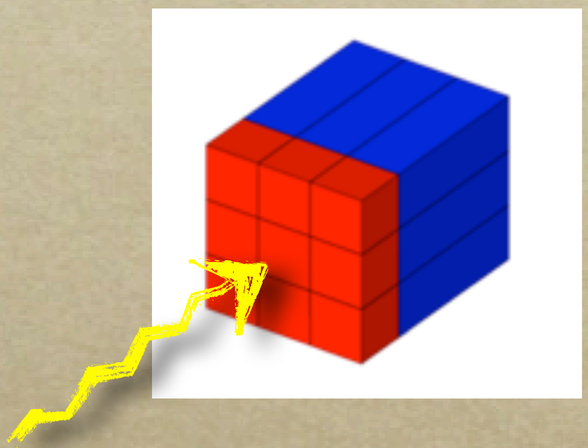
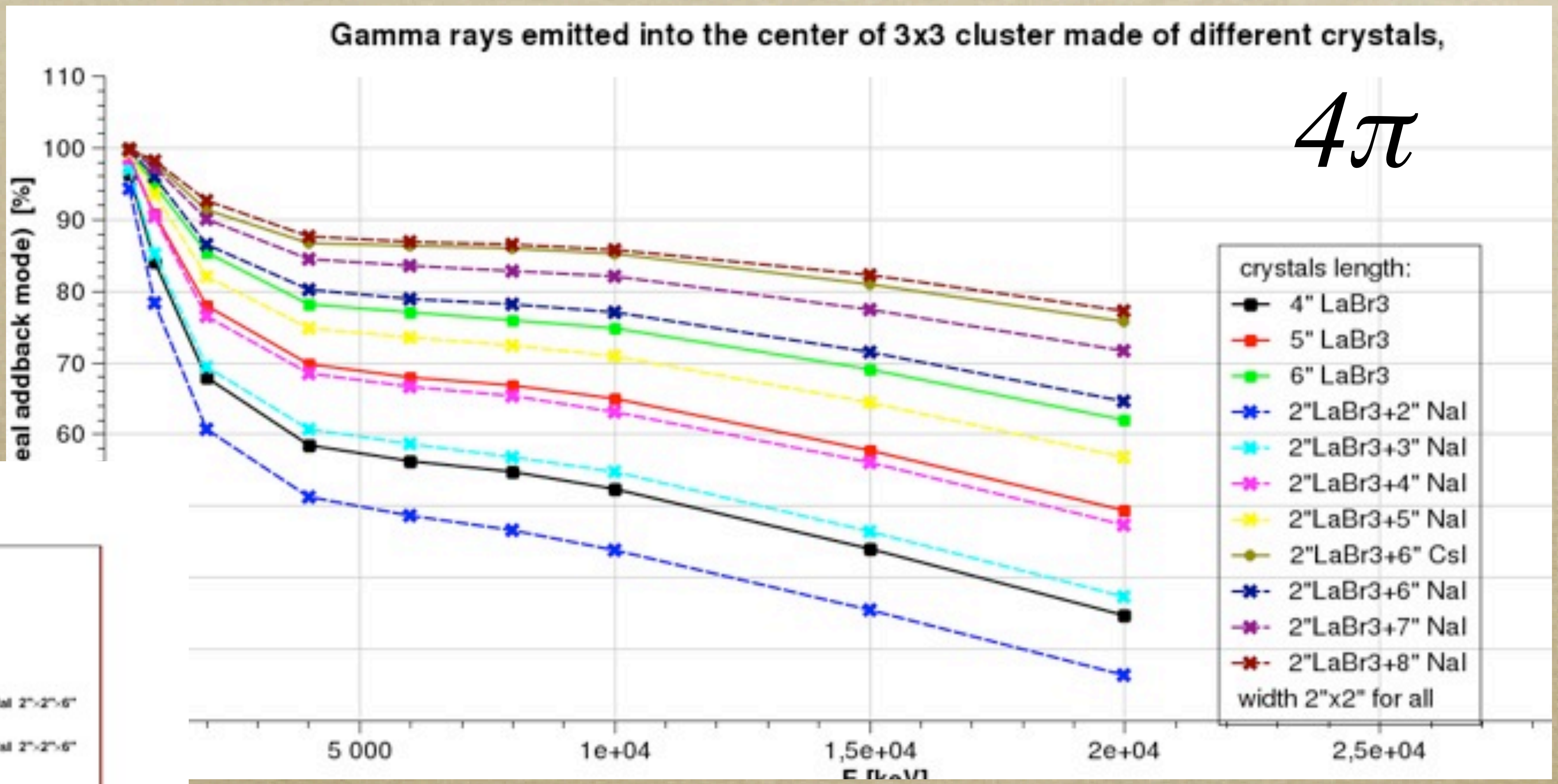
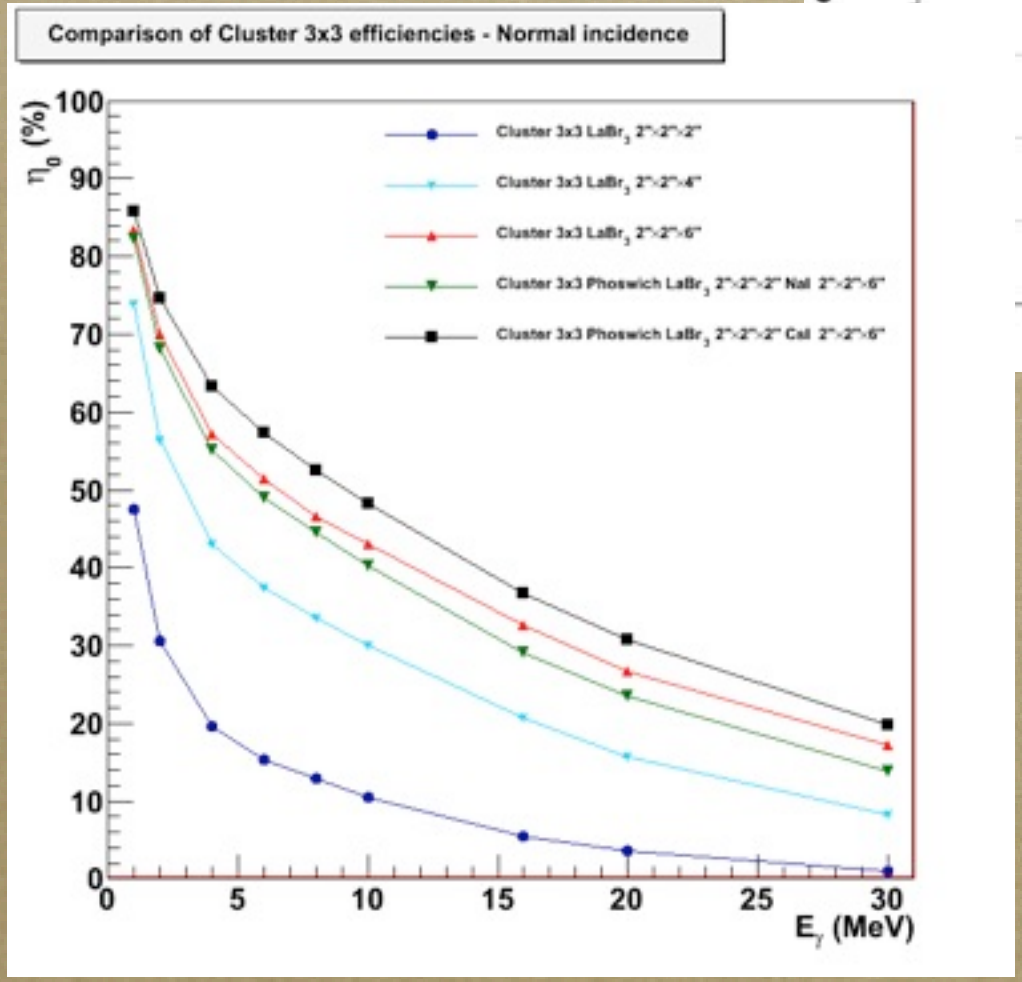




4π



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In this report

Summary

Package evolution
More complex physics
More realistic arrays
Studies on algorithms

Recent news

Conclusions

Recent news

What has been done ...

Evolution of the Paris (G4) Package

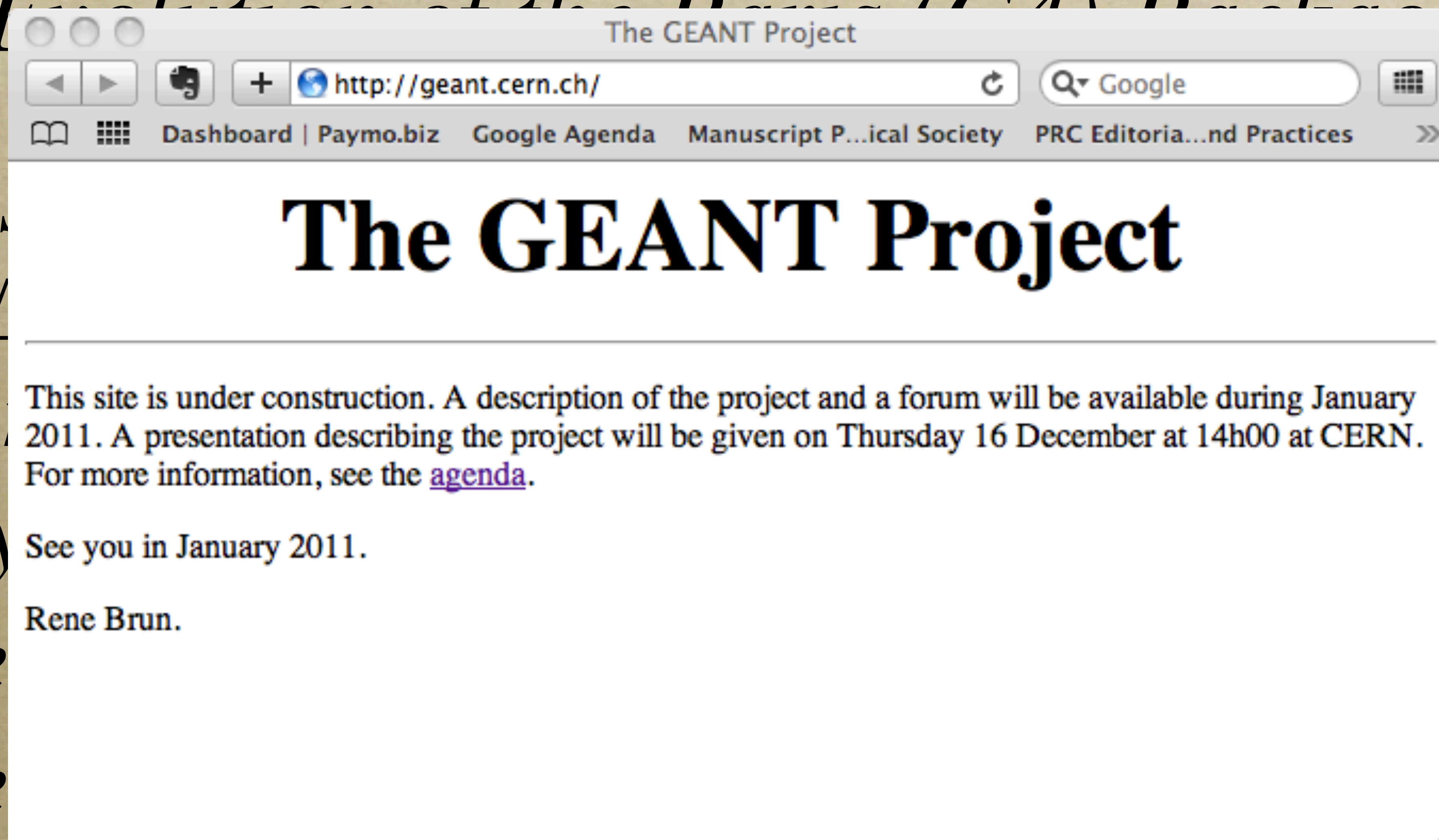
- *SVN server : everybody works on the same code* *https://svn.in2p3.fr/paris/*
- *Import/export xml geometries*
- *Analysis package*
- *More ROOT (input of G4/output of G4)*
- *More generator (ions, radioactivity)*

Next step : wait for GEANT ... (ROOT + G4)

Recent news

What has been done ...

Evolution of the Paris (G4) Package



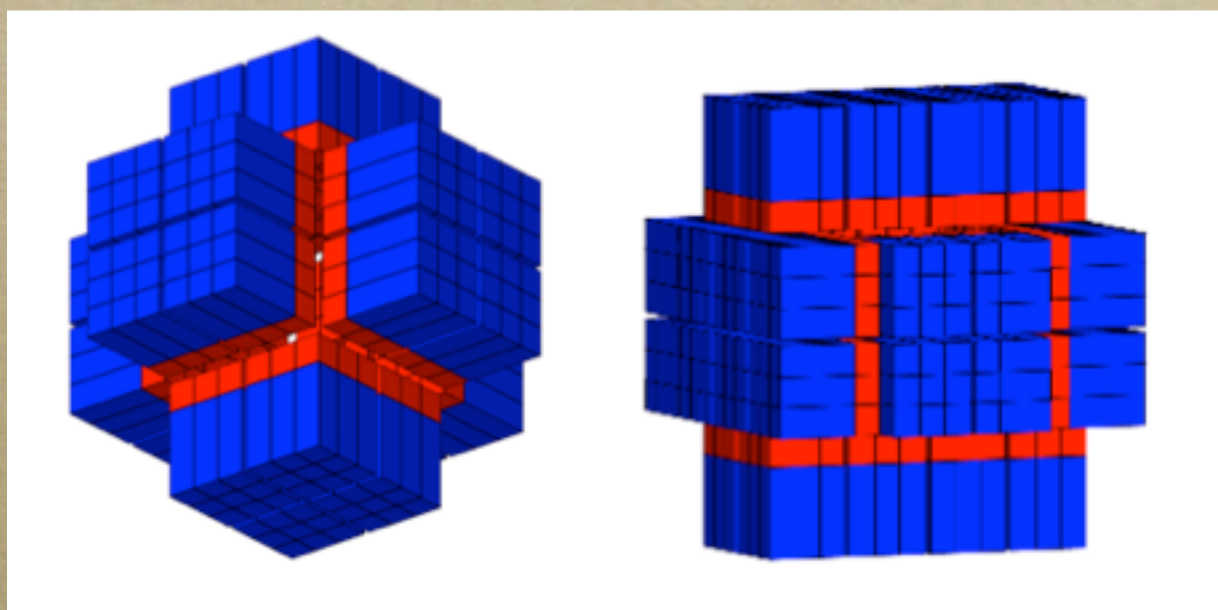
- *SVN ... ne code* *https://*
- *Impo*
- *Analy*
- *More*
- *More*

Next step : wait for GEANT ... (ROOT + G4)

Recent news

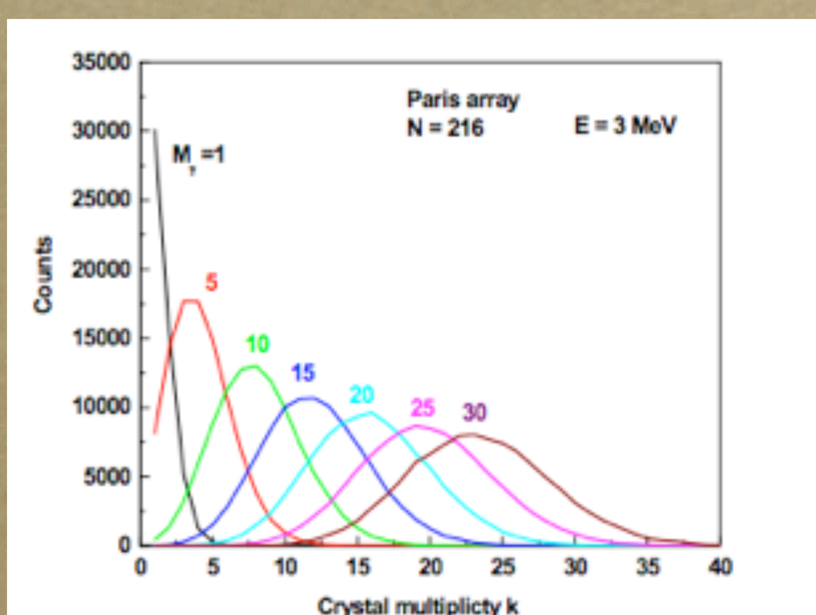
What has been done ...

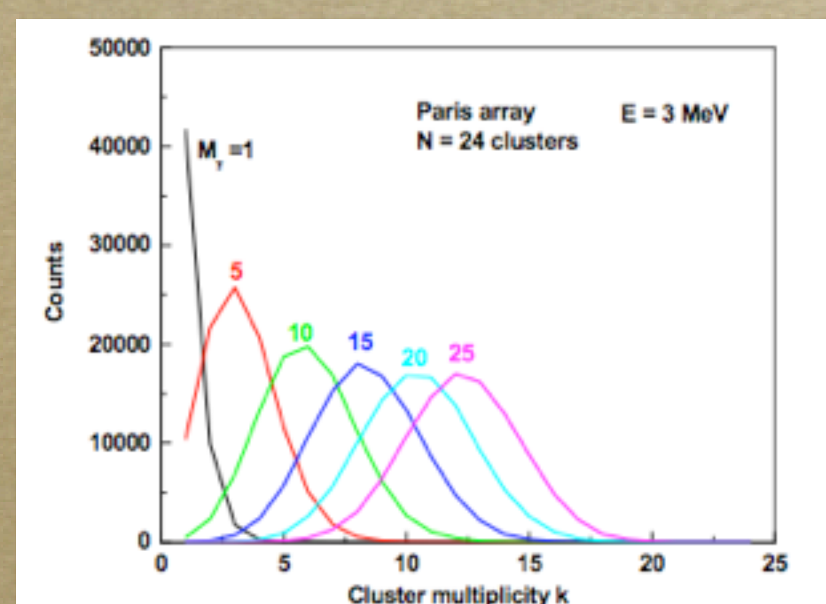
Anil Kumar Gourishetty and Michal Ciemala

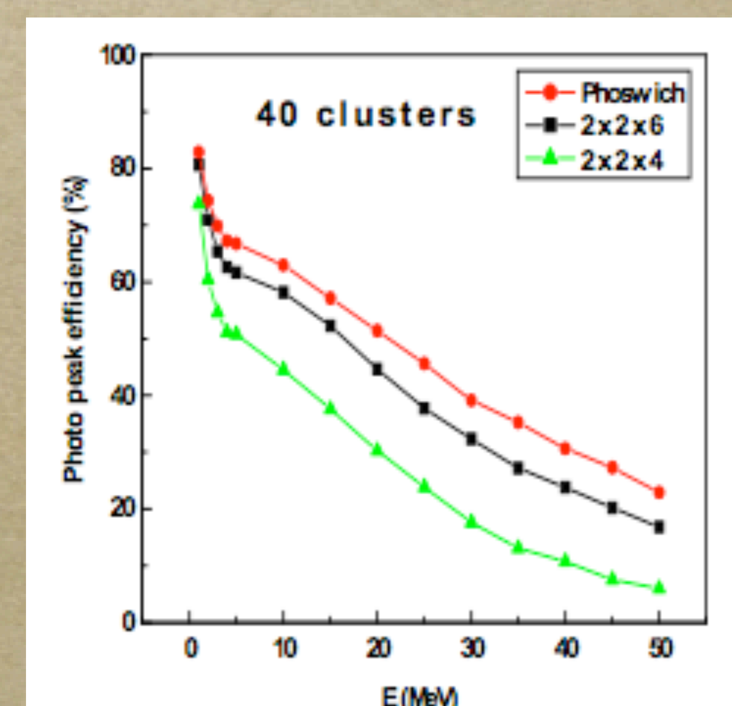


Thickness of Aluminum = 1 mm
Gap between adjacent crystals inside a cluster = 0.2 mm
Gap between adjacent clusters = 5 mm
Distance between source and detector = 165 mm

With Al casings !

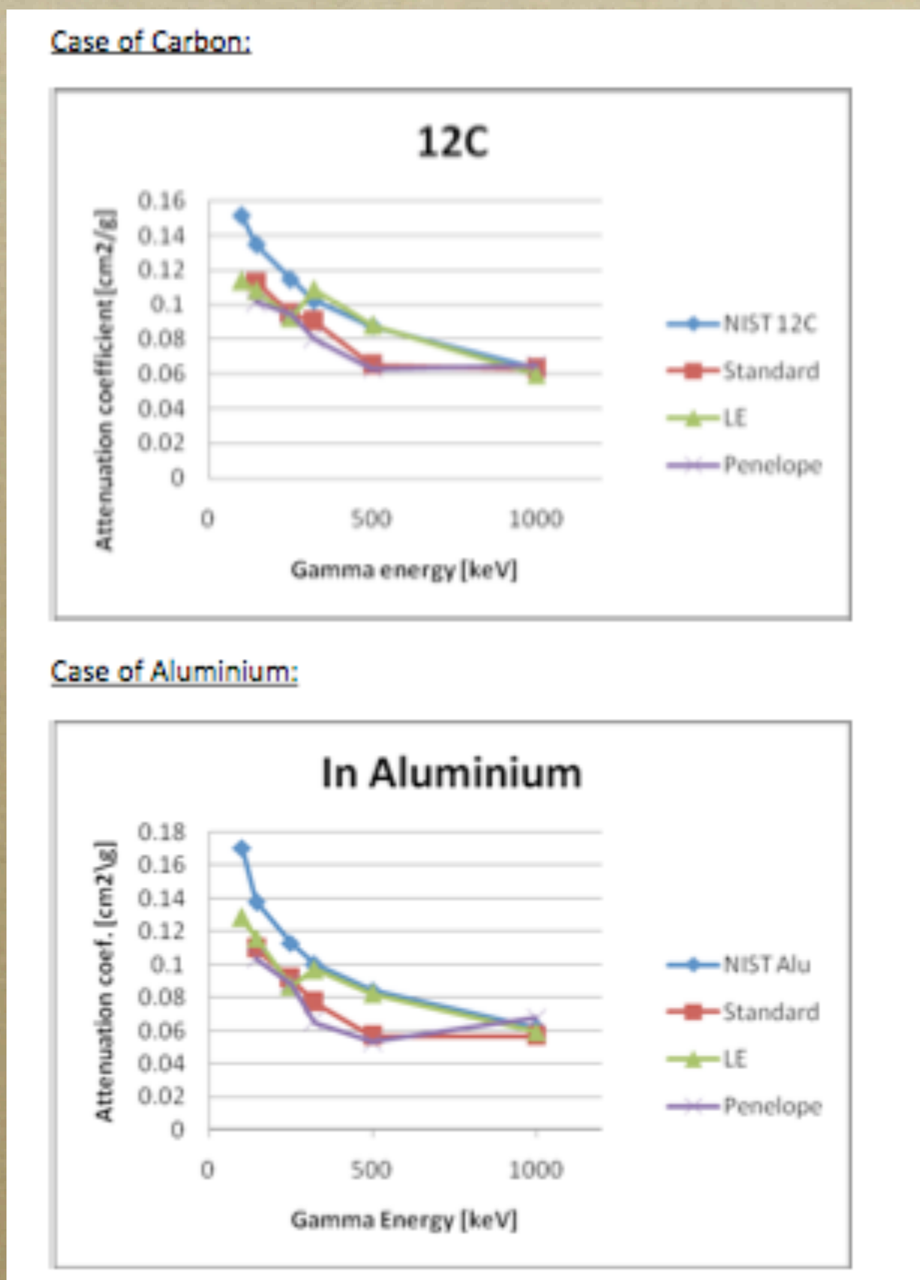






Recent news

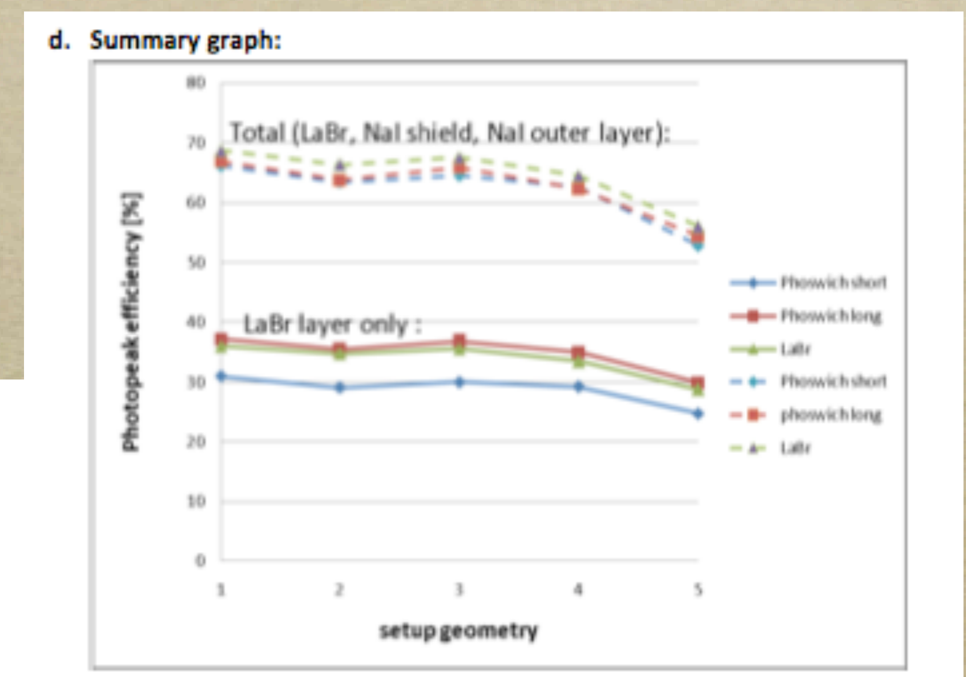
What has been done ...



Marc Labiche : PARIS + GASPARD

@ 662 keV

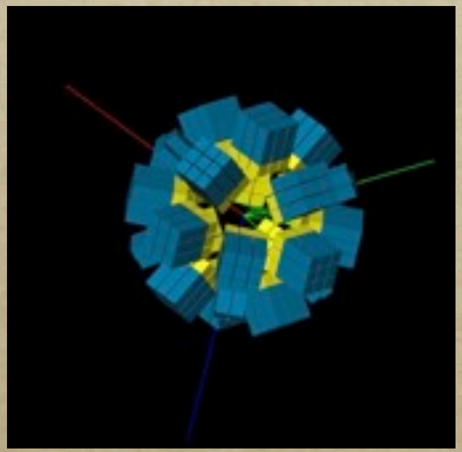
Figure 3: As fig. 1 with GASPARD detector



- 13% in efficiency in PARIS due to GASPARD

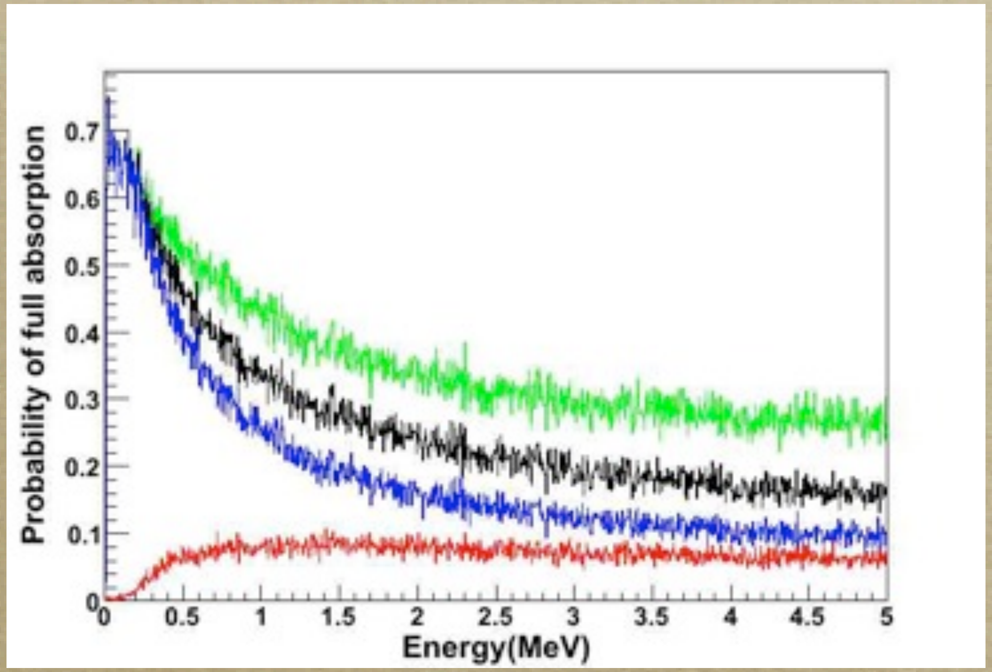
Recent news

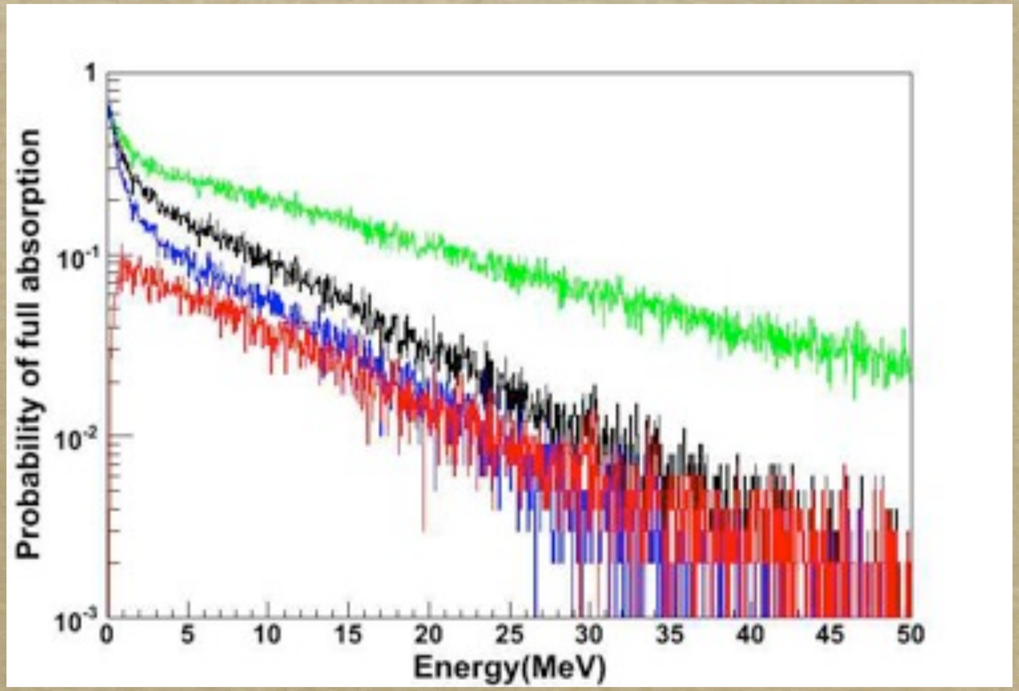
What has been done ...



180 phoswich

Dorothée Lebhertz





Recent news

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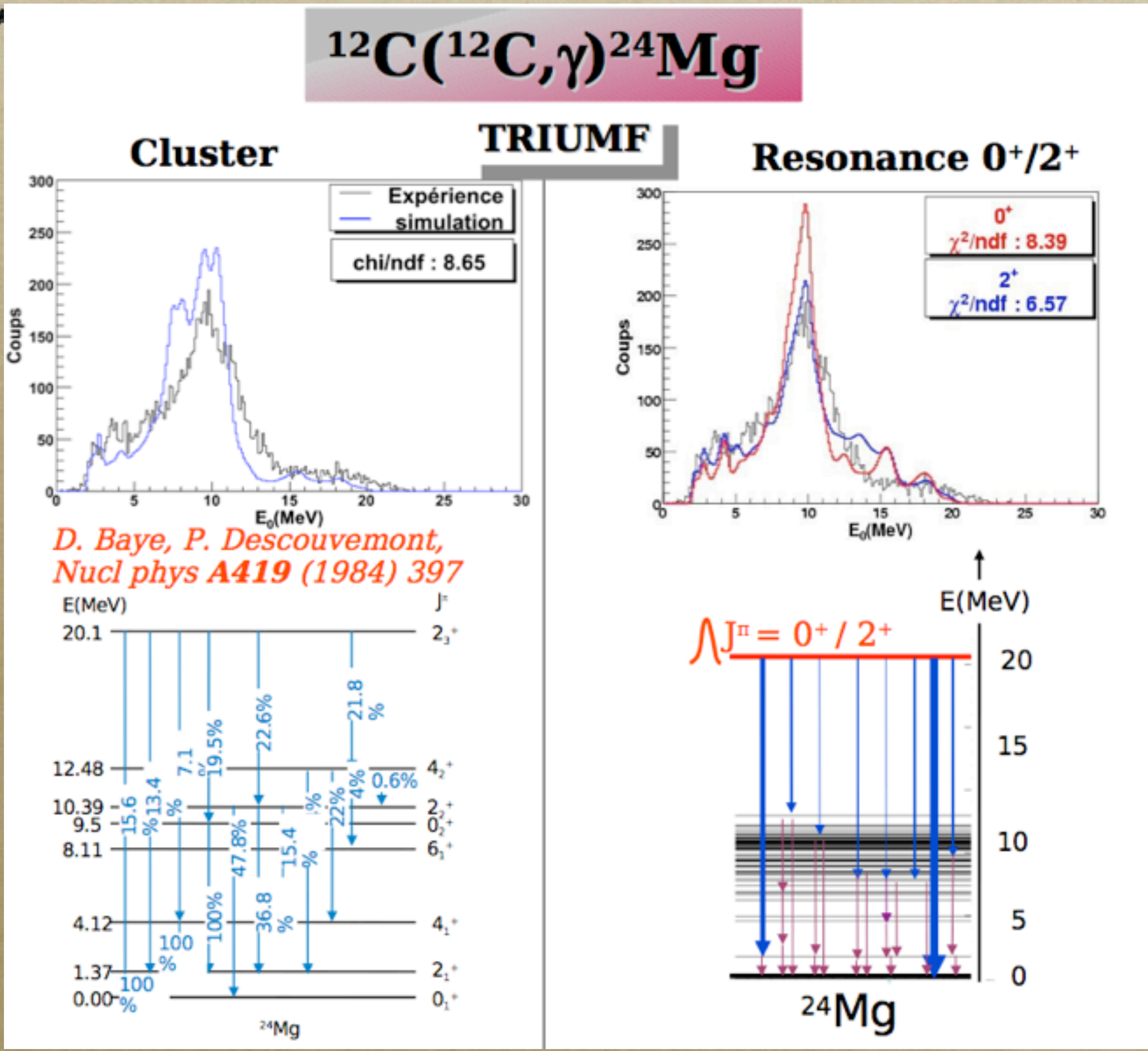

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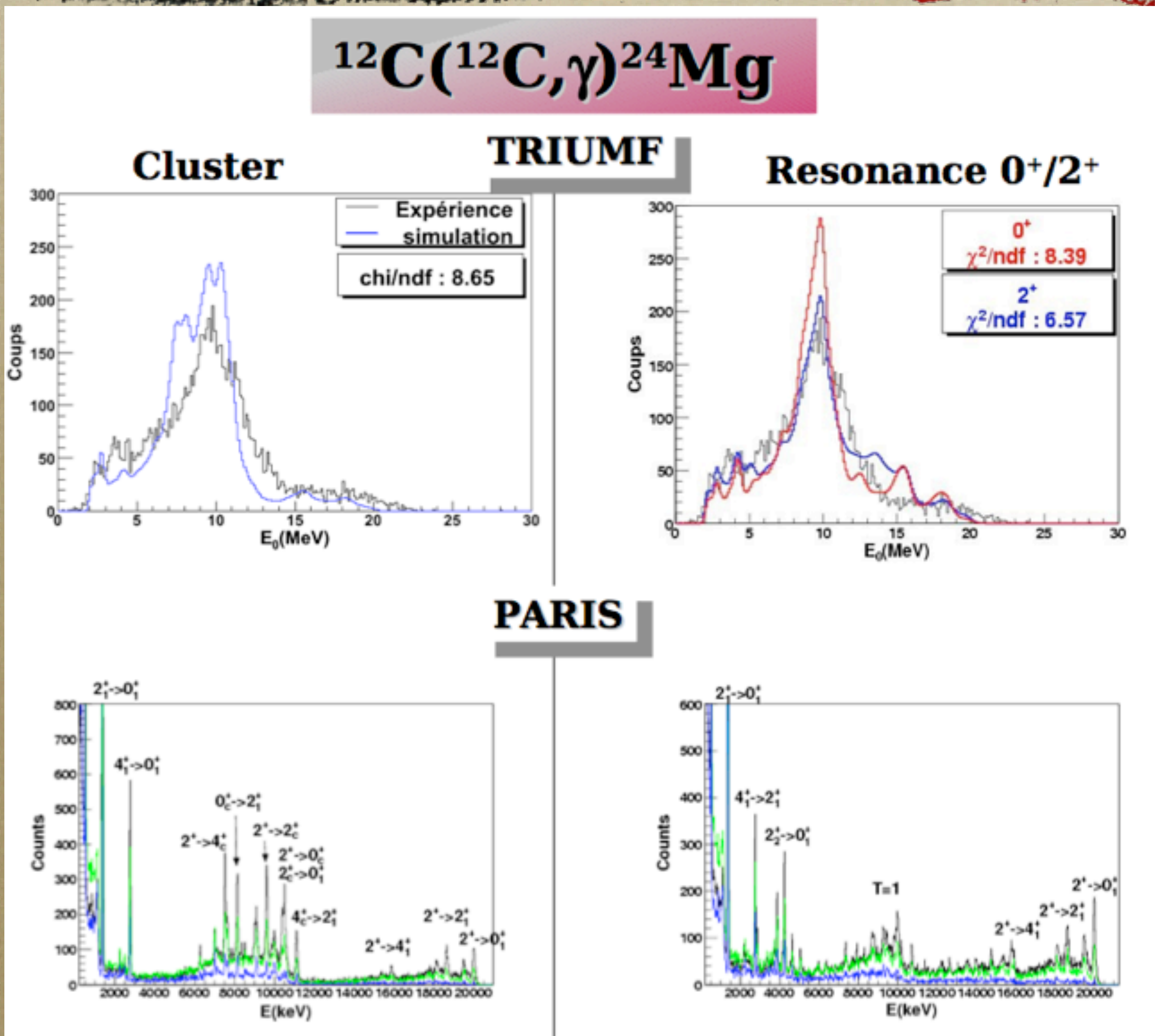
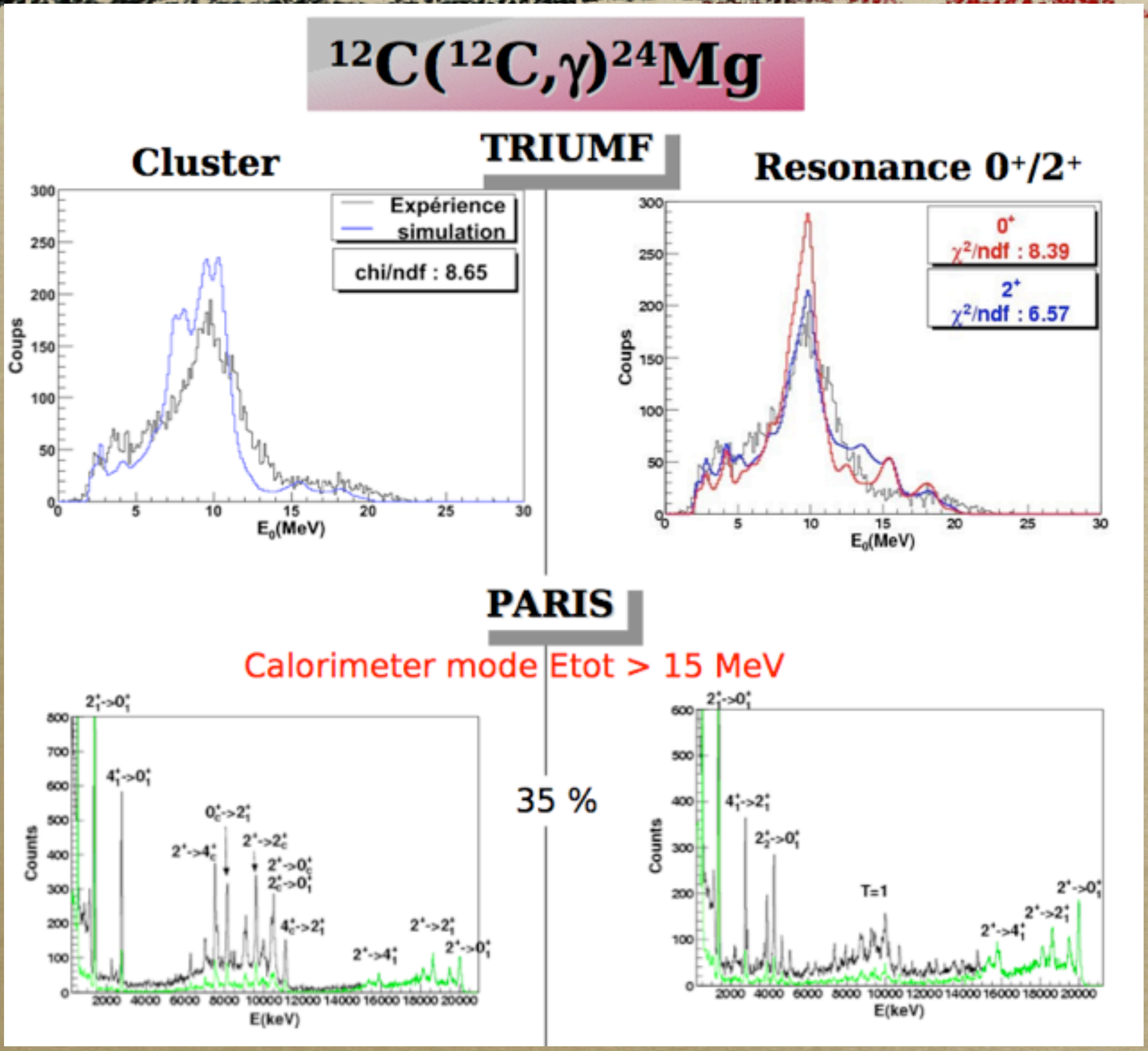


Dorothée Lebhertz

Recent news

What has been done ...



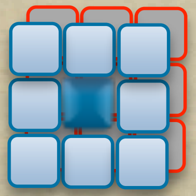
Dorothée Lebhertz

Recent news

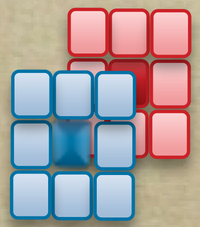
What has been done ...

<u>RawPerformances</u> : one element = one γ –ray

- **0_0 : only the first shell**

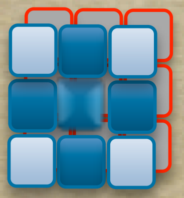


- **1_0 : both shells**

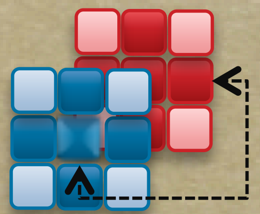


<u>AddBack</u> : smallest cluster
(starting from the highest deposited energy)

1_0 : closest only in the first shell



1_1: + addback between the 2 shells

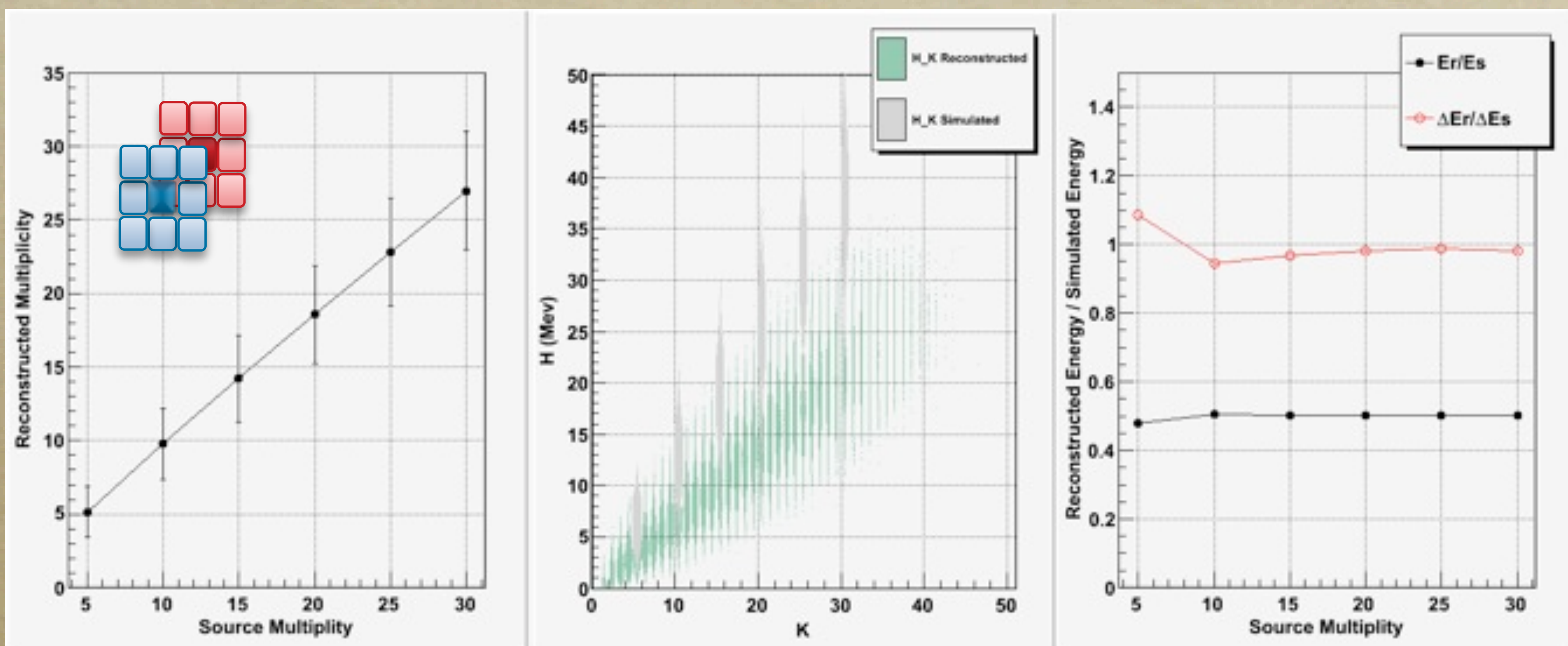


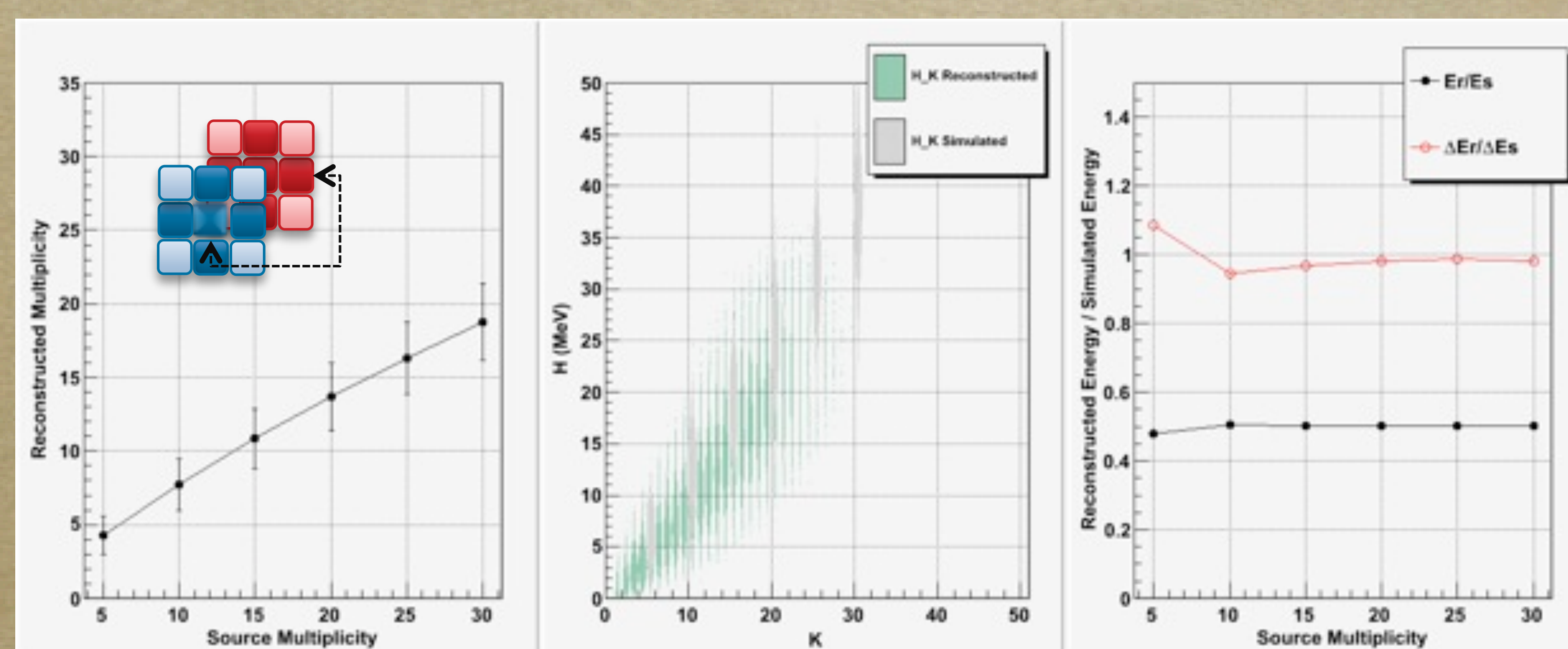
+ AddBack1_A1 : second shell Anti-Compton

Recent news

What has been done ...

Calorimeter

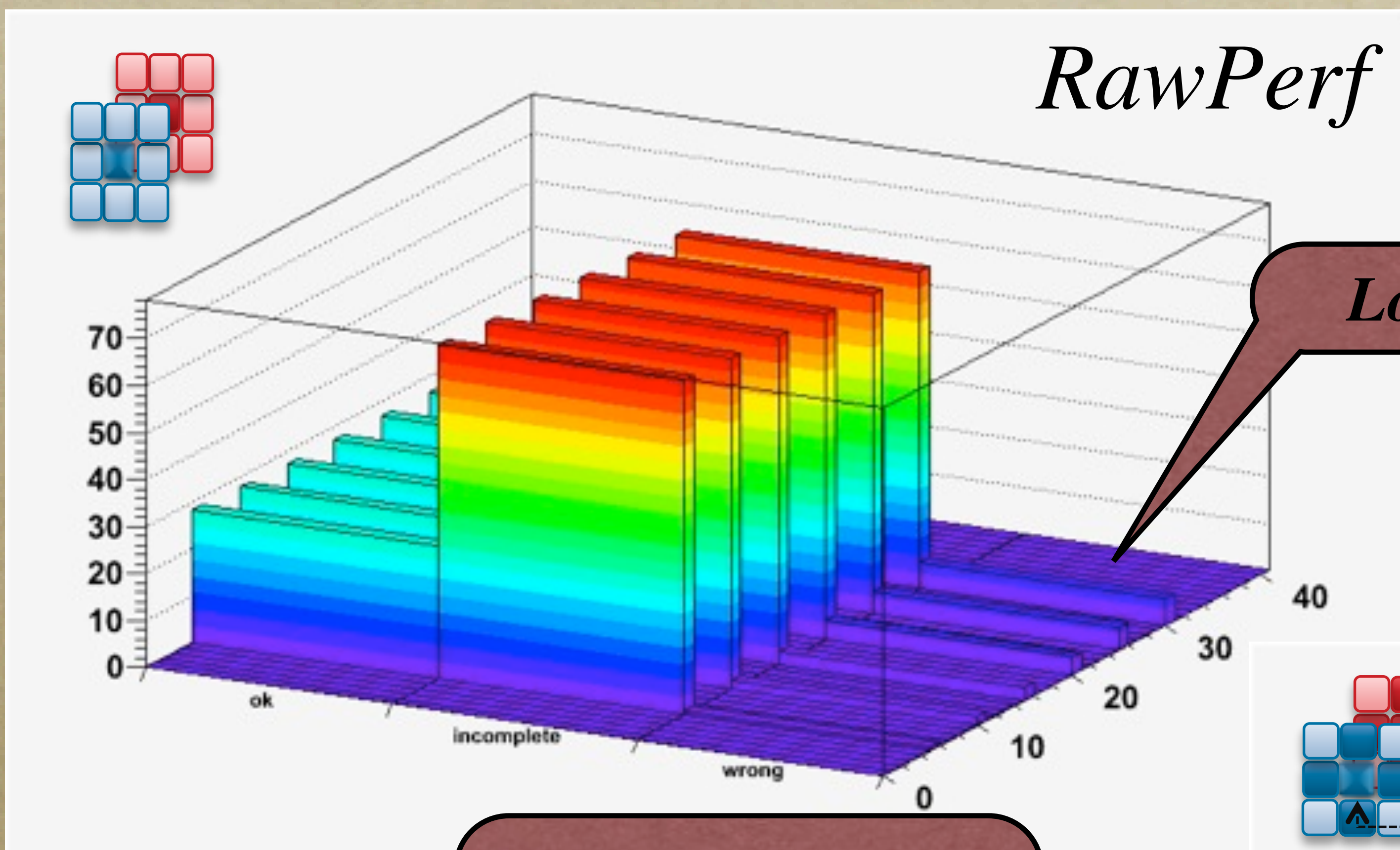




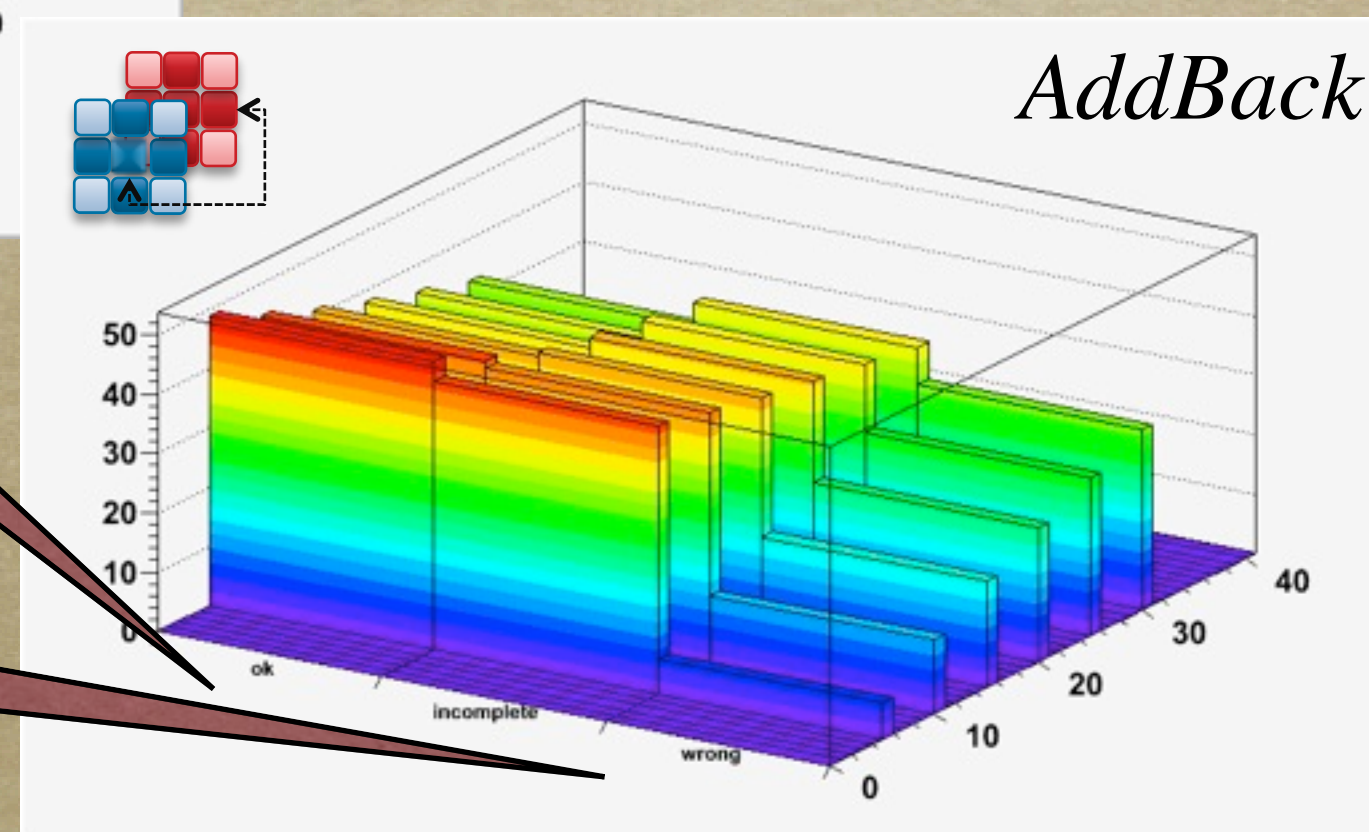
Recent news

What has been done ...

Cluster 'Quality'



Low pileup



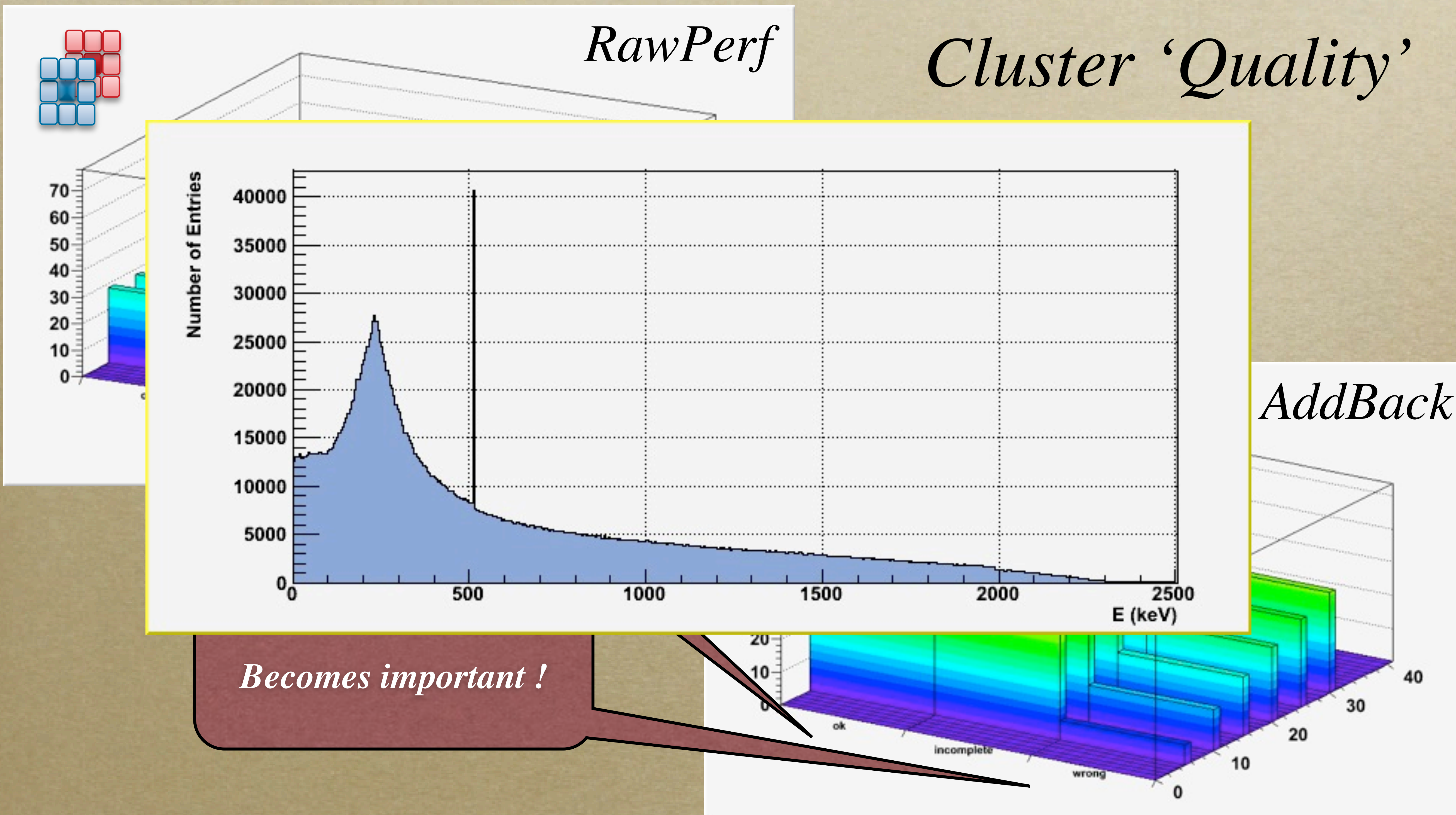
Gain !

Becomes important !

Recent news

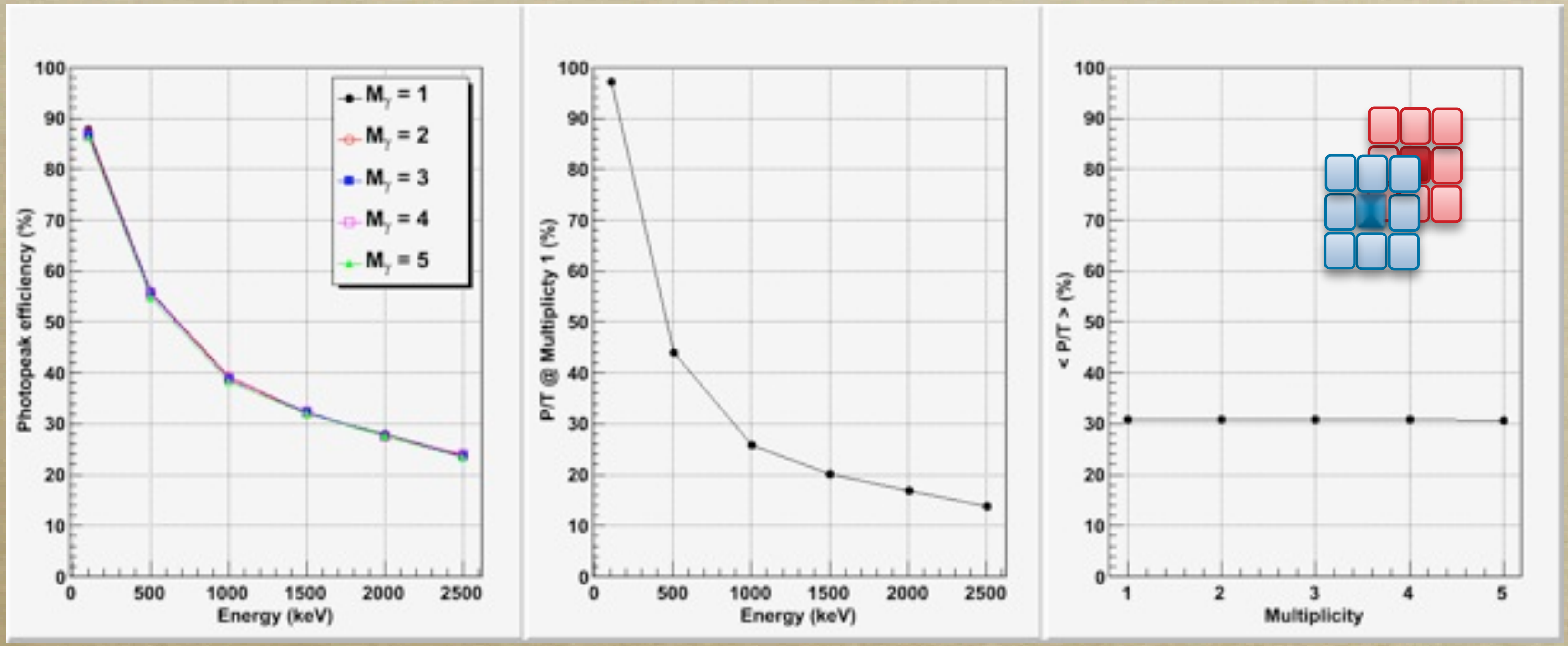
What has been done ...

Cluster 'Quality'

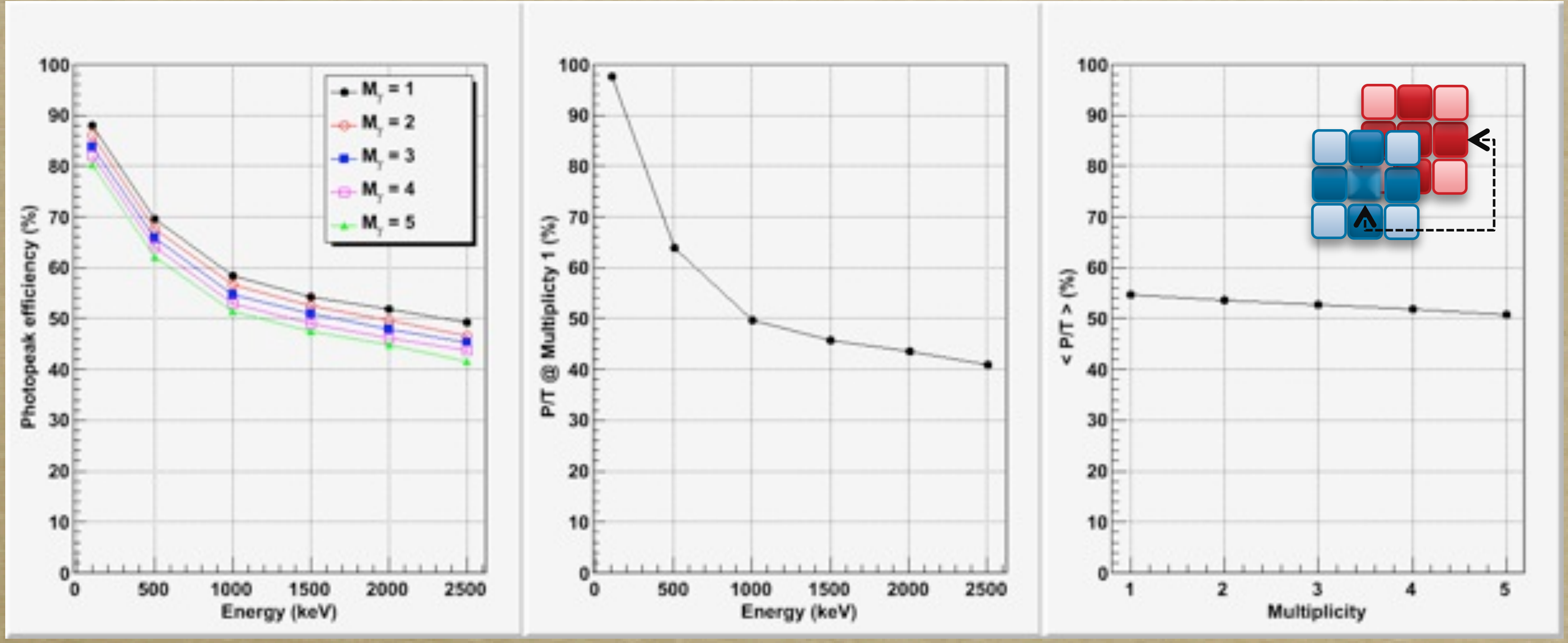


Becomes important !

What has been done ...



Discrete Spectroscopy



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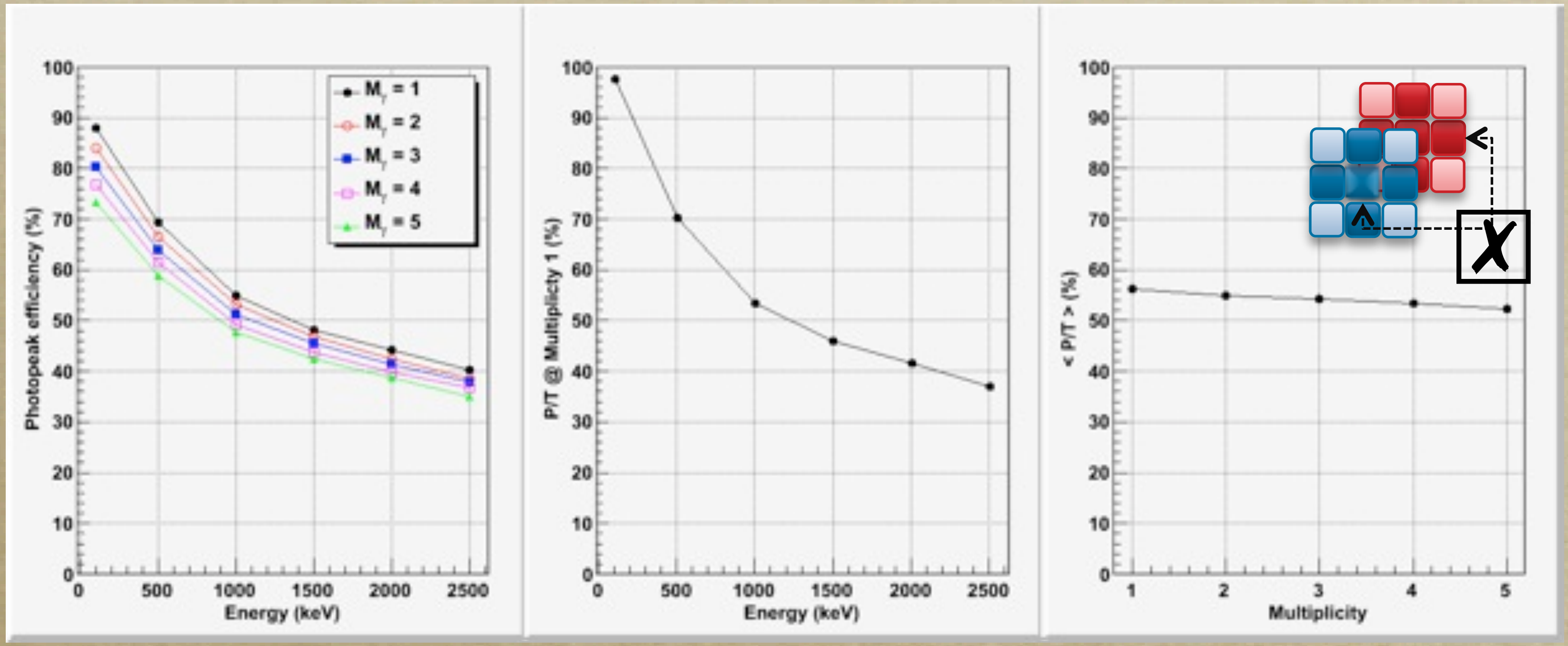

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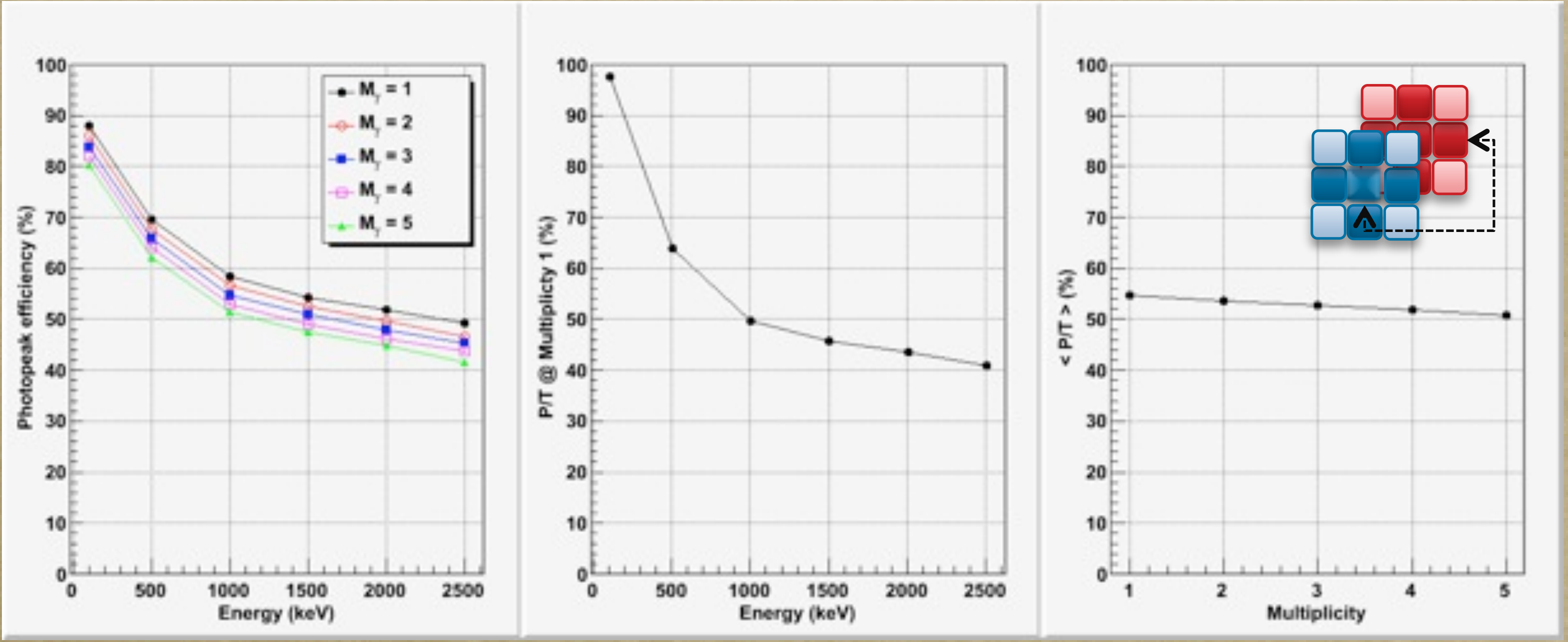

Recent news

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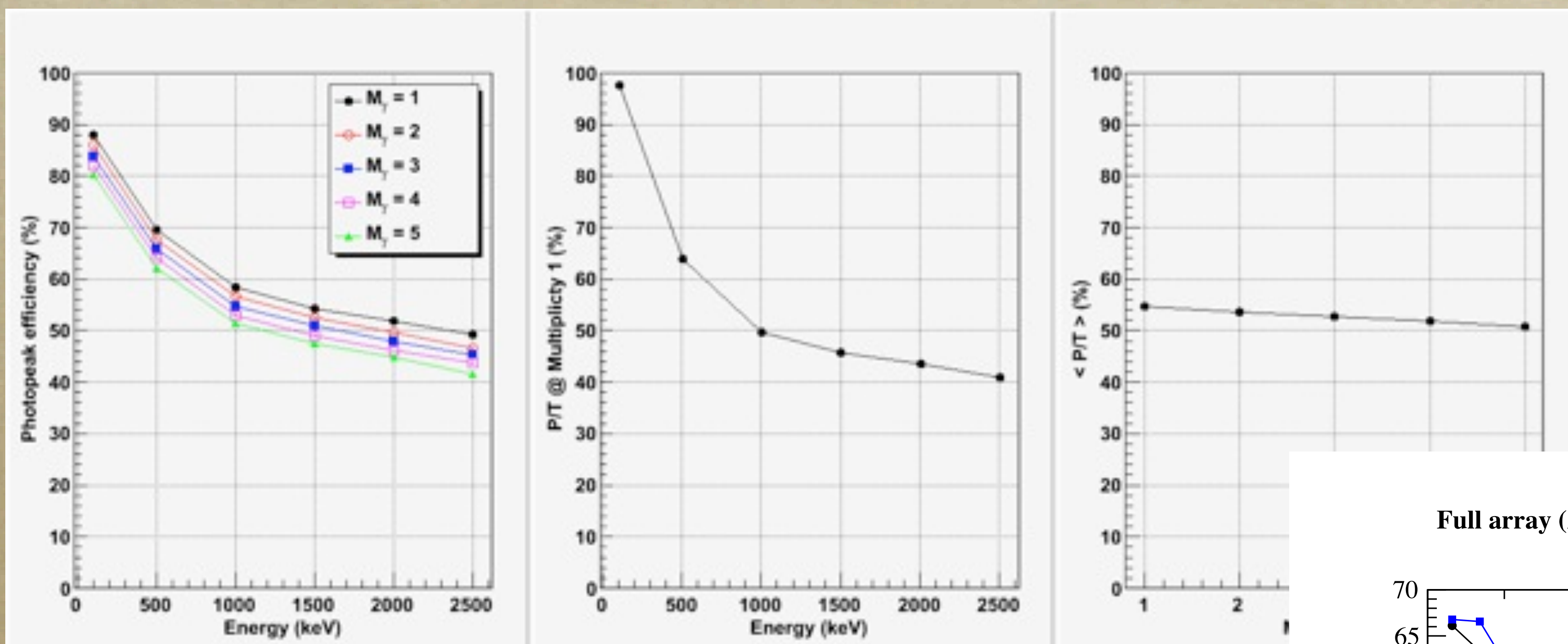
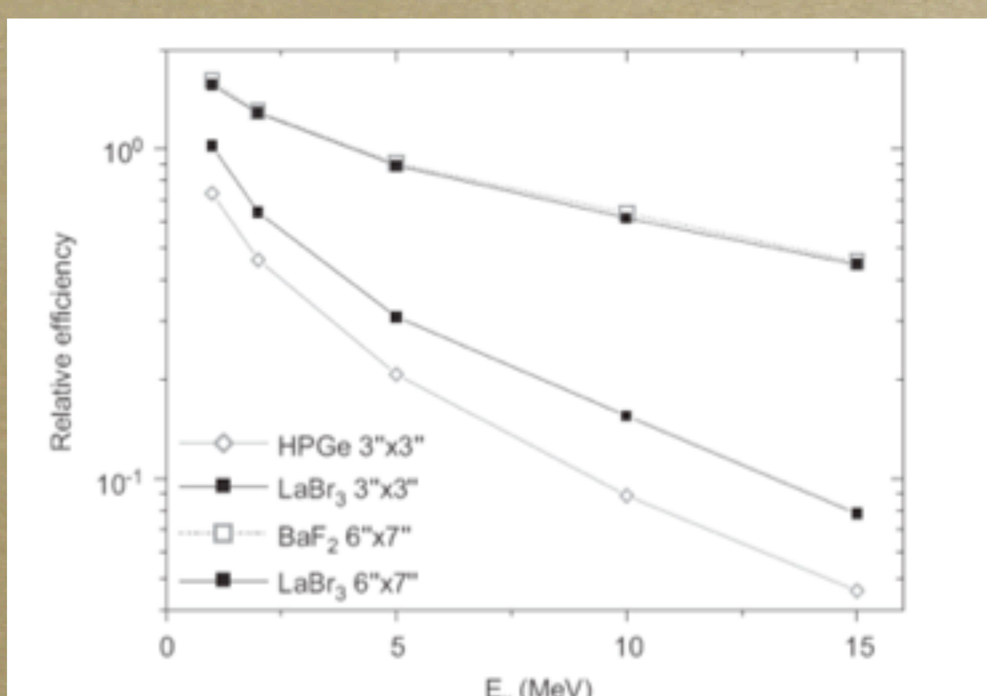
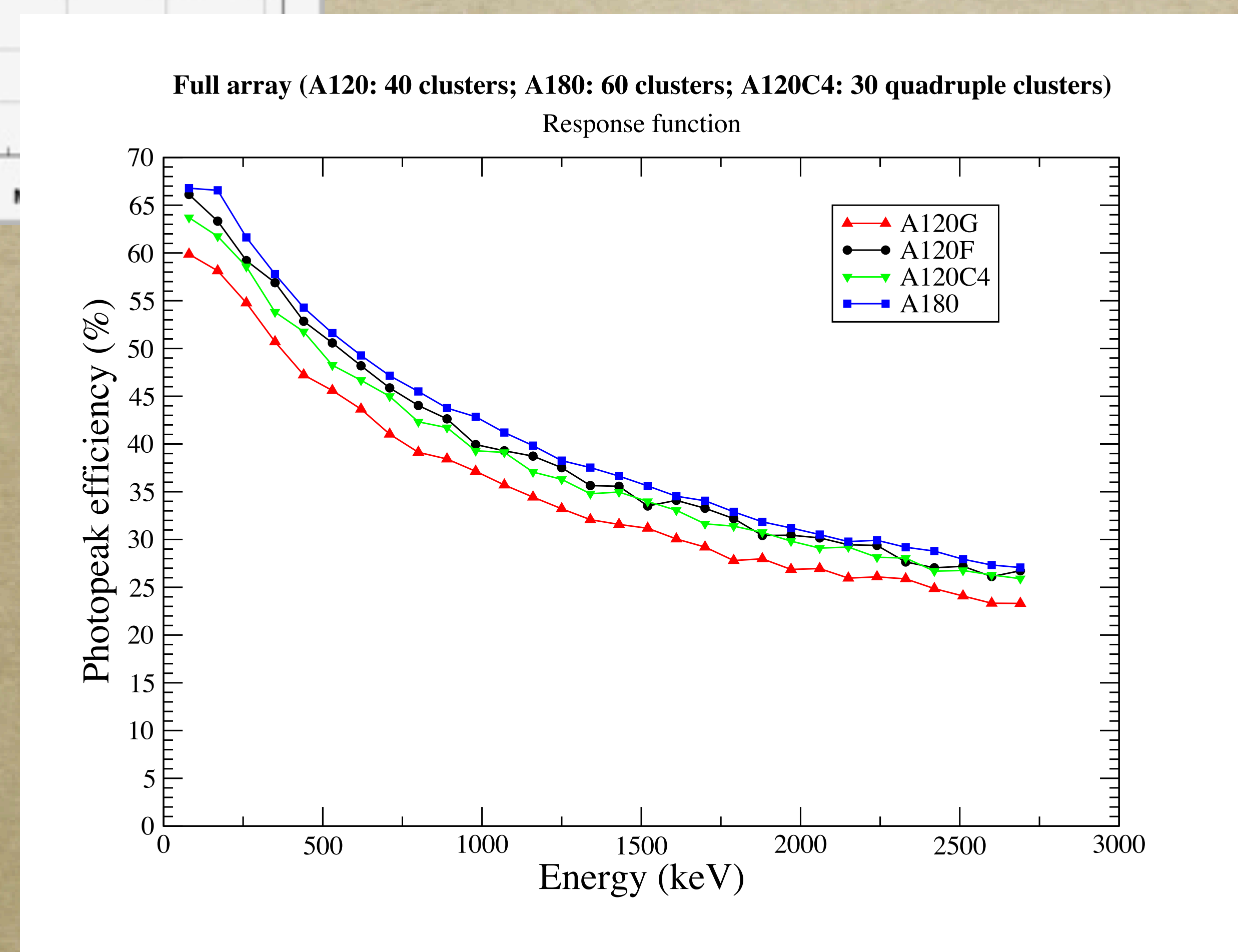


Discrete Spectroscopy

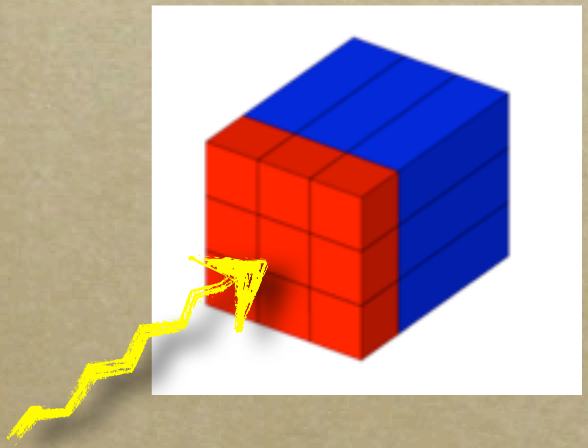


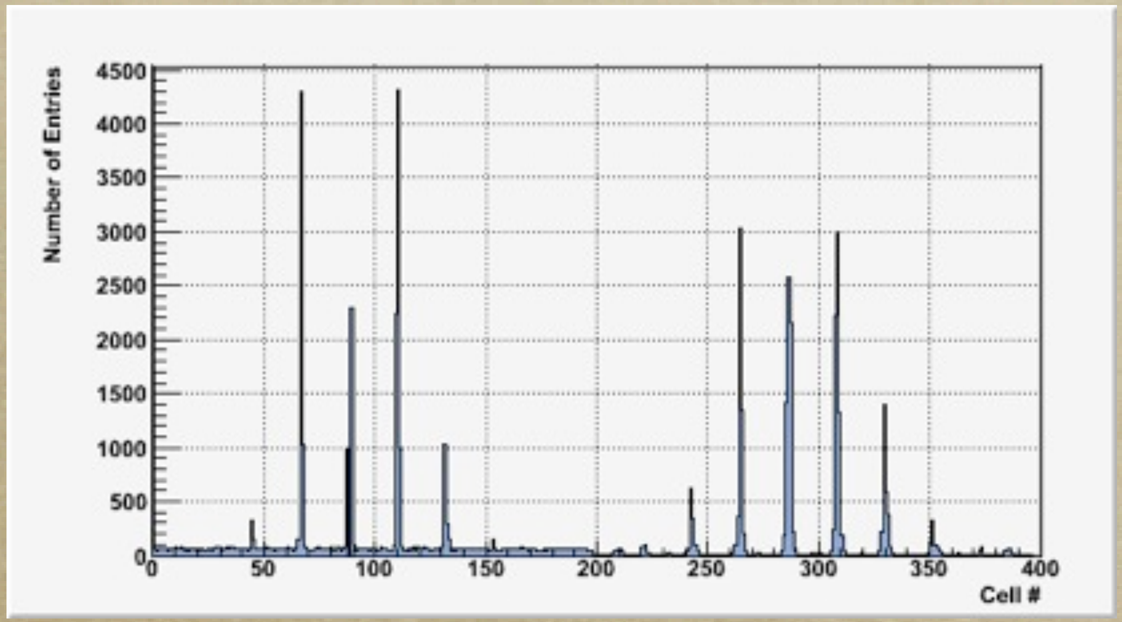


Recent news

What has been done ...

How to improve clusters ? some directions :





Recent news

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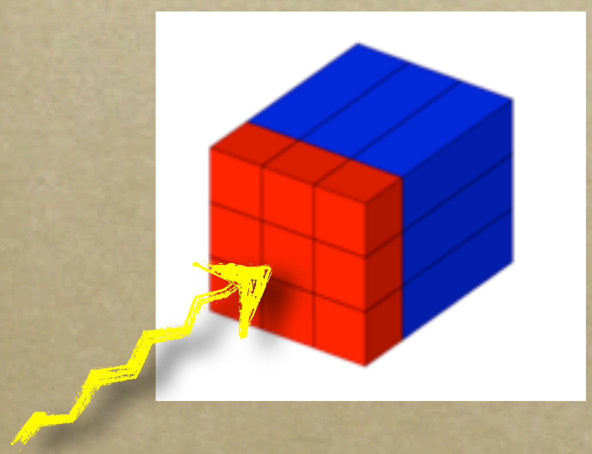

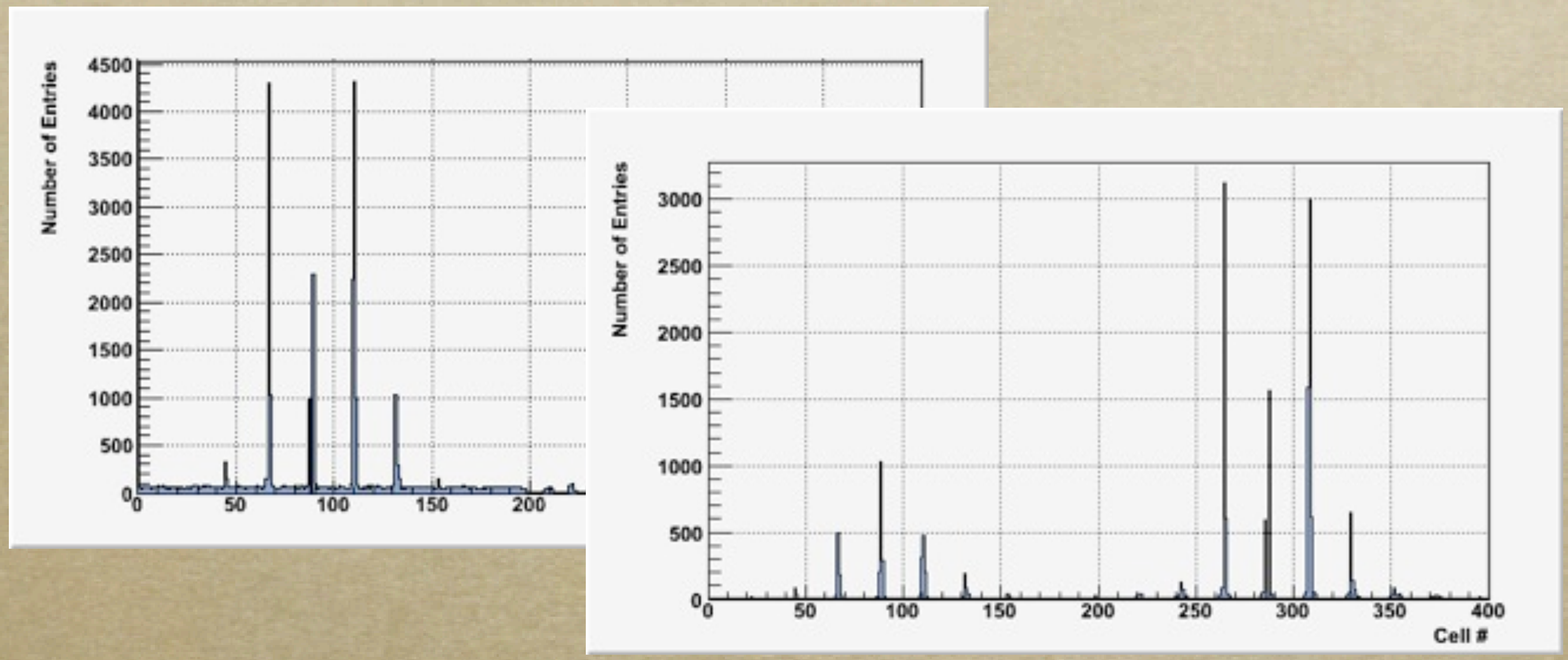

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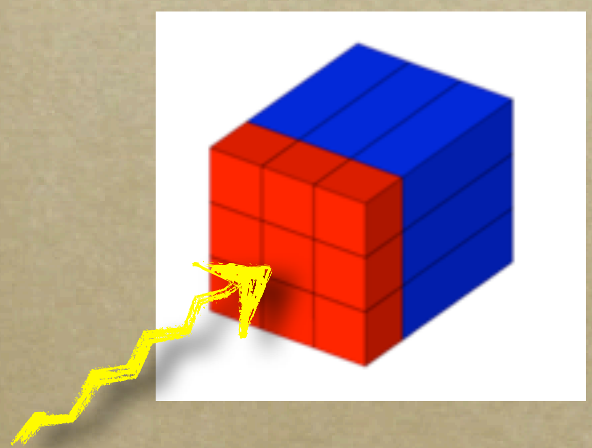

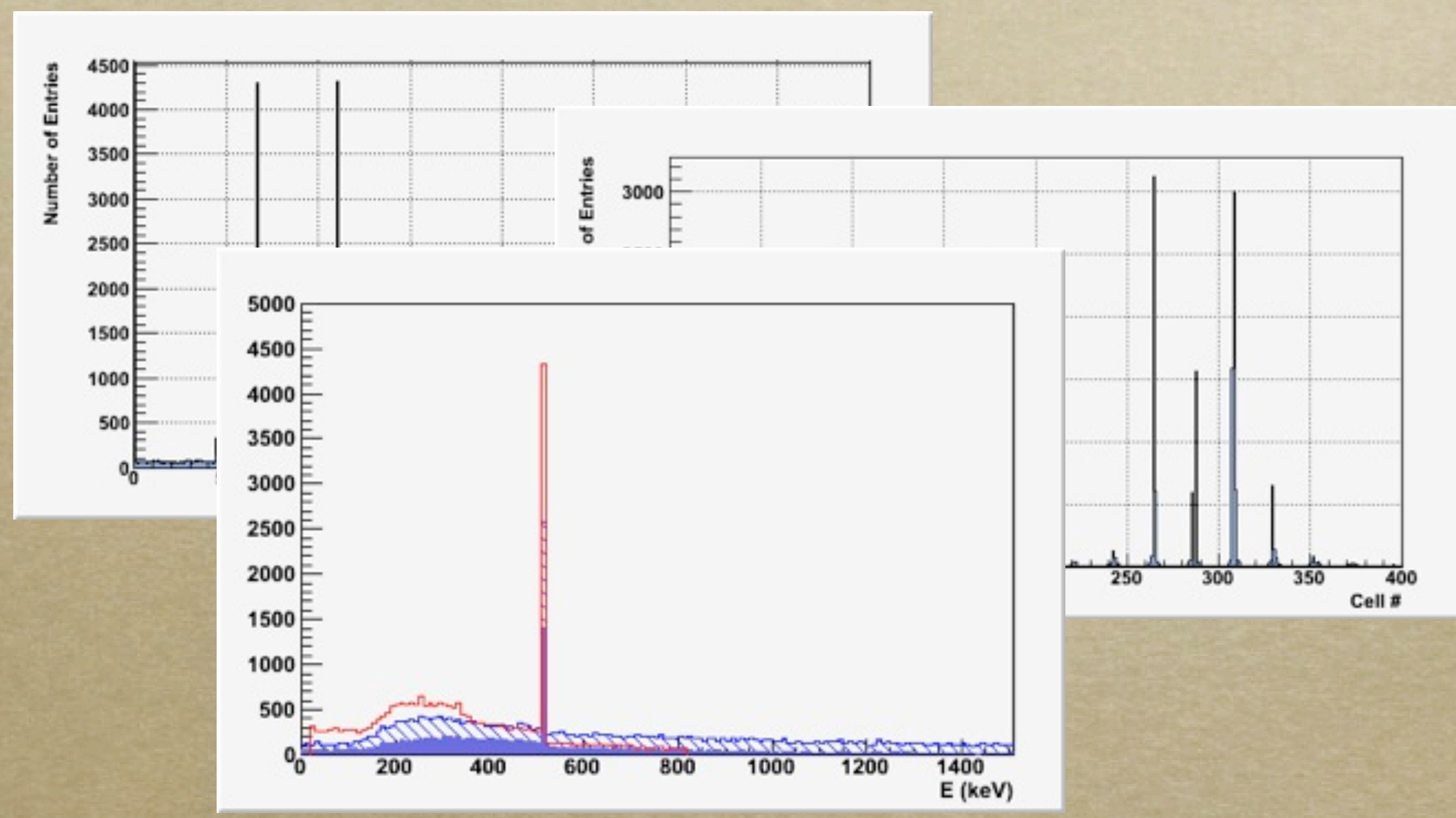

Recent news

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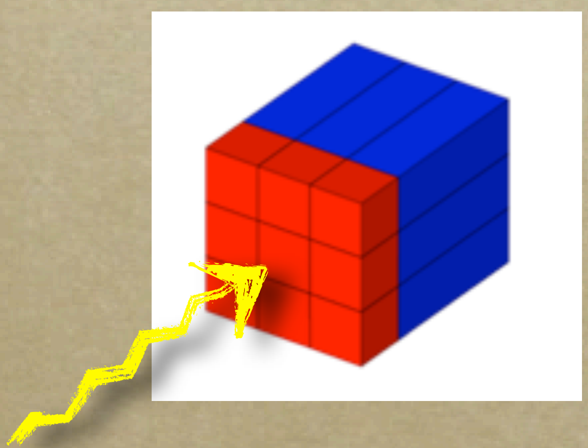

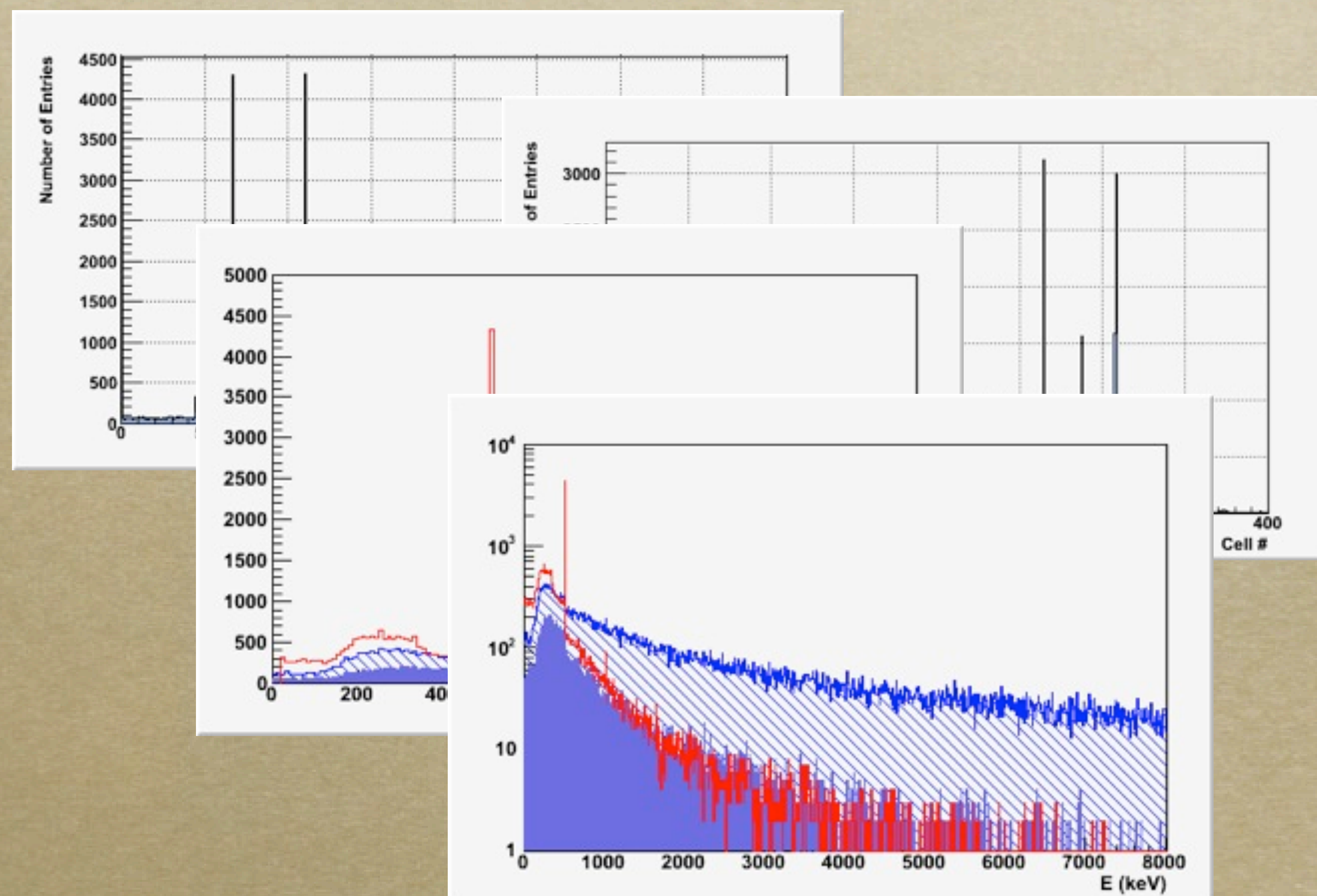

Recent news

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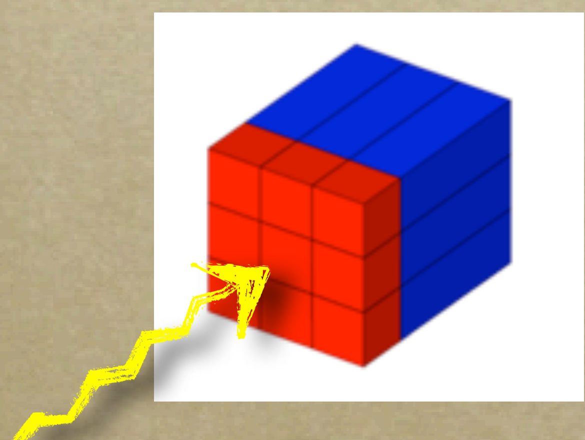

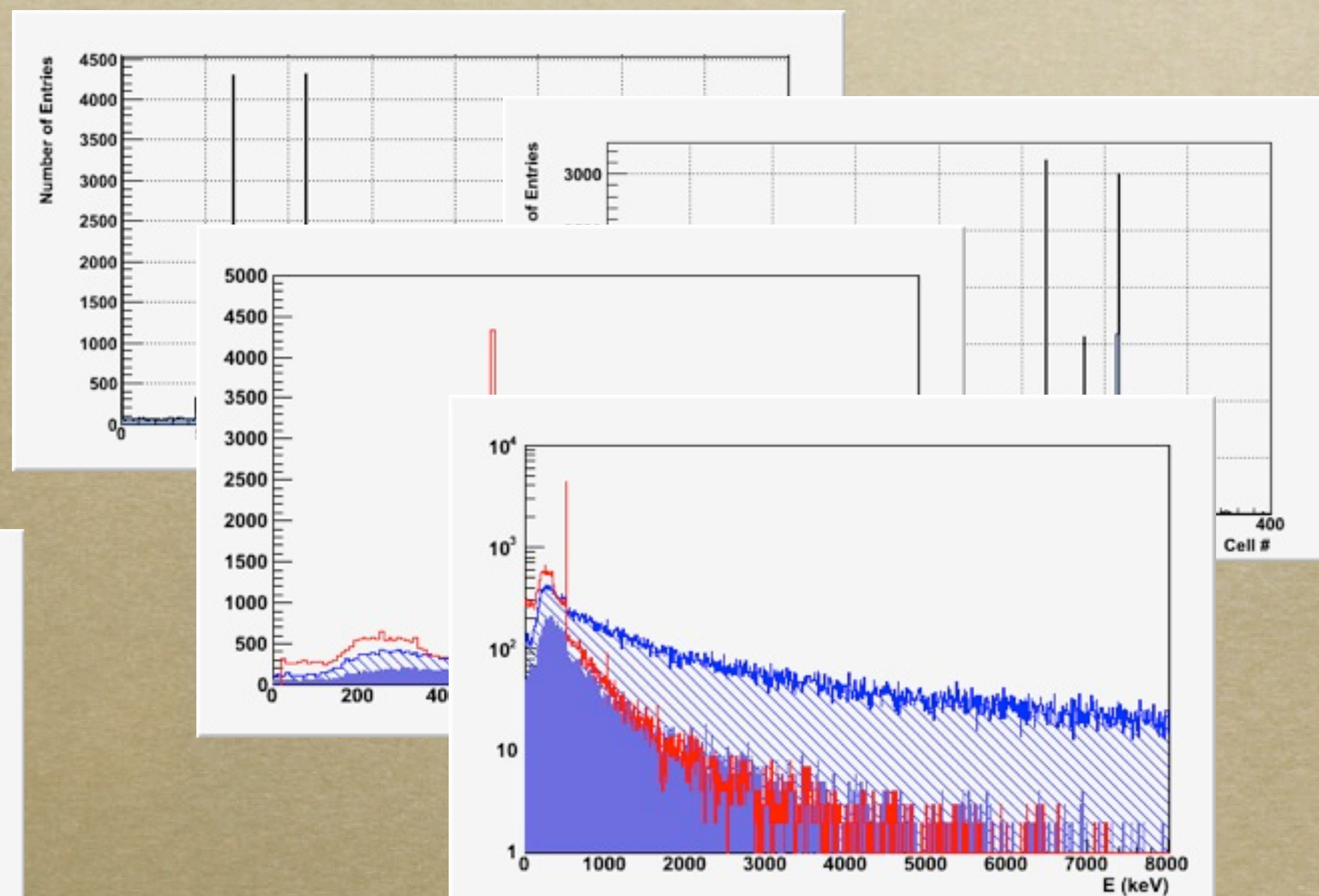

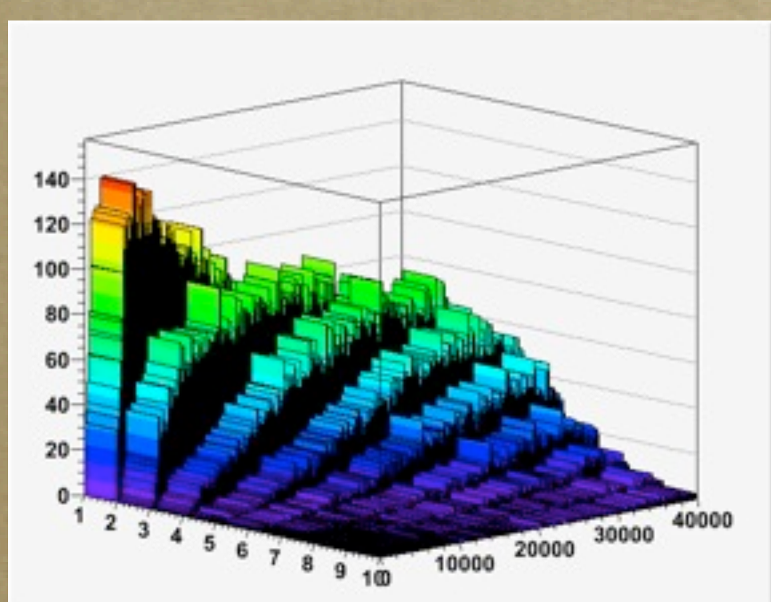

Recent news

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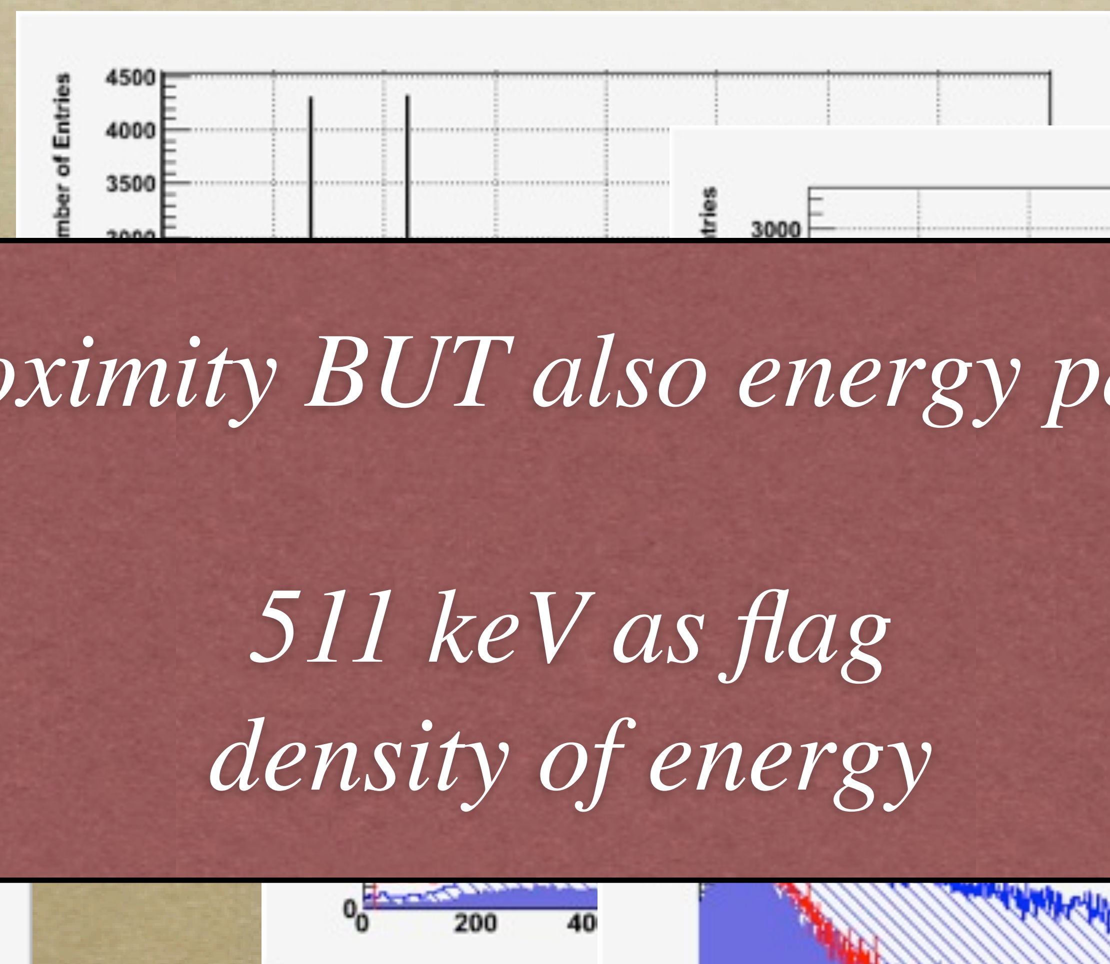
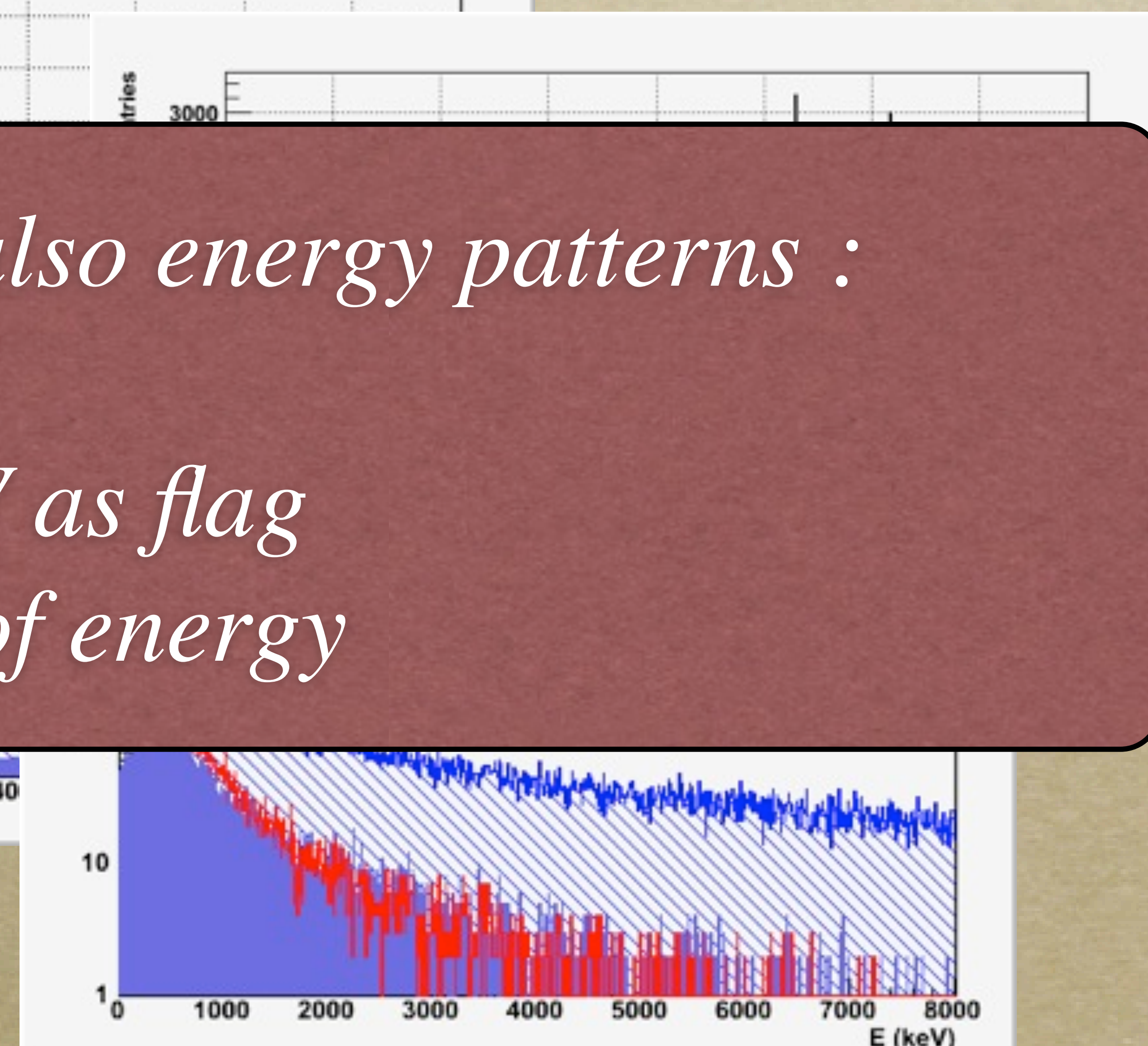
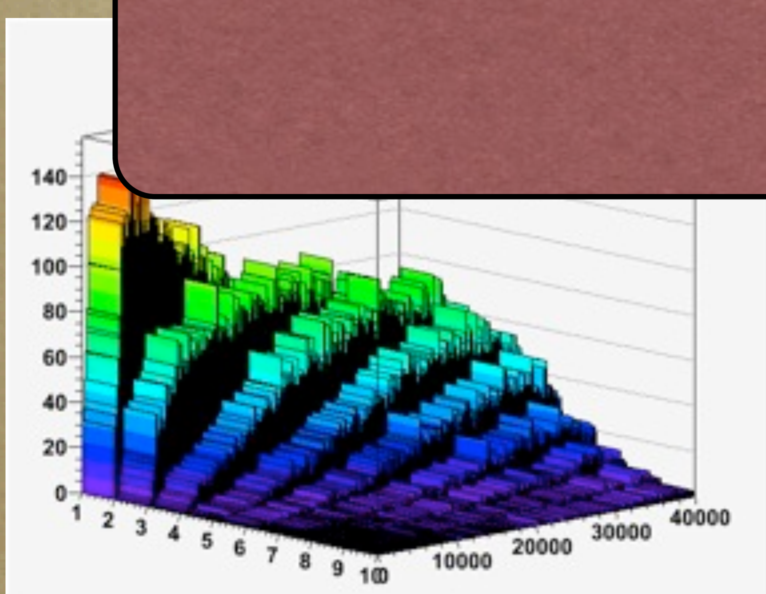




Use proximity BUT also energy patterns :

511 keV as flag
density of energy



Conclusions and perspectives

More realistic simulations (algo., generators)

Studies to really compared the geometries

... on going ...

Never enough people working on simulation