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Quantum Chromodynamics

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Double cumulative photon spectra at mid rapidity and high pt in C+Be collisions at 2.0 and 3.2 AGeV. FLINT experiment.

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for FLINT collaboration
ITEP

Outline

- The idea of FLINT experiment
  - Phase diagram, process schema
- FLINT setup
  - Current status of experiment
  - New results
- Development of FLINT setup
- Conclusion

Abstract

DOUBLE CUMULATIVE PHOTON SPECTRA AT MID RAPIDITY AND HIGH PT IN C+BE COLLISIONS AT 2.0 AND 3.2 AGEV.

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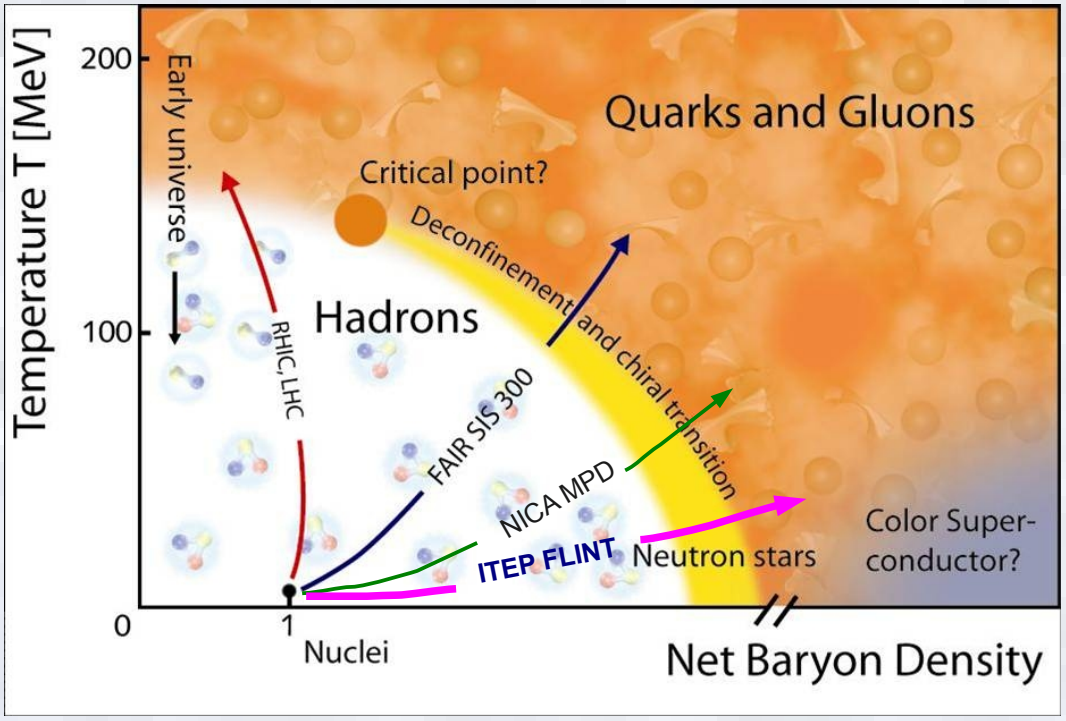
The photon spectra in central rapidity region were measured in C+Be collisions at beam energy 2.0 and 3.2 AGeV. The experiment was done in ITEP accelerator. The FLINT setup was wide acceptance (35^0-73^0 in lab. system) electromagnetic calorimeter. The energy range of measured photons was from 1 to 3 GeV. It was shown that most photons produced in the flucton-flucton interaction and it was up to 6 nucleons involved into interaction. Such kind of the interaction could be called “double cumulative” interaction.

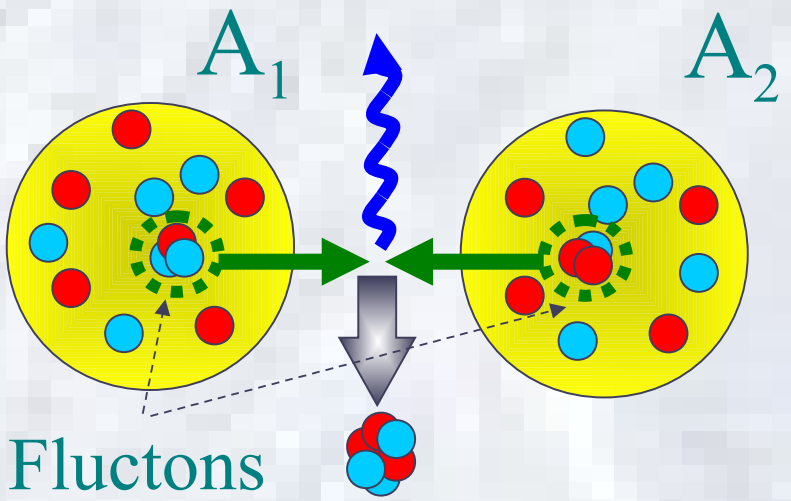
The idea of FLINT (FLucton INTeraction)

Phase diagram*



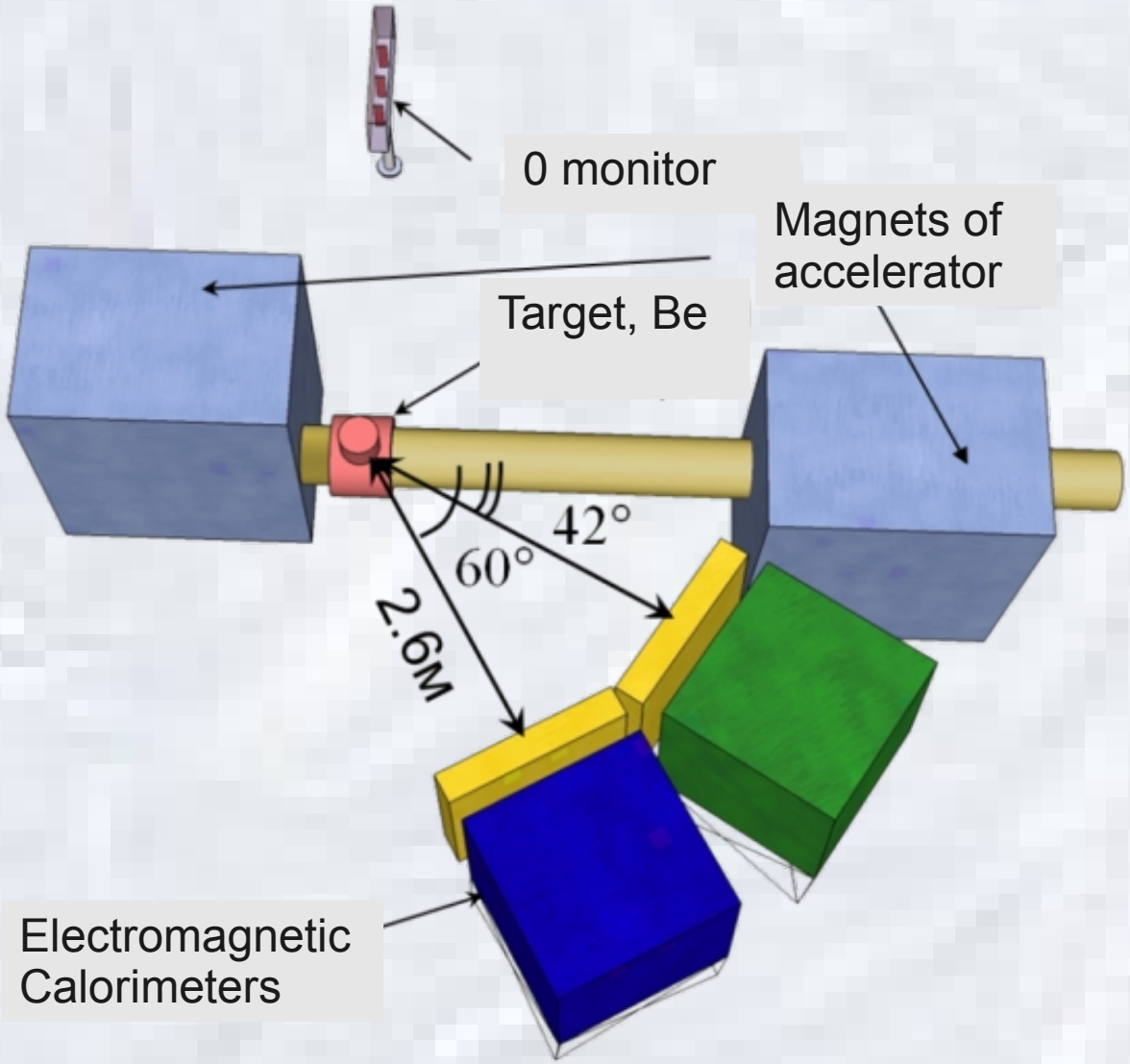
*http://www.gsi.de/forschung/fair_experiments/CBM/

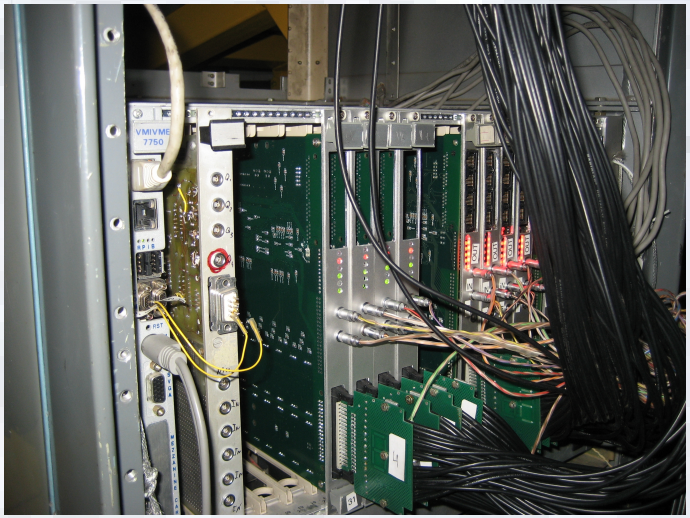
Scheme of process



Dense baryon system

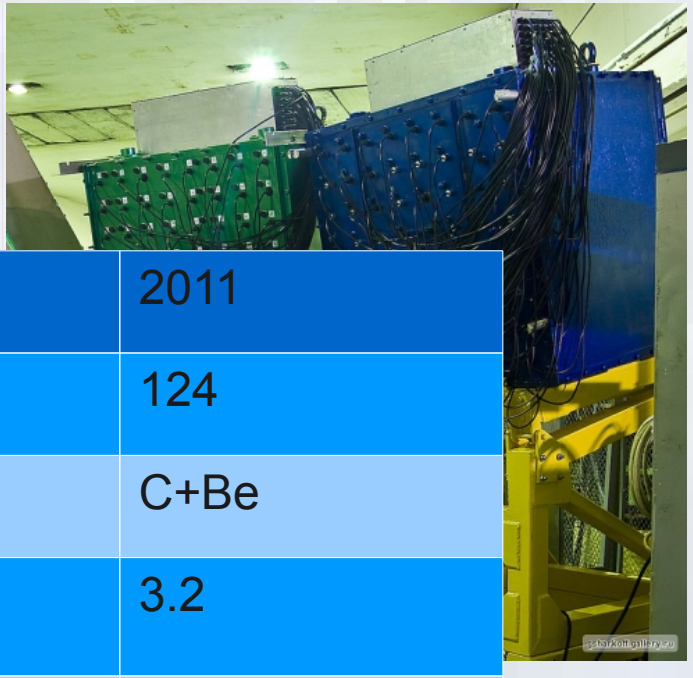
FLINT Setup


0 monitor
Magnets of accelerator
Target, Be
42°
60°
2.6м
Electromagnetic Calorimeters

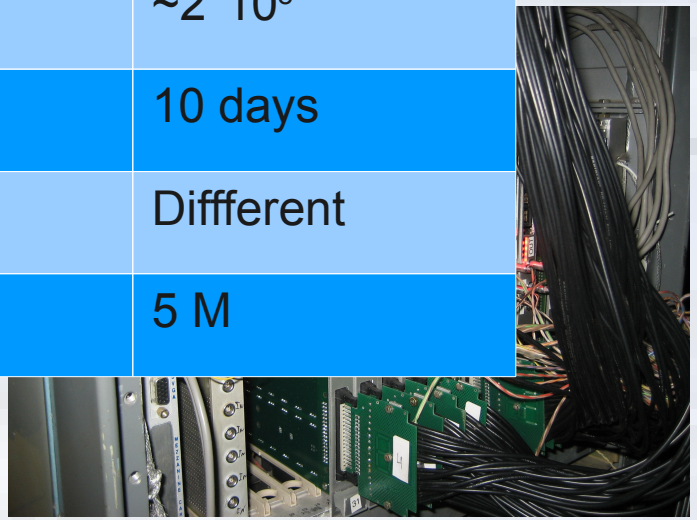


FLINT experiment

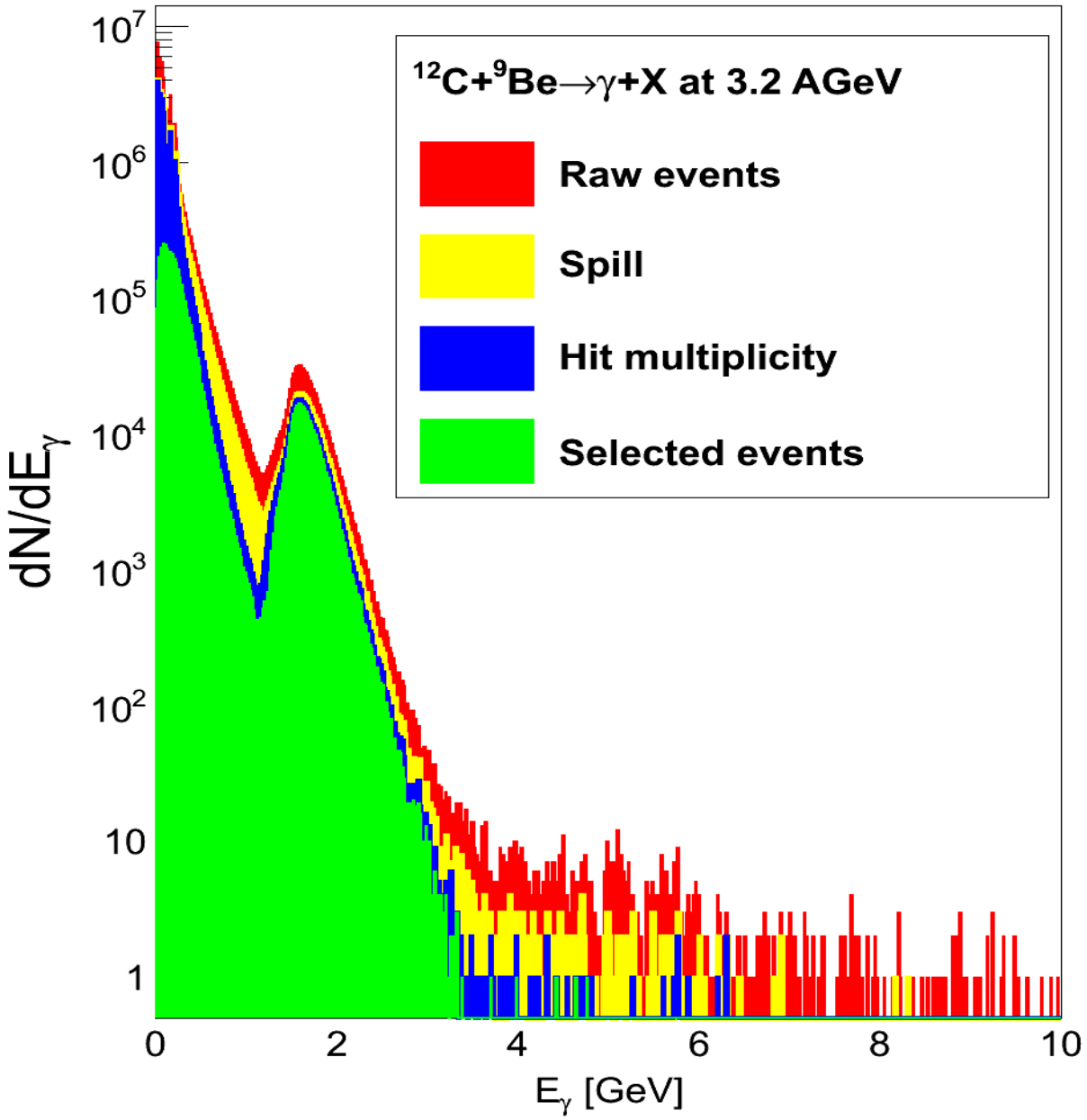
0 monitor



Runs	2007	2010	2011
EC channels	~50	124	124
Reaction	C+Be	C+Be	C+Be
E_{Kin}, AGeV	3.2	2, 3.2, 4	3.2
Intensity, ions/spill	~10^7	~$2*10^8$	~$2*10^8$
Exposition	1 day	20 days	10 days
Trigger	1 GeV	Different	Diffferent
Data	750 k	10 M	5 M



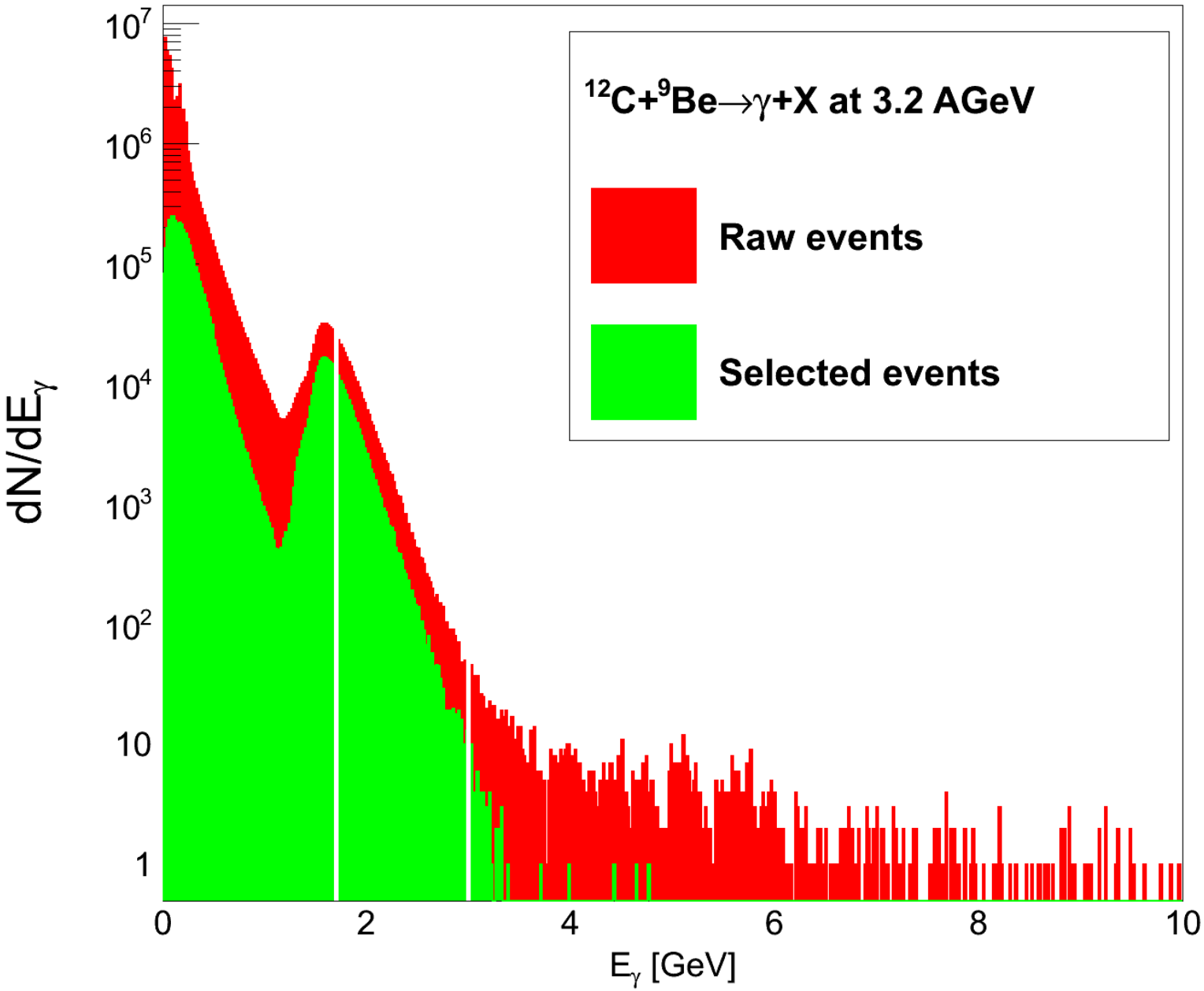
Data quality cuts



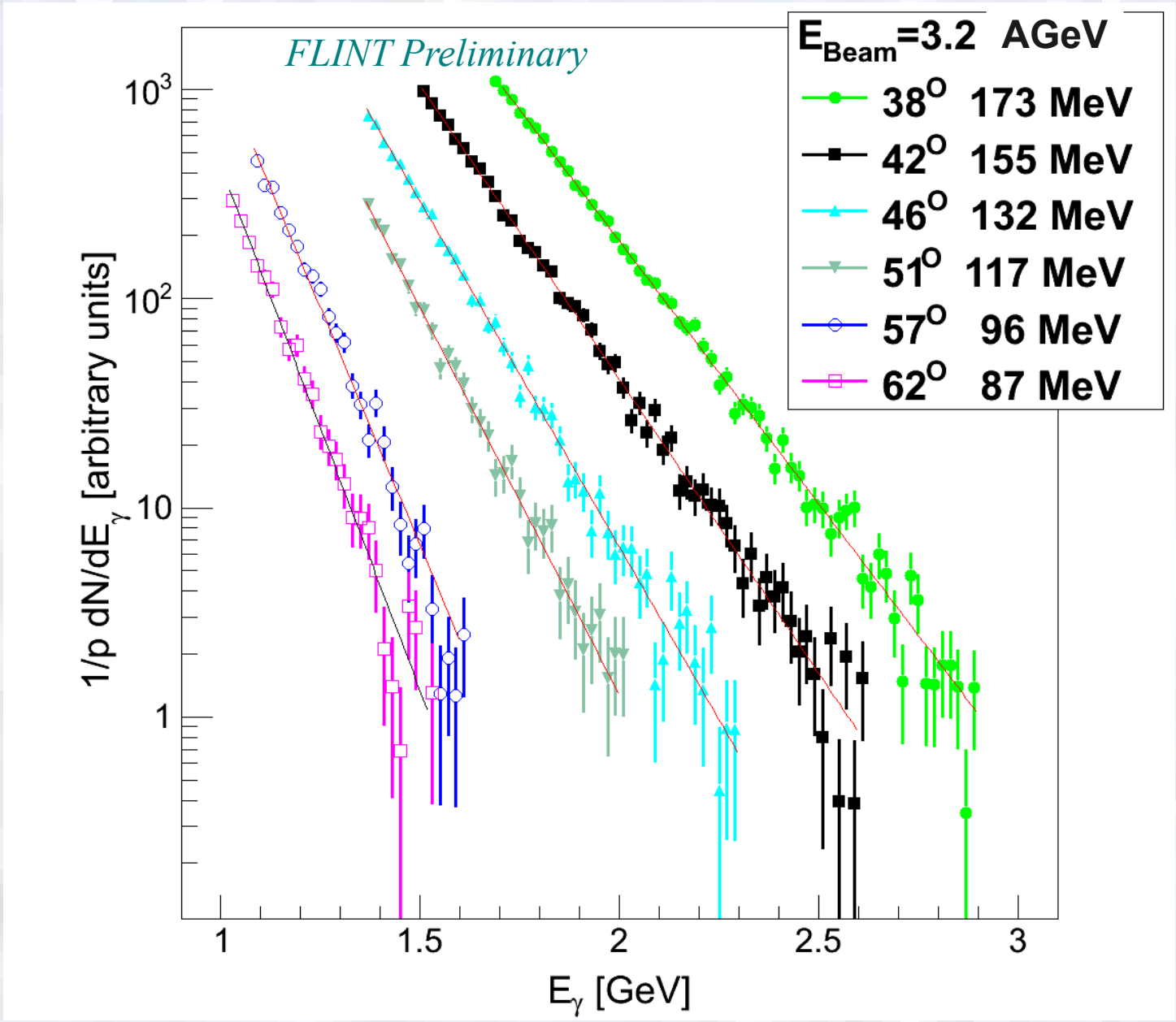
Three groups of cuts:

- Spill
- Hit Multiplicity
- Signal shape

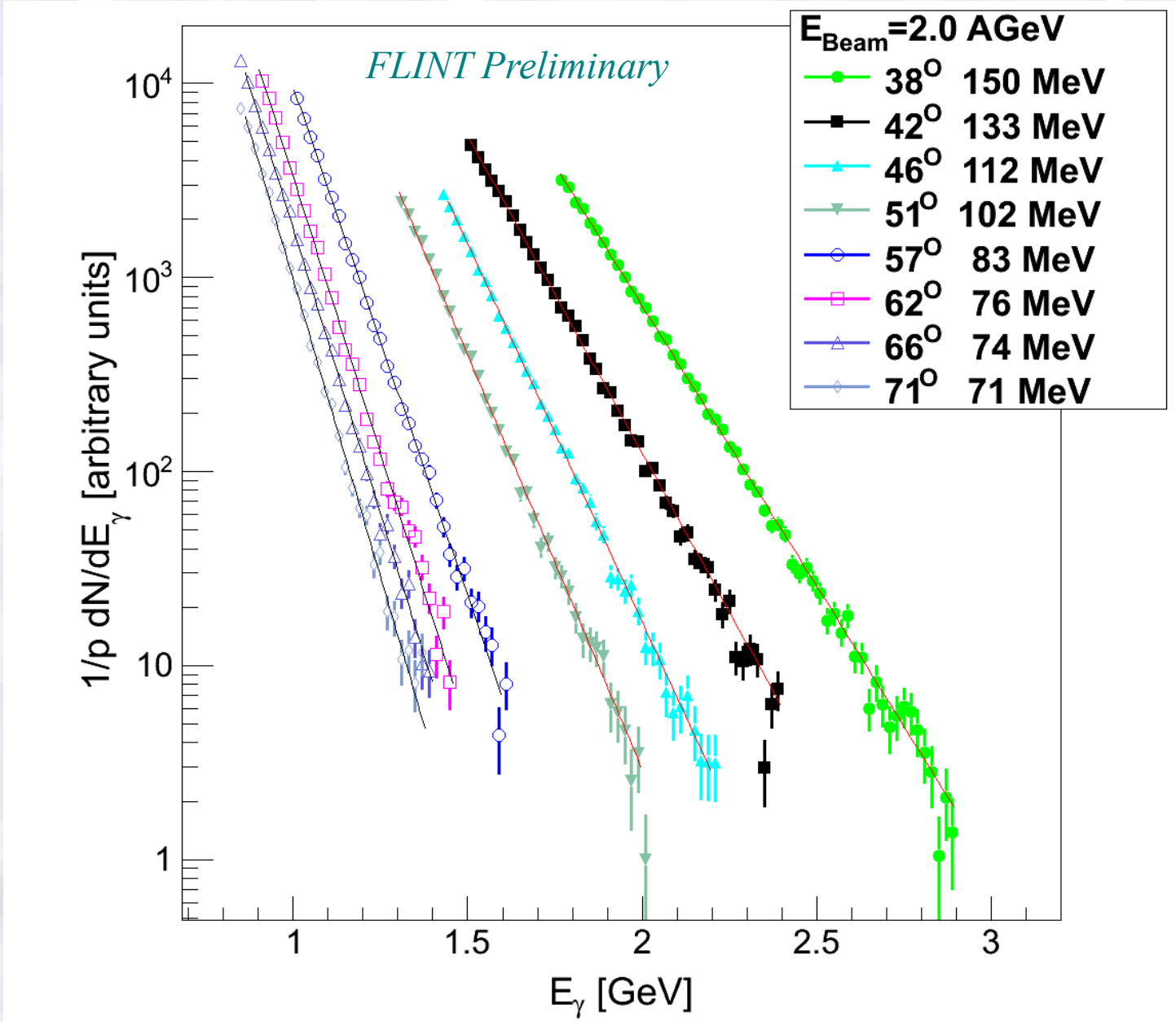
Data quality cuts



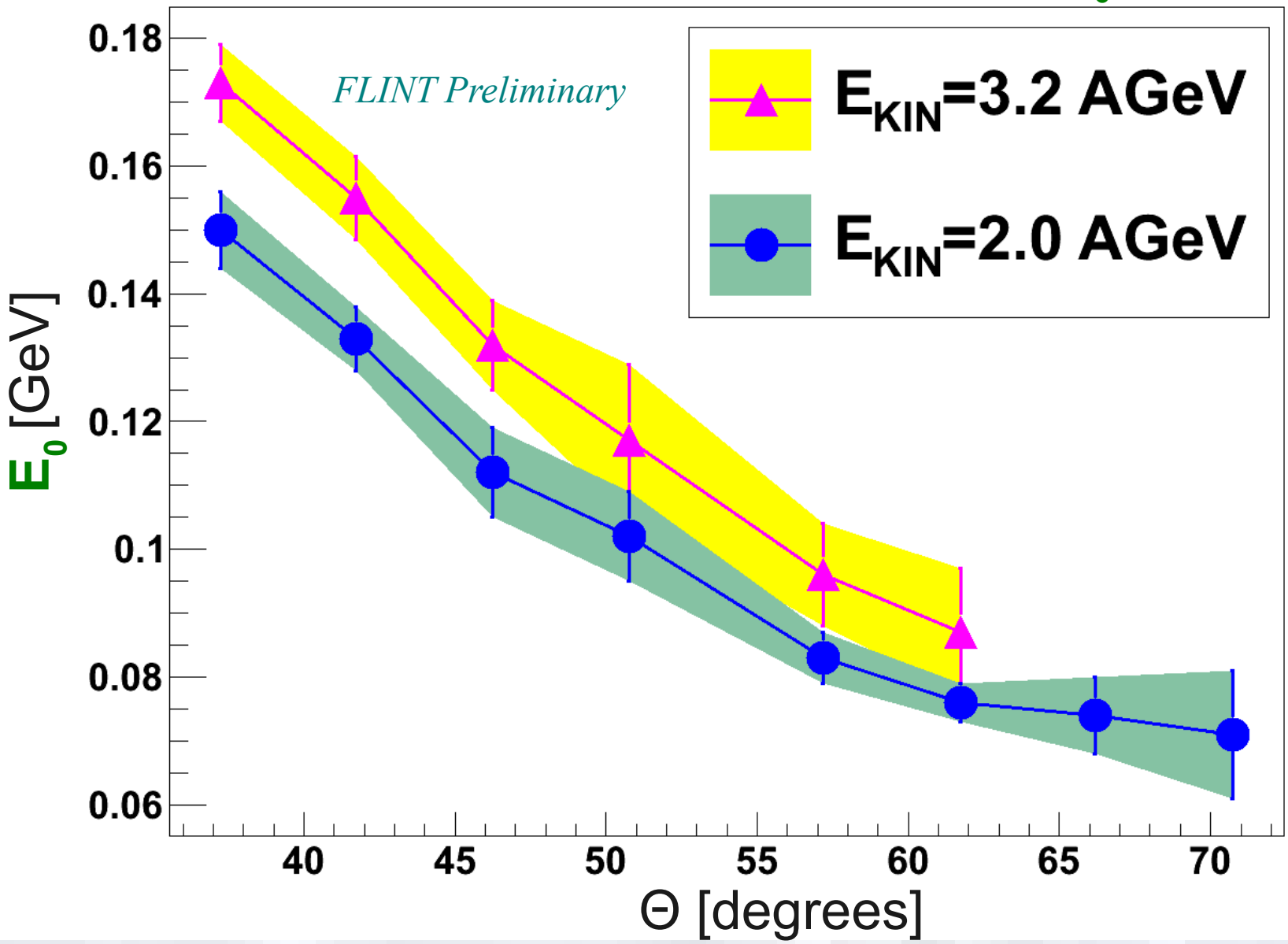
Photon spectra CBe→γX 3.2 AGeV



Photon spectra 2.0 AGeV

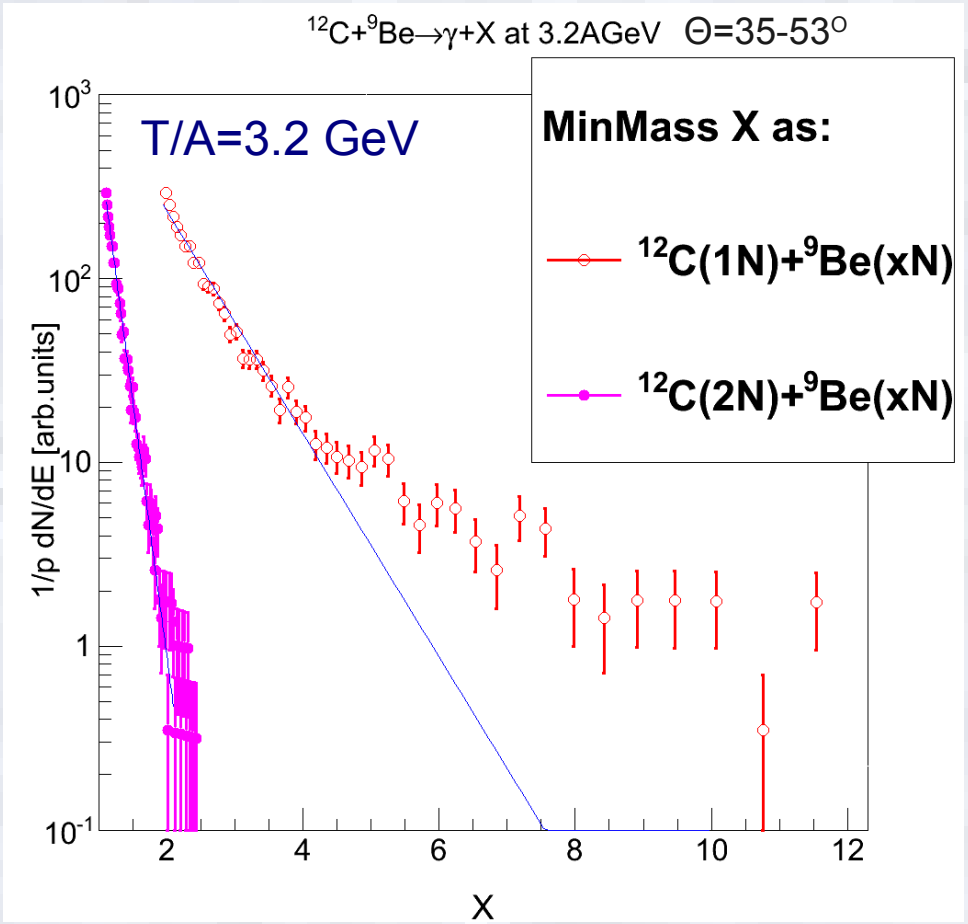


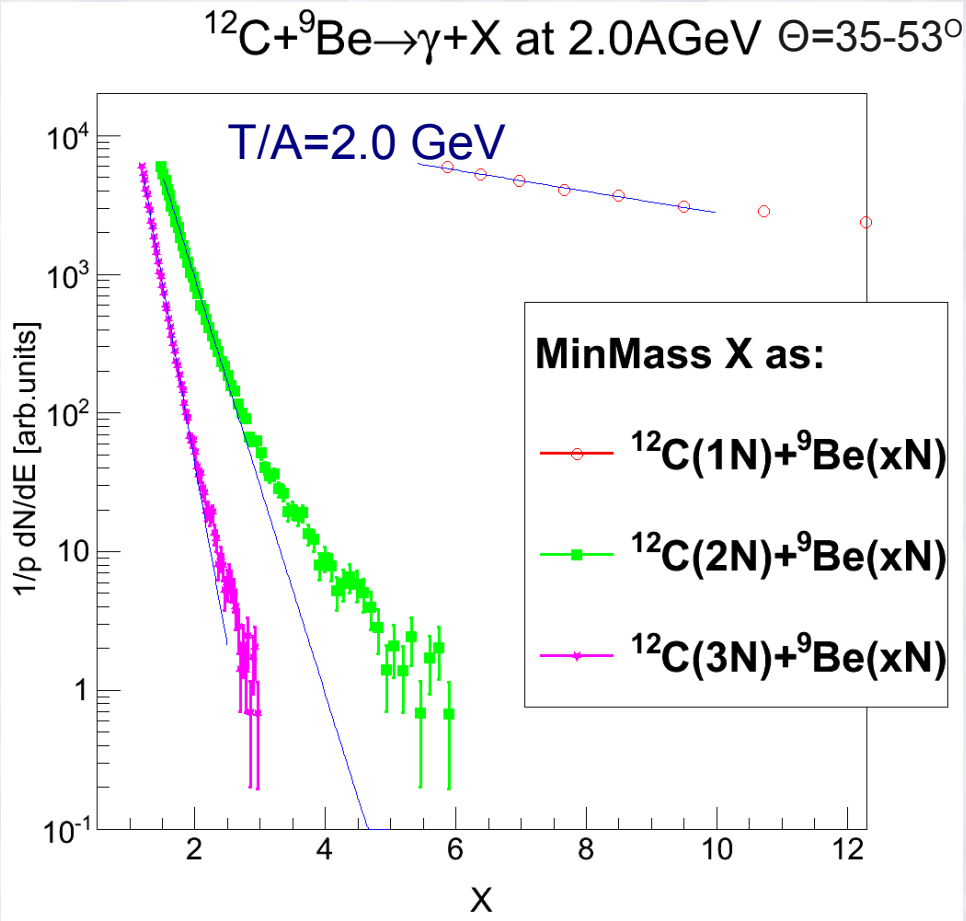
Slope vs angle $^{12}C+^{9}Be \rightarrow \gamma + X$



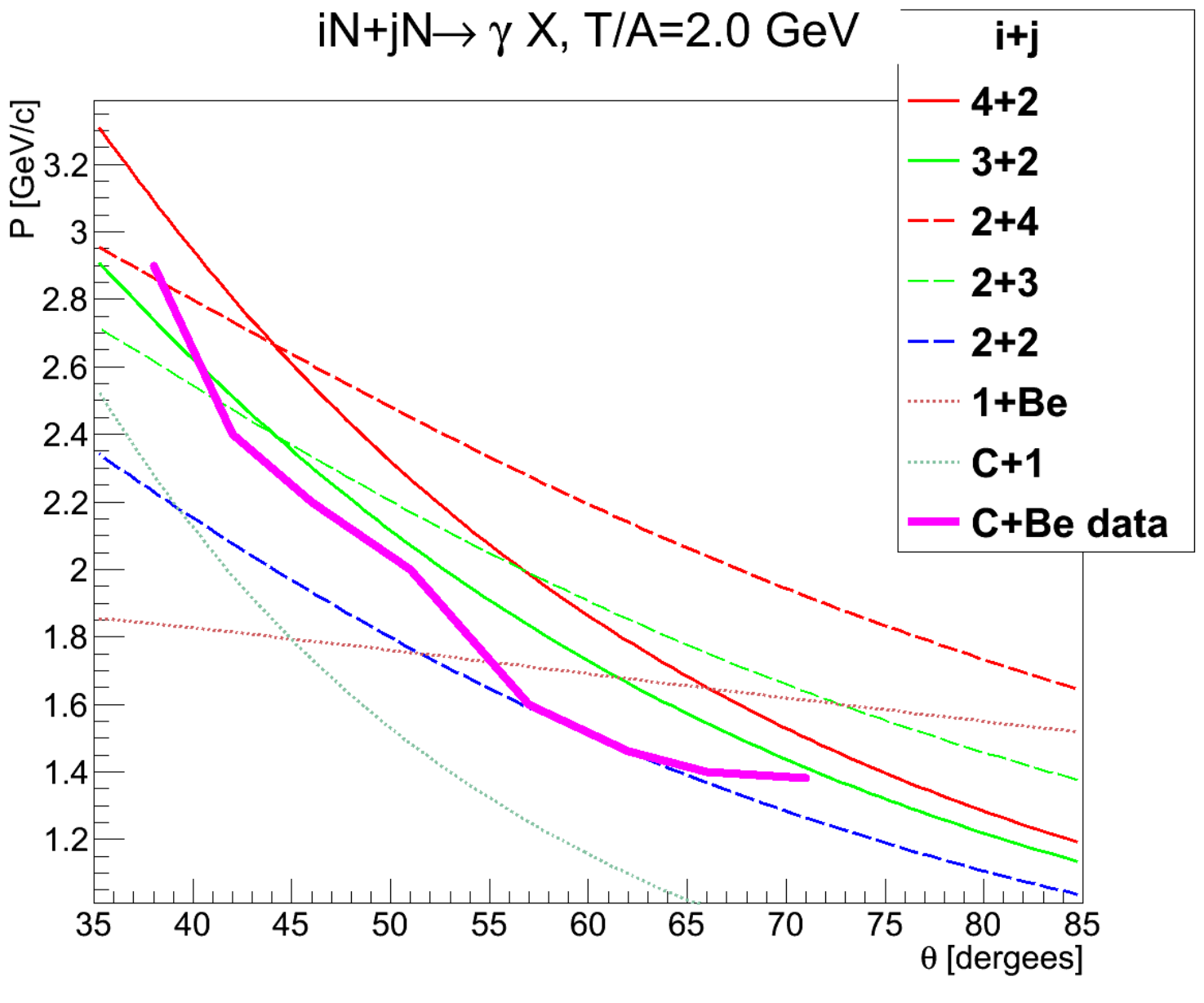
Spectrum vs cumulative number

1/p dN/dE fitted by *const*exp(-X/X$_0$)*

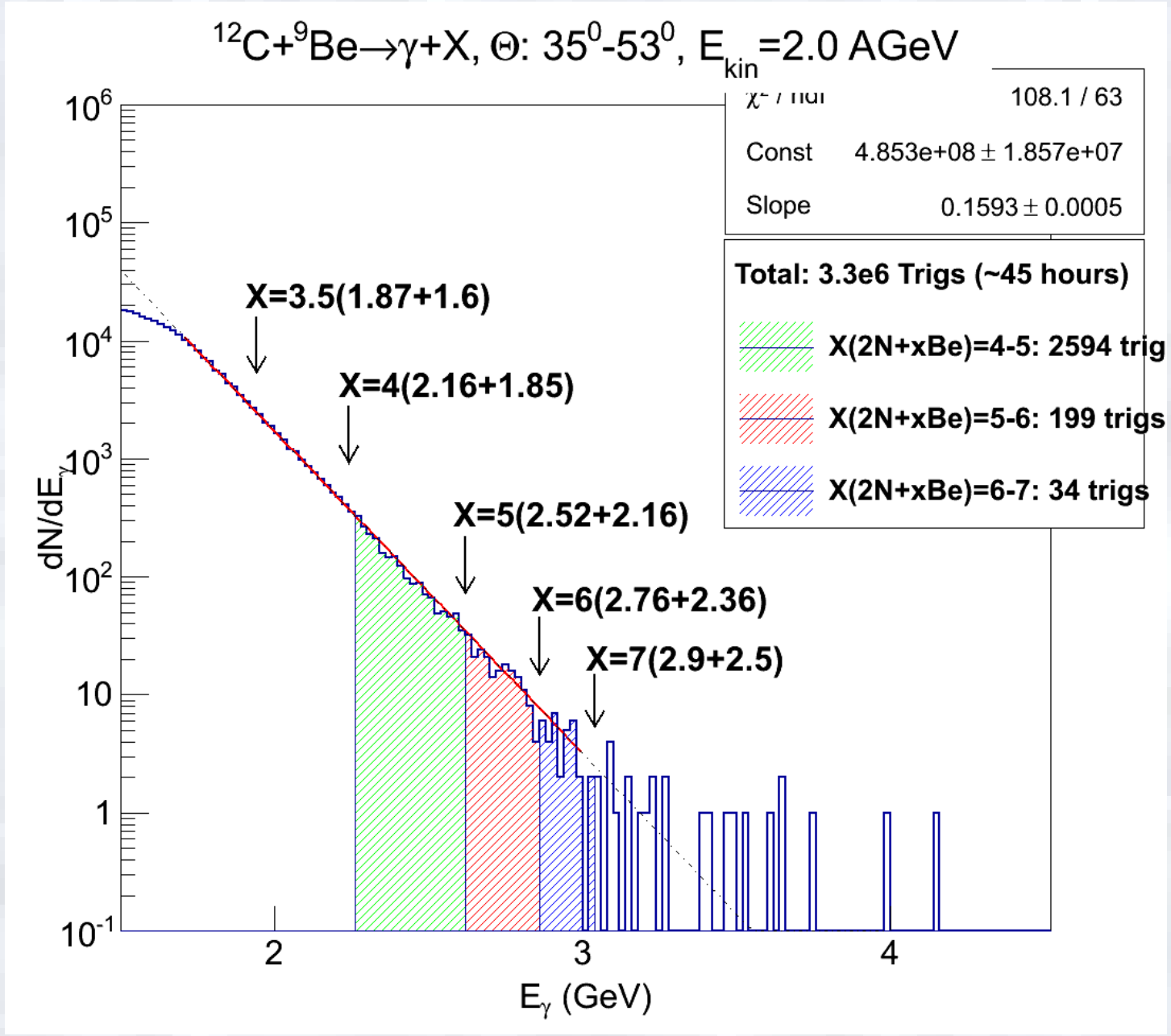




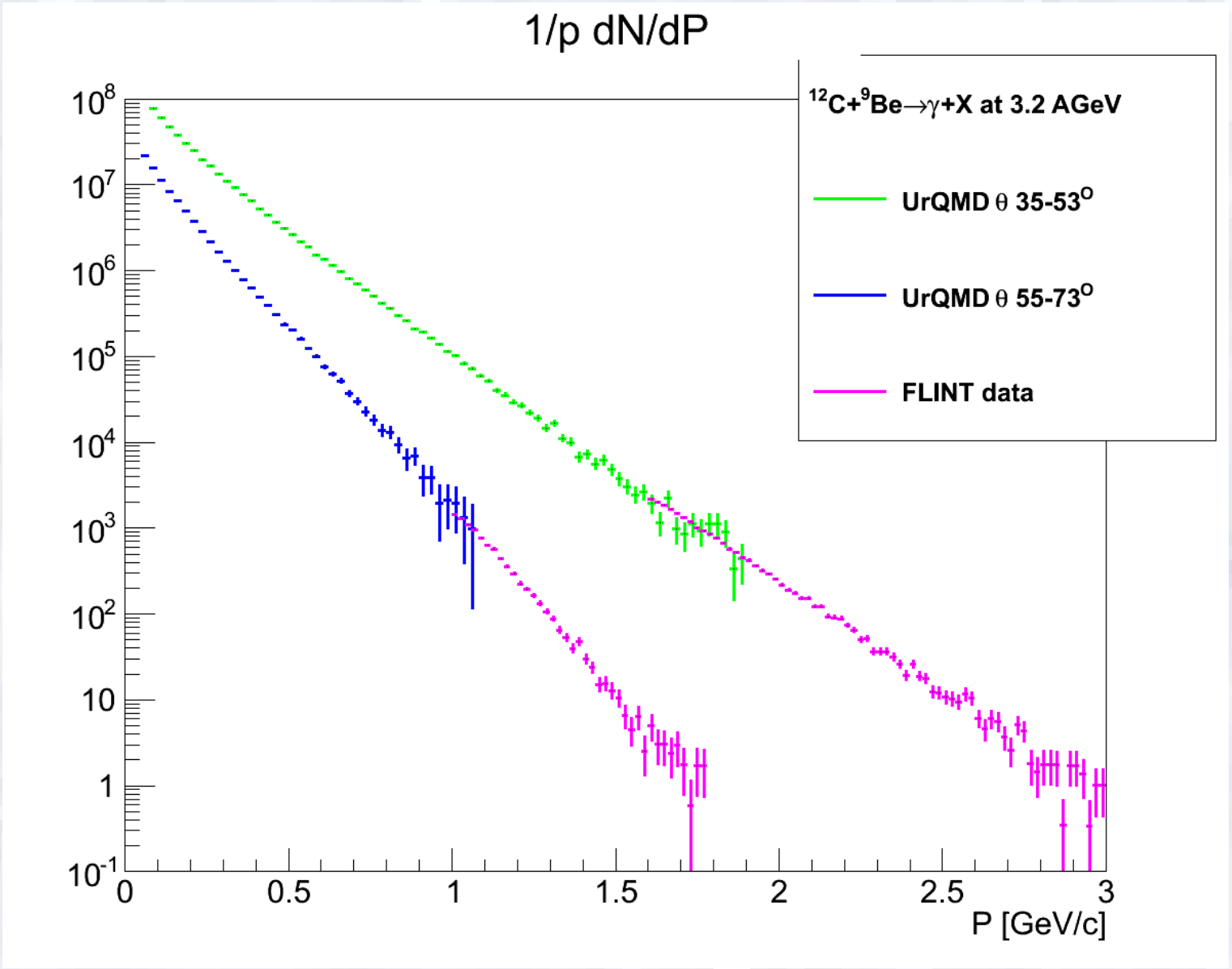
Kinematical Boundaries



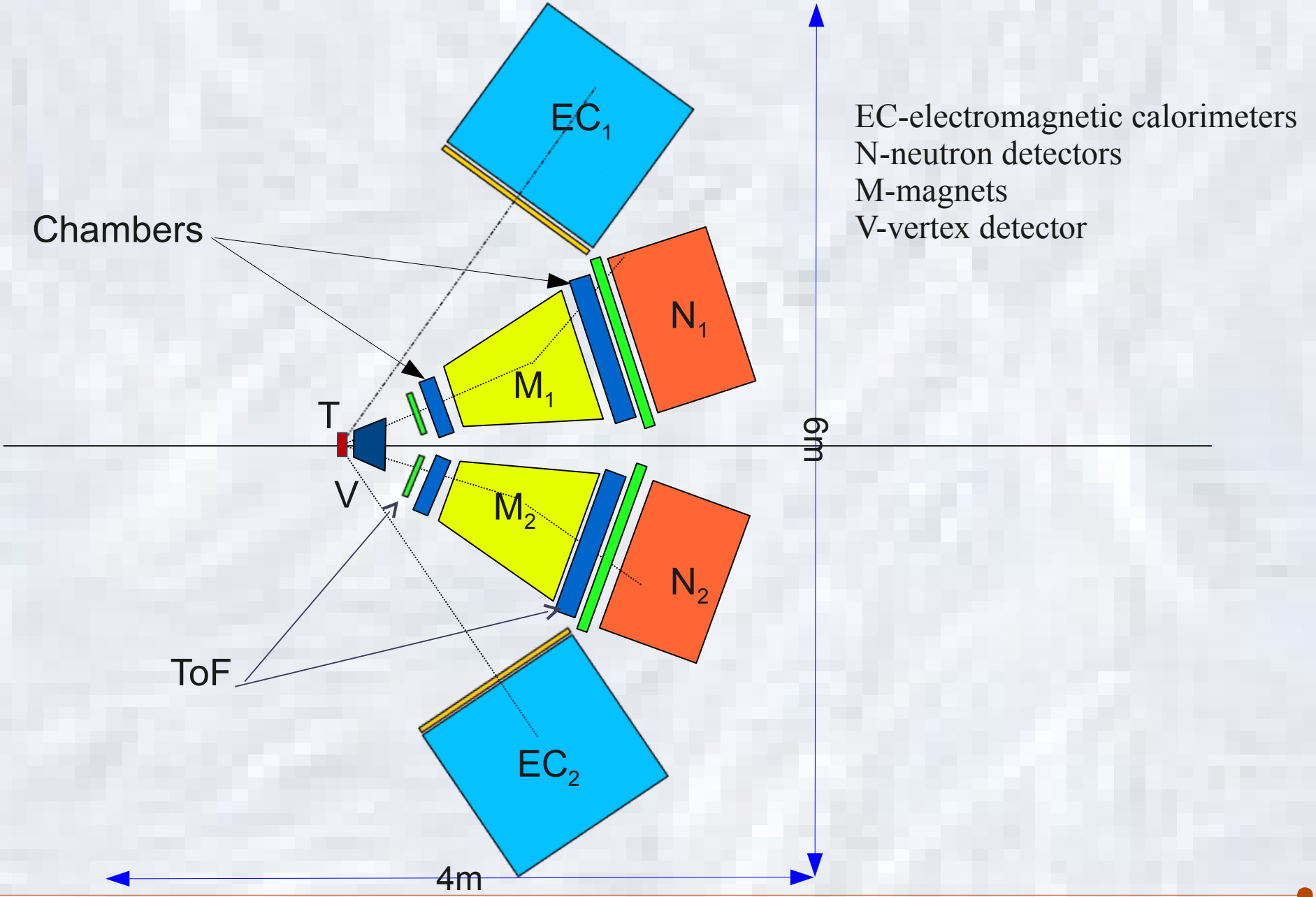
X_1+X_2 as minimal mass fractions



Data and UrQMD

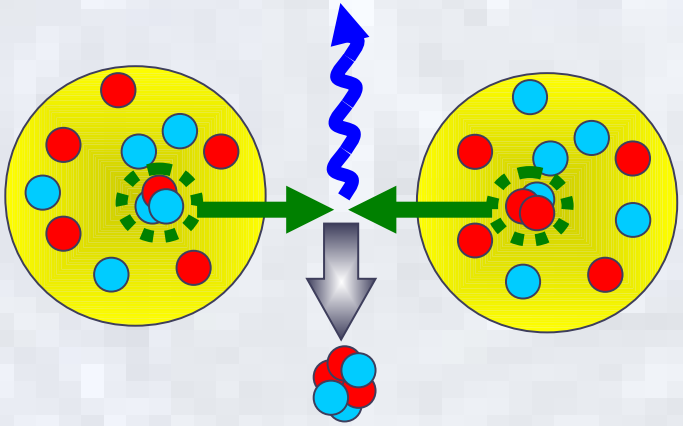


Development of FLINT setup



EC-electromagnetic calorimeters
N-neutron detectors
M-magnets
V-vertex detector

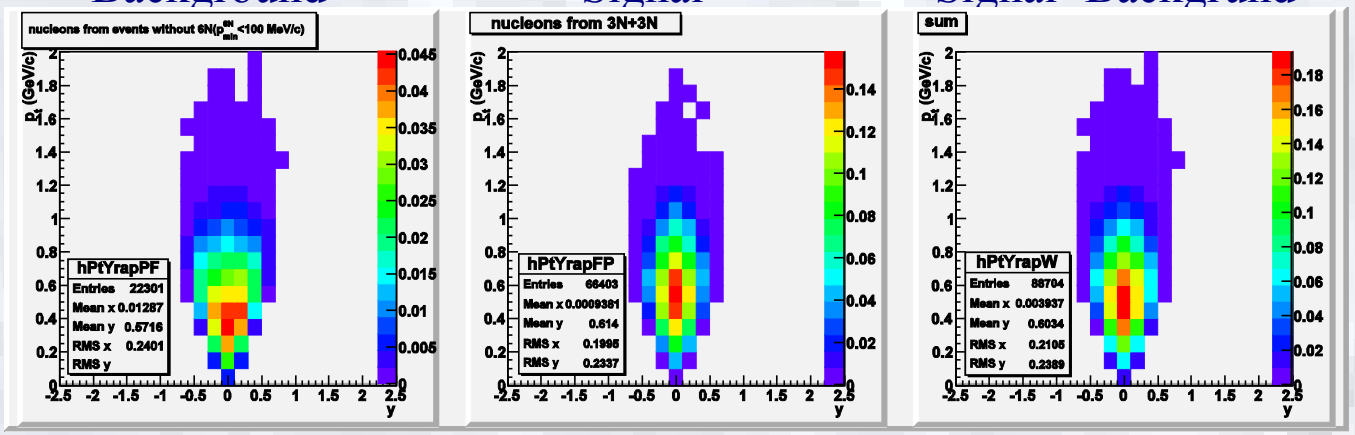
Background with UrQMD

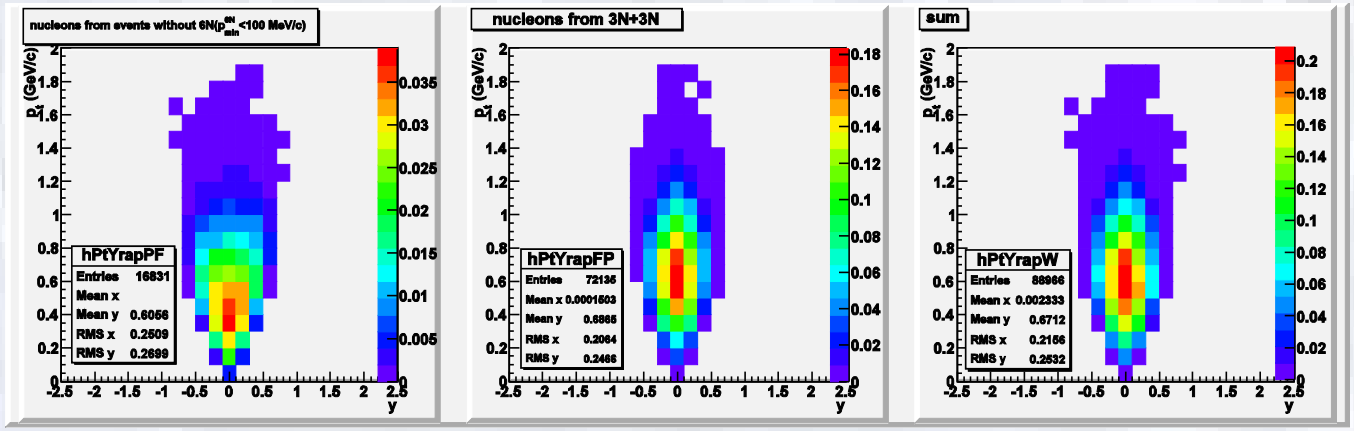


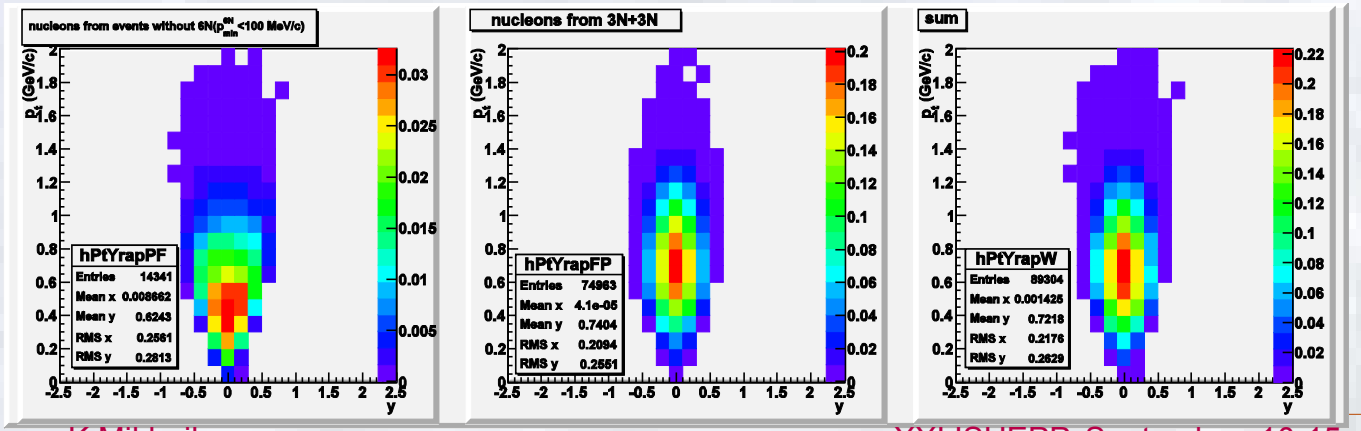
- UrQMD: C+Be at T/A = 2.0, 3.2 and 4.0 GeV
- Select events with 6 (or more) nucleon-participants
- Require momentum sum of any 6N is less than 100 MeV/c
- Change these 6 nucleon system to π^0+6N system
- momentum of each nucleon in π^0+6N system is smeared with a parameter σ_{smear}: $\sigma_x=\sigma_y=\sigma_z=\sigma_{smear}$=340 MeV/c
- Background is selected UrQMD event w/o 6 nucleon system
- Signal is new 6N

Signal to background

Background | Signal | Signal+Backgrund







T/A=2.0

Results in the region of maximum

T/A GeV	S/B
2.0	~ 3
3.2	~ 5
4.0	~ 7

T/A=3.2

T/A=4.0

Conclusions

- The acceptance of FLINT setup increased two times due to new super module
- New FLINT experimental results was presented
- Photon spectra in CBe→γX reaction at 2.0, 3.2 AGeV were measured with FLINT setup
- Spectra were fitted by exponential function
- The slope of the spectrum depends on the energy
- The slope of spectrum depends on theta angle for both energies
- Data confirm flucton-flucton interaction (up to 6 nucleons)
- Development of FLINT setup and first estimation of S/B was presented

Thank you very much
for your attention!

Table of max X from data:

Z.Phys. A350, 101-113 (1994)
A.Schroter et al.
^{20}Ne(1.69)+Sn->ap+X, P=1.5, X1+X2=5.46 (33.1 nbarnGeV^{-2}c^{3})

pp(ALICE, arXiv:1007.0516[hep-ex],K.Aamodt et al.)

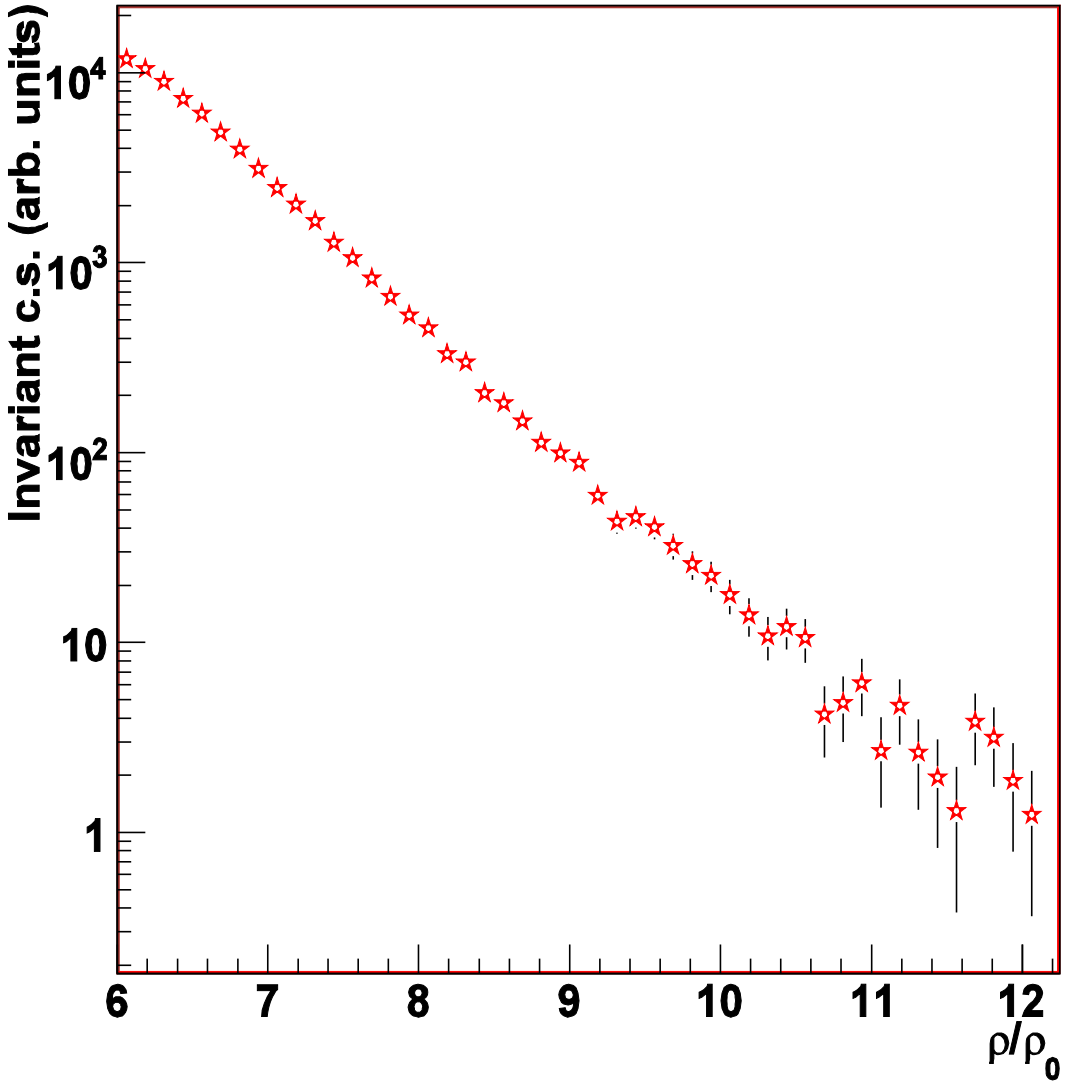
dNch/dη	Rinv(fm)	Description
3.2	~0.9	Without hydro (arXiv:1106.1786[hep-ph] M.Nilsson et al.)
7.7	~1.1	
11.2	~1.2	With hydro (arXiv:1010.0400[nucl-th],K.Werner ety al.)

Criterium: r»l

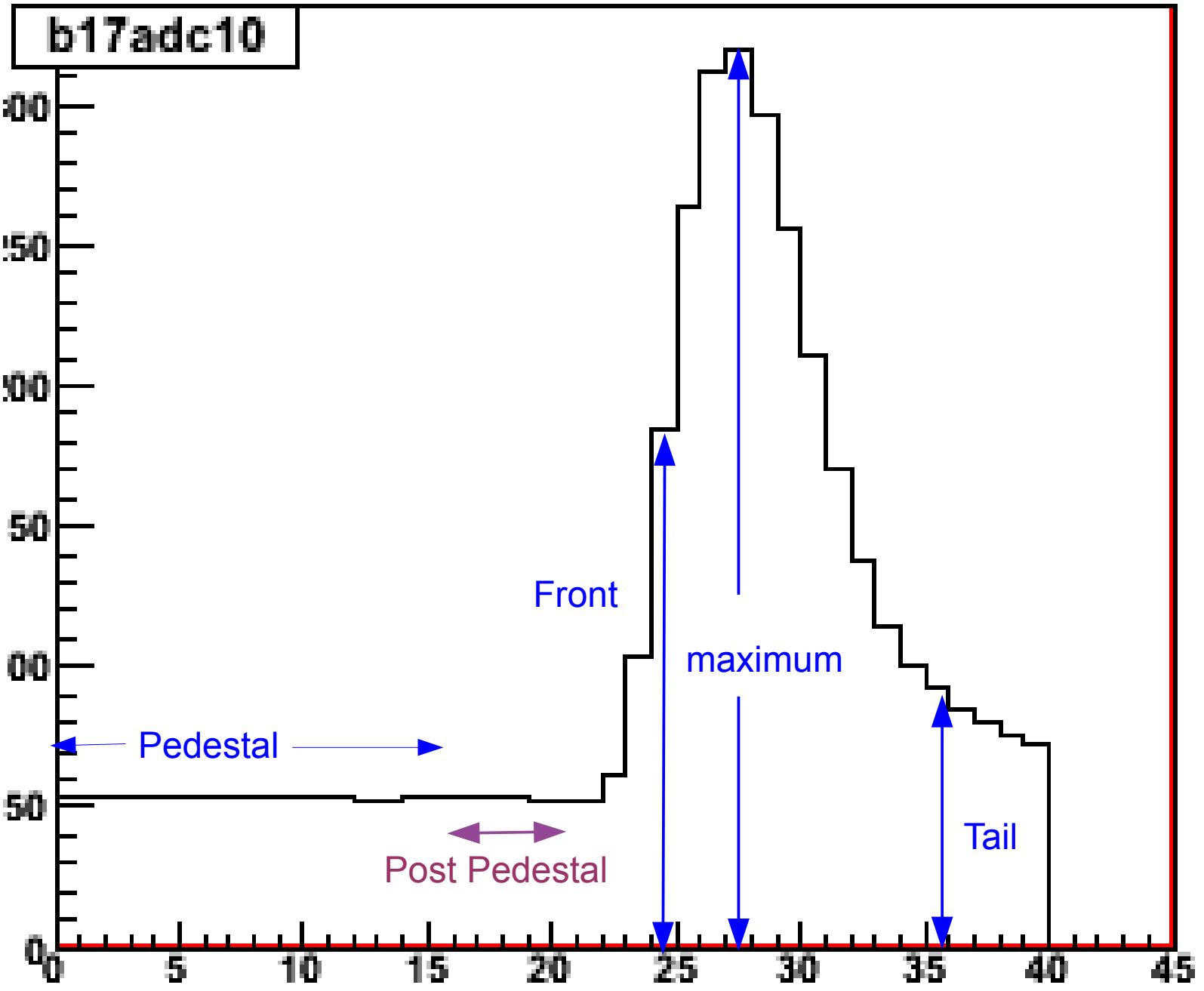
	number of particles	Size(r), fm	free path, (l)fm
Heavy Ions:	1000	10	1
flucton-flucton	10	1	0.1

An estimate of baryon density

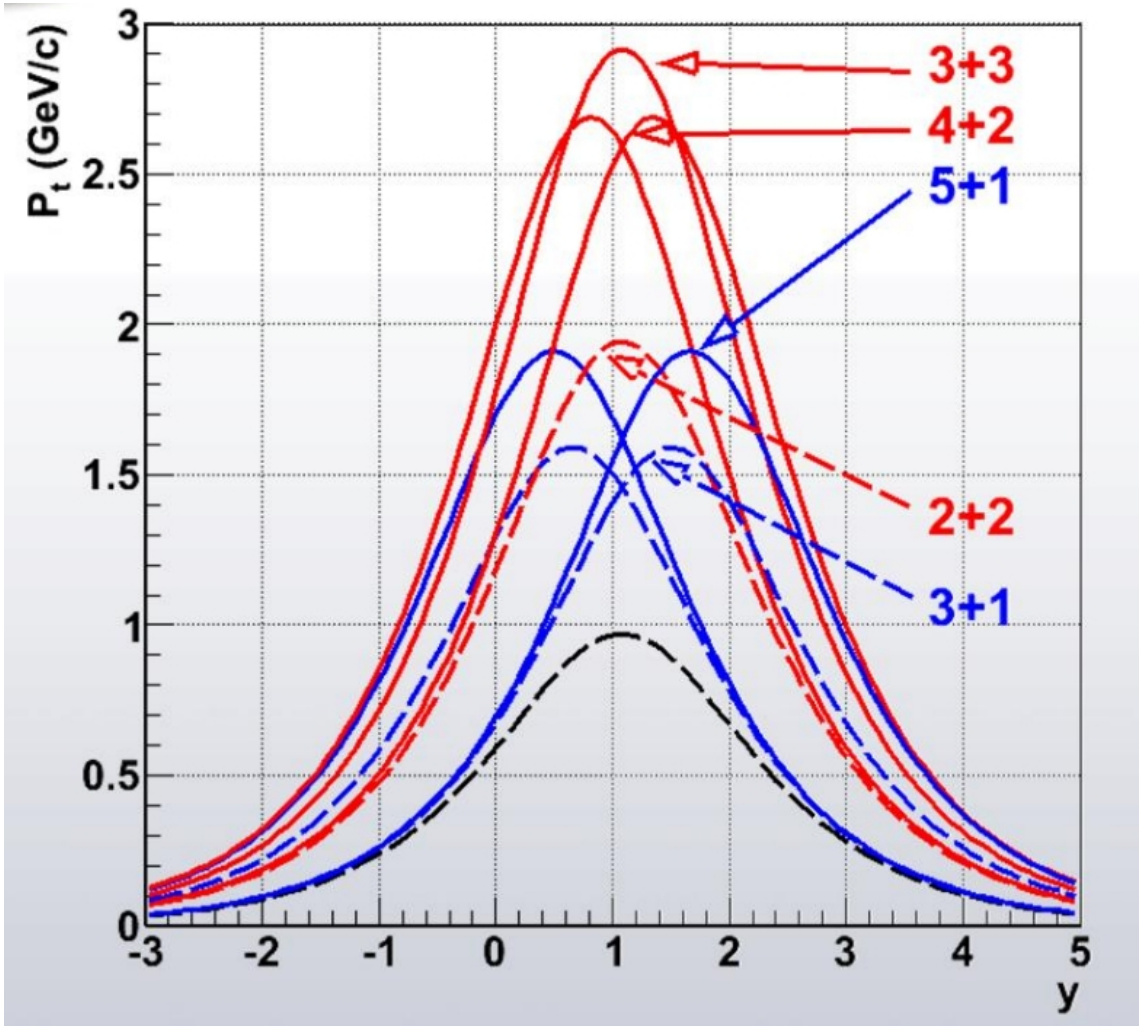
rf~1.5fm



Example of signal



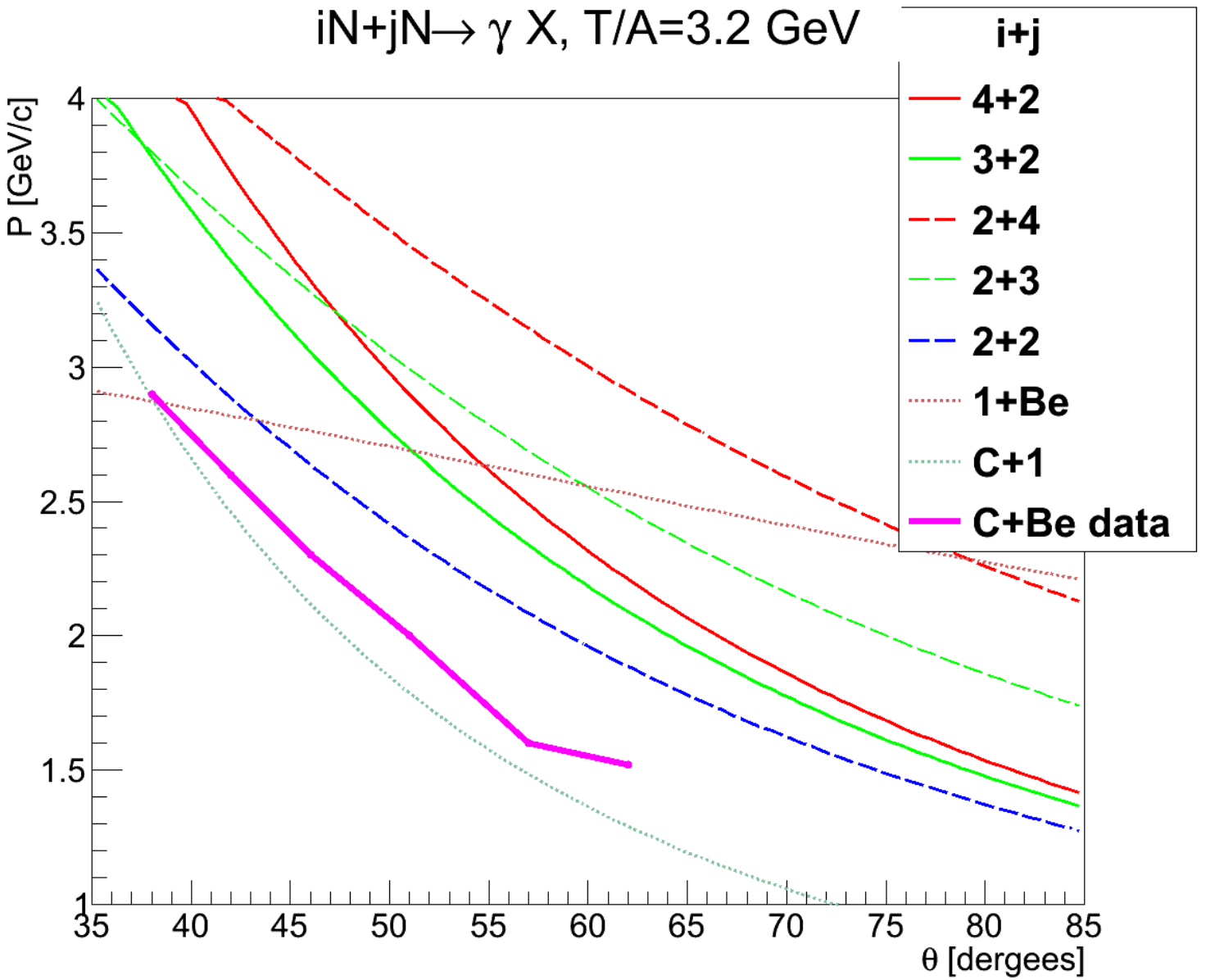
Kinematical Boundaries

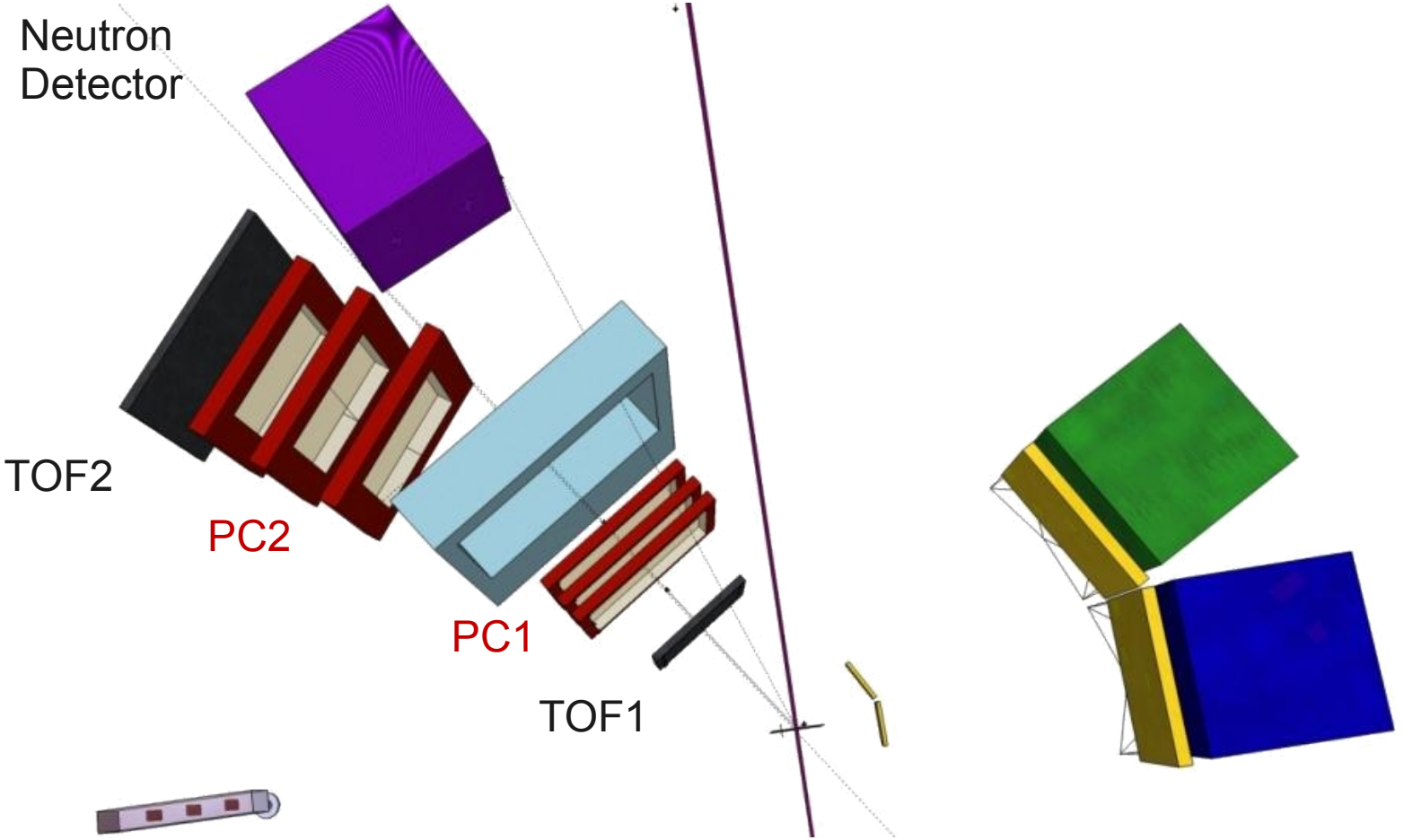


C+Be->gamma+X

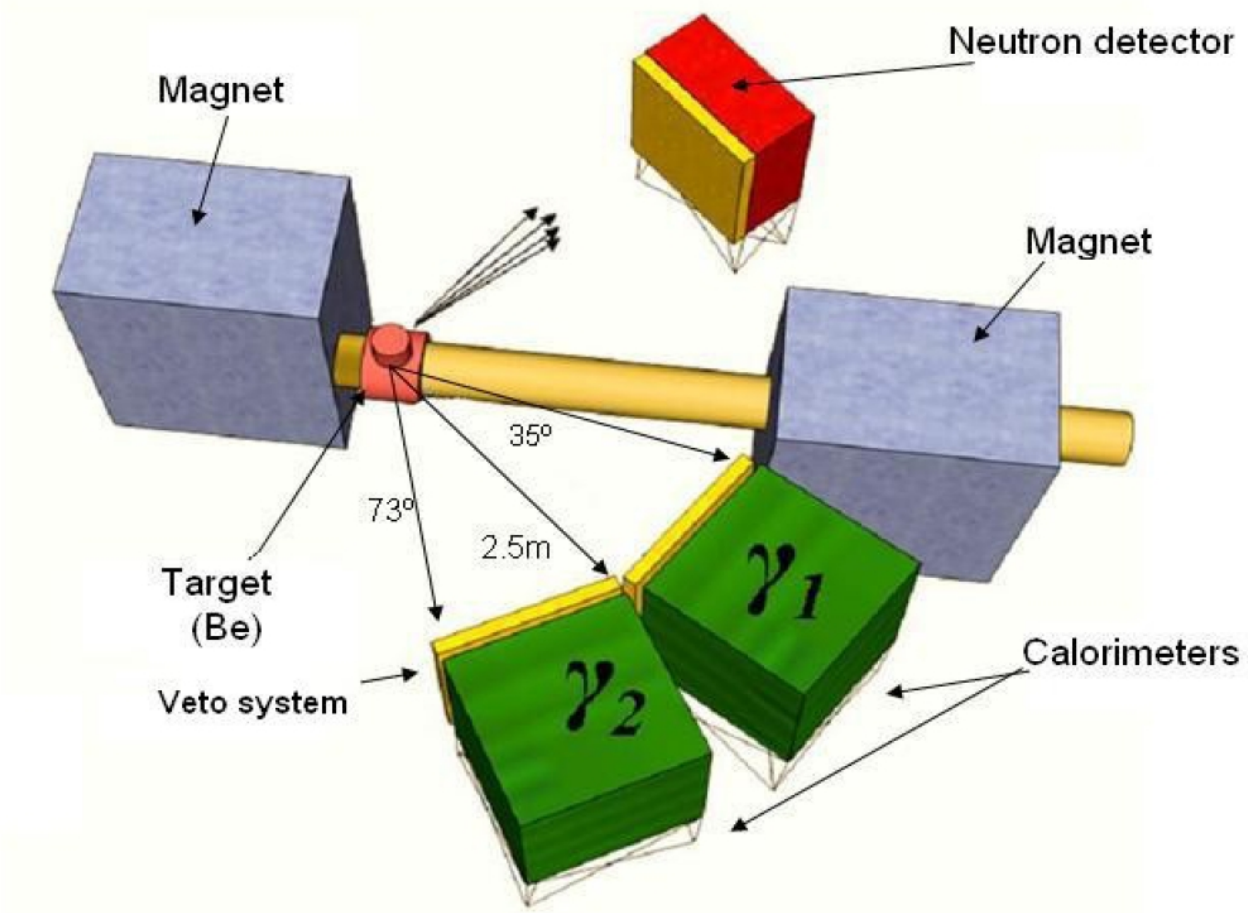
T/A=3.2 GeV

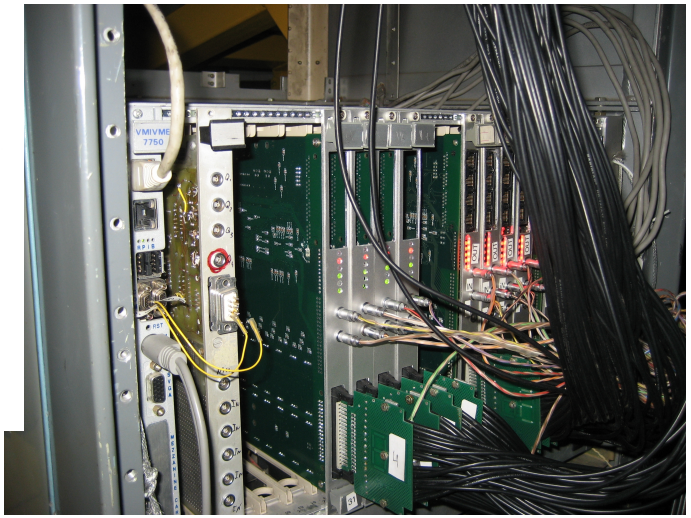
Kinematical Boundaries 3.2AGeV



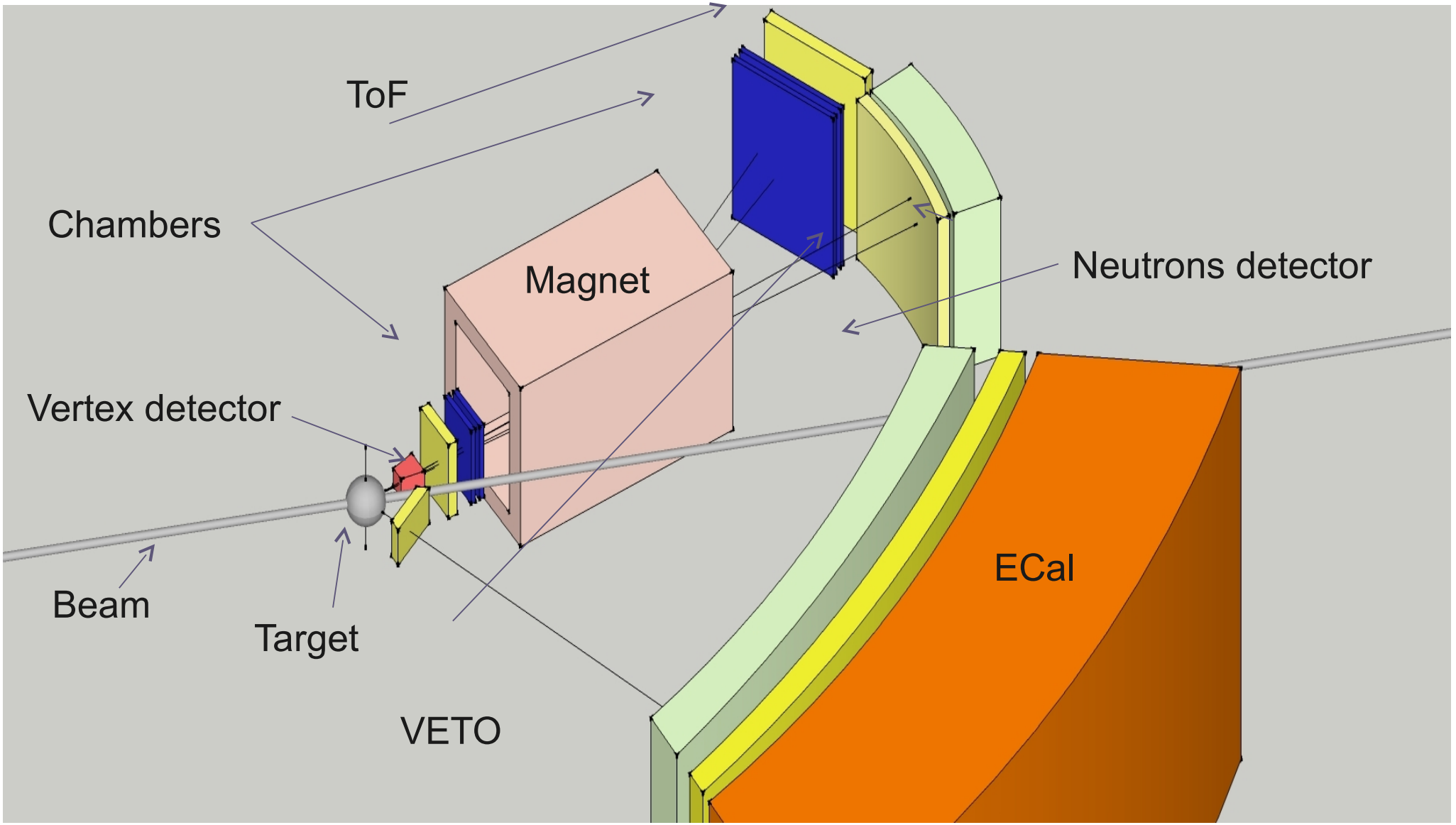

Neutron
Detector
TOF2
PC2
PC1
TOF1

FLINT Setup with Ndet

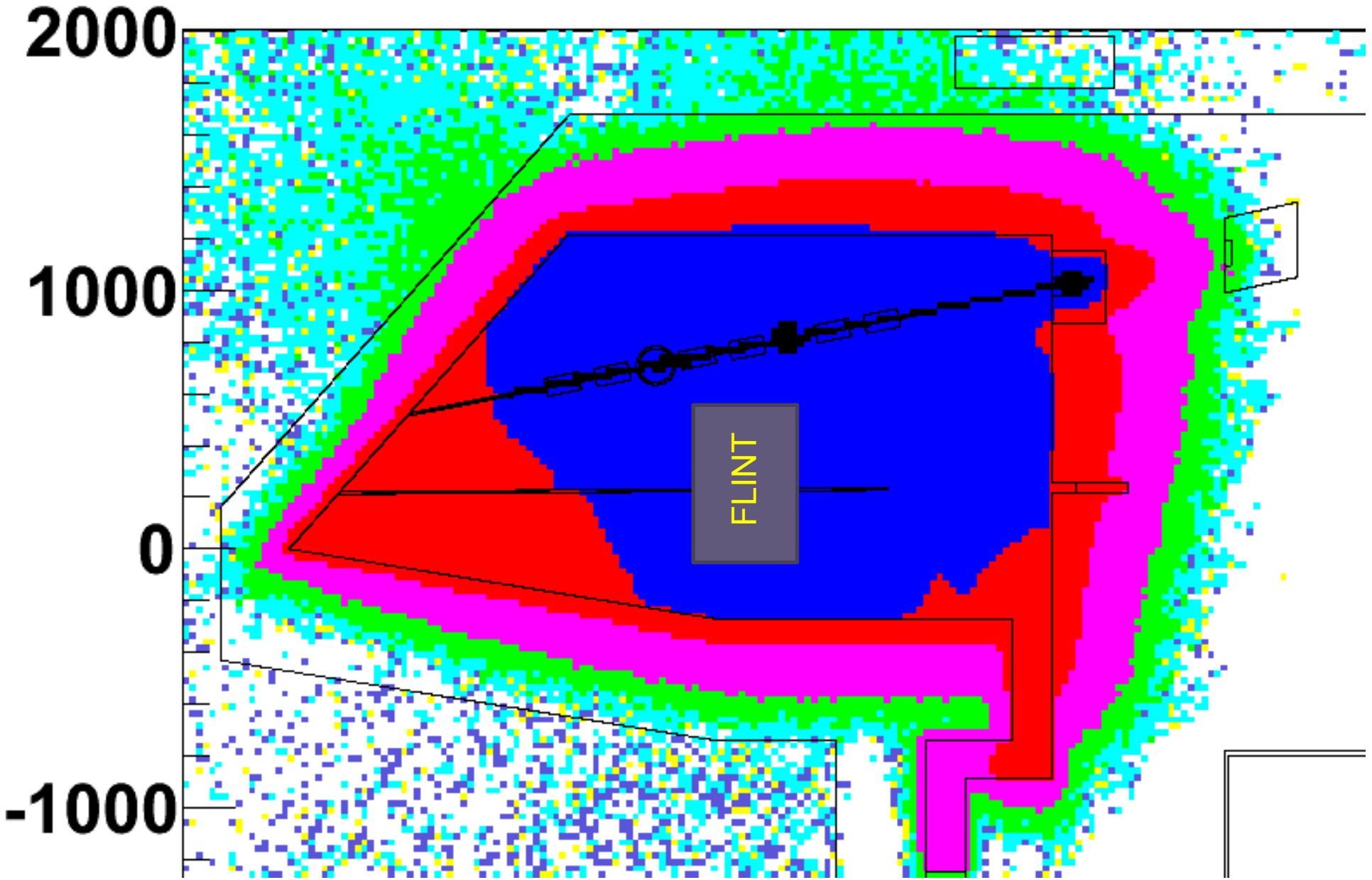




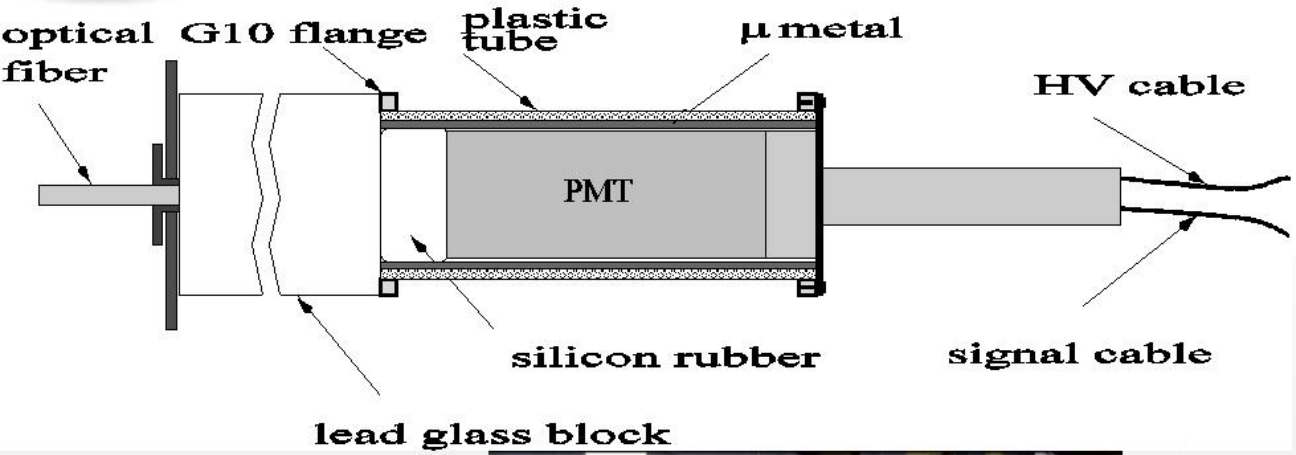
DCM detector(project)



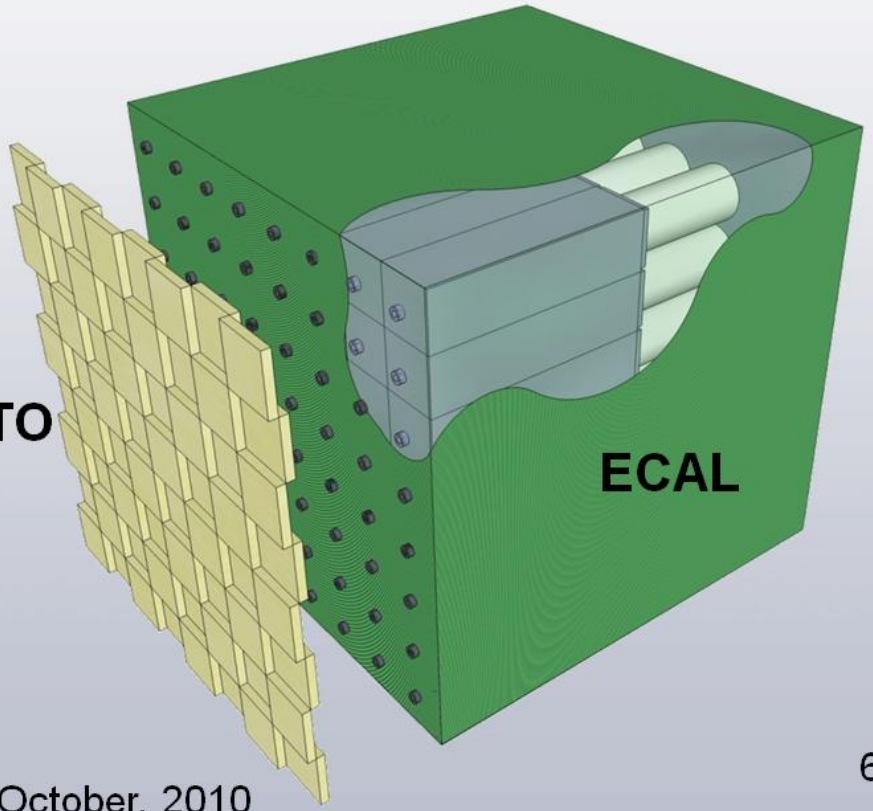
New ITEP experimental hall



FLINT supermodule



matrix 8x8
100x100x380 mm^3
Lead glass F8
$\rho=3.6 g/cm^3$
$X_{rad}=3.1cm$
$R_M=3.6cm$
Mass~1.5 Tonn



Calibration with electron beams @ ITEP accelerator facility

p_{e-}: 0.5,.. 4.0 GeV/c