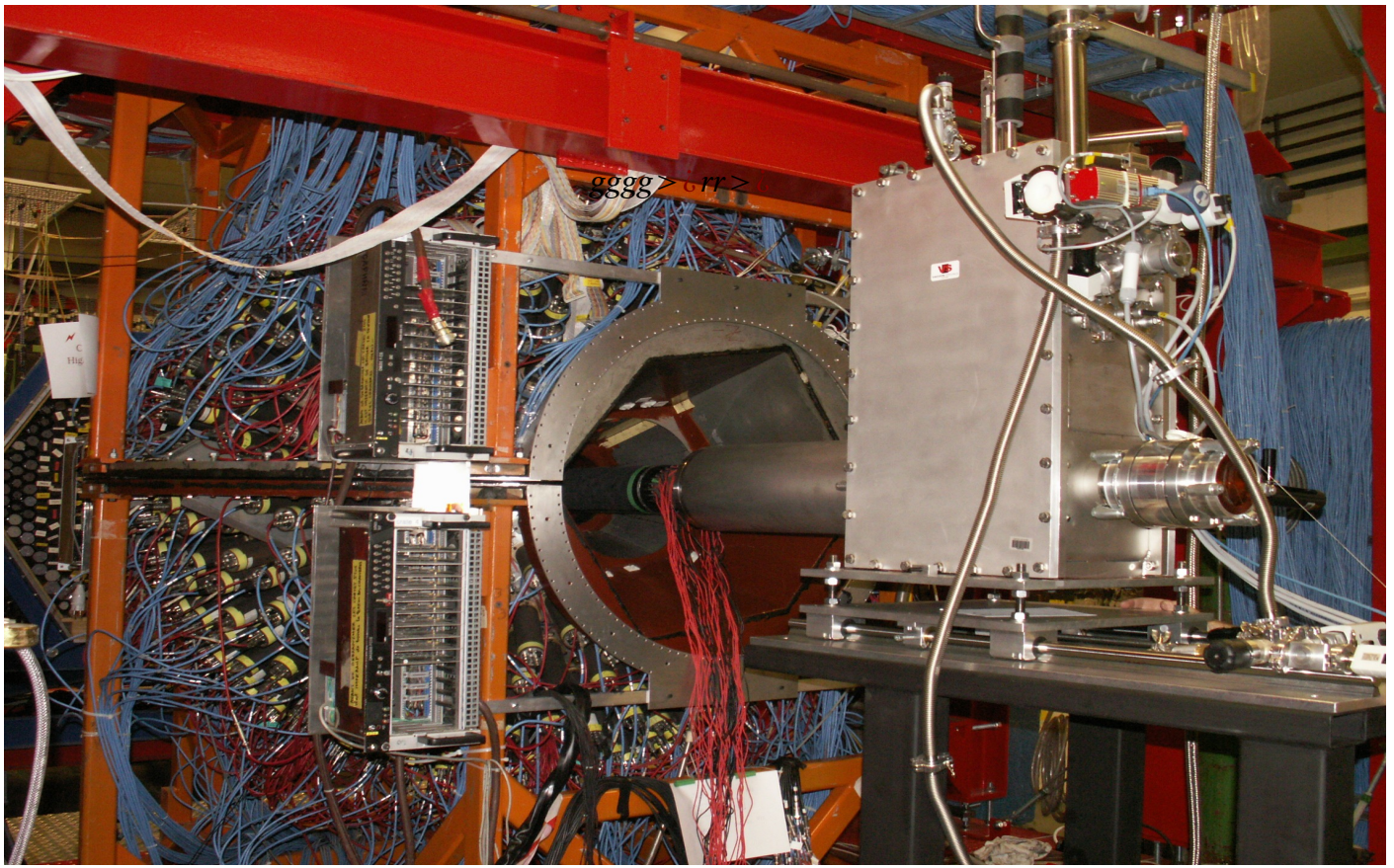
Vive les gros seins !!!!!!!!

L^3He Data analysis

(Theoretical background and analysis status)



Content

- Motivation

- Experimental set-up
  -> Particles identification

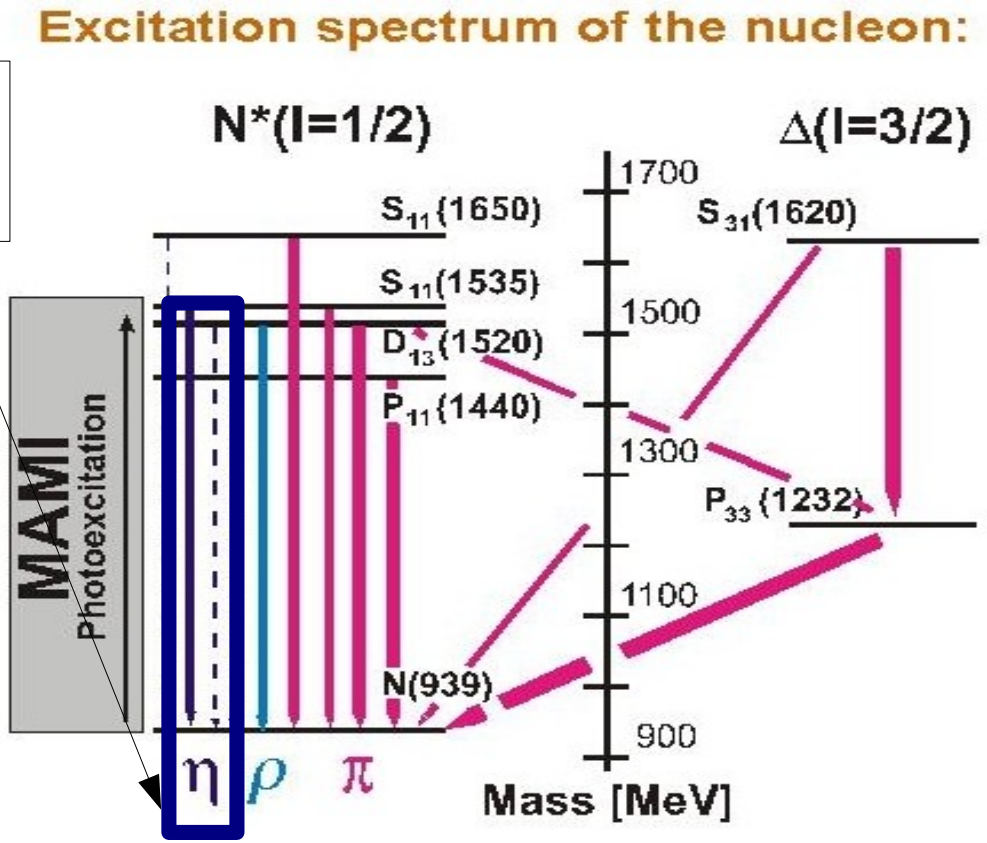
- Eta-production off 3He
  -> Missing Energy and Missing Mass spectra
(Preliminary)

Overview

In general: study of nucleon resonances via photoexcitation and selection of specific channels like : πN, ηN, ππN, (ωN):

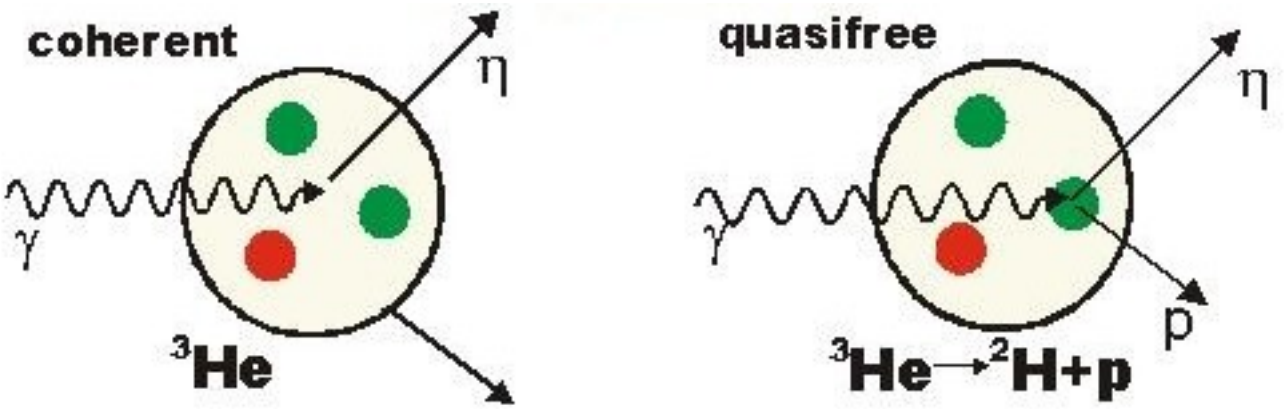
$\gamma N \longrightarrow N^*,\Delta \longrightarrow N + \text{meson}$

Interesting aspects in the study of the η nucleon interaction



MOTIVATION

Production mechanism of coherent and quasifree production on ^{3}He :



So why we choose an ^{3}He nucleus ?

η-photoproduction dominated by excitation of $S_{11}(1535)$ resonances :

- **γ(E1) + N ⟶ S11 ⟶ N + η**
  Jz : -1 +1/2 -1/2 -1/2 0 | **Spin flip transition**

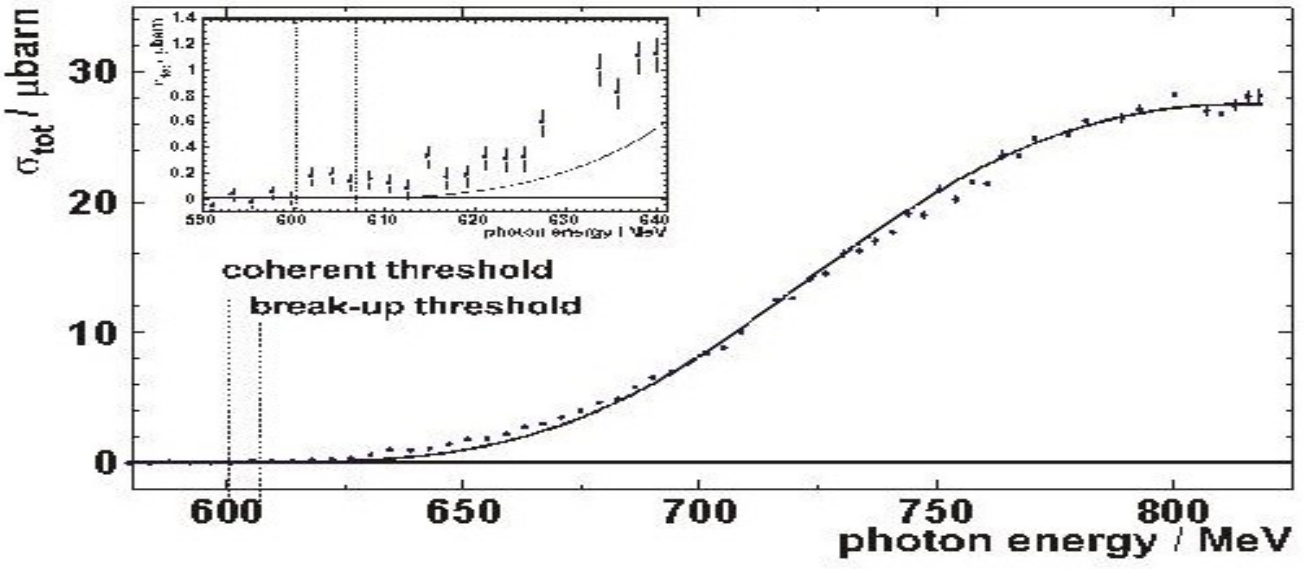
- **Isospin structure $A^{IS}_{1/2}/A^{p}_{1/2} = 0{,}05 \ll 1$** | **Isovector Dominate**

MOTIVATION

"Production proceed by isovector, spin flip amplitude"

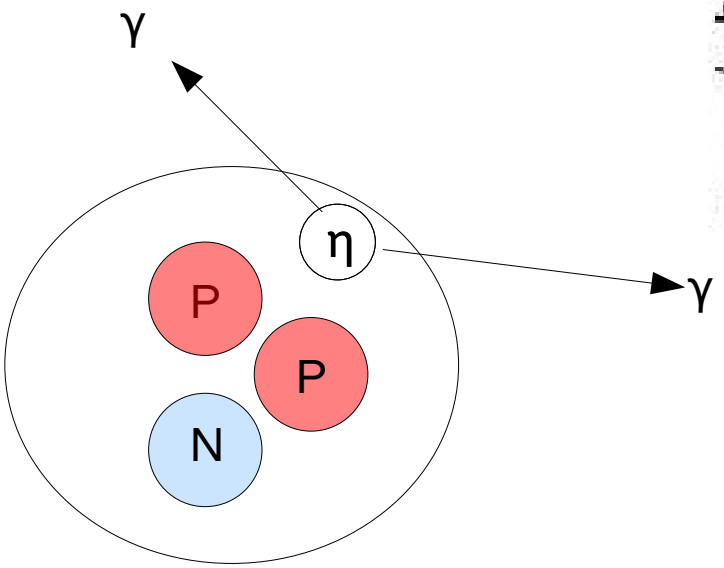
Quantum numbers for different light nuclei :

^{2}H: J=1 I=0 : Isoscalar
^{4}He: J=0 I=o : Isoscalar, no spin-flip
-> coherent production suppressed
^{3}He: J=1/2, I=1/2:
-> stronger coherent signal expected
-> Ideal candidate for the formation of **eta-mesic nuclei**

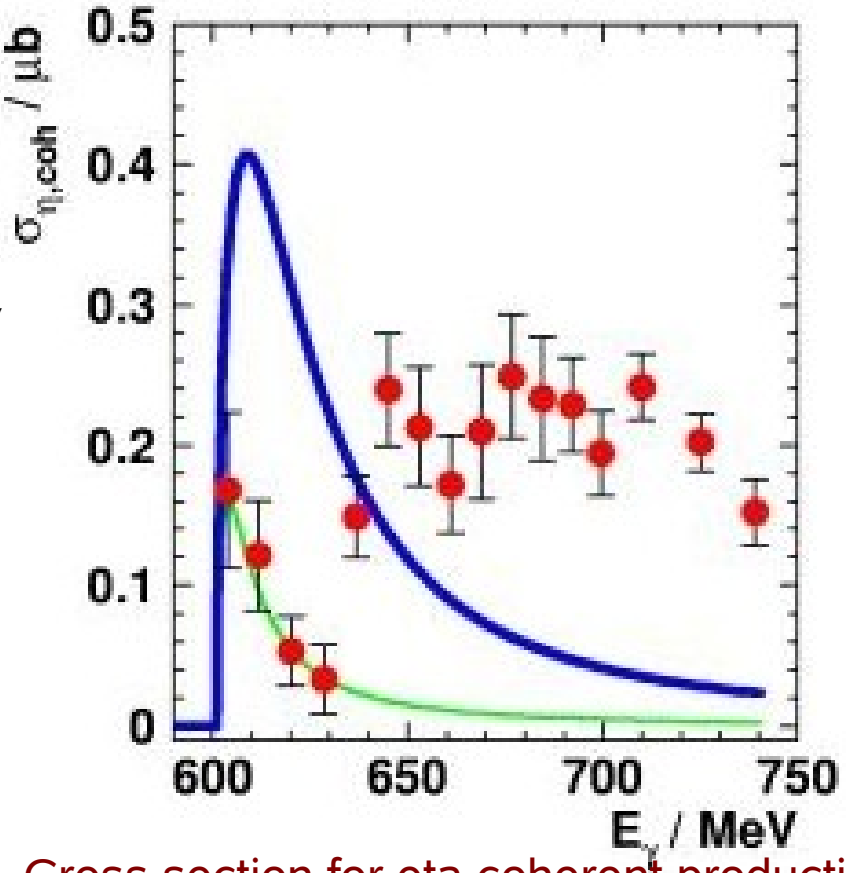


Total cross section for η production from previous experiment.

Bound state or not ?



Quasi bound state in ^{3}He nucleus



Cross section for eta coherent production
compared to expected cross section

Properties of eta meson :

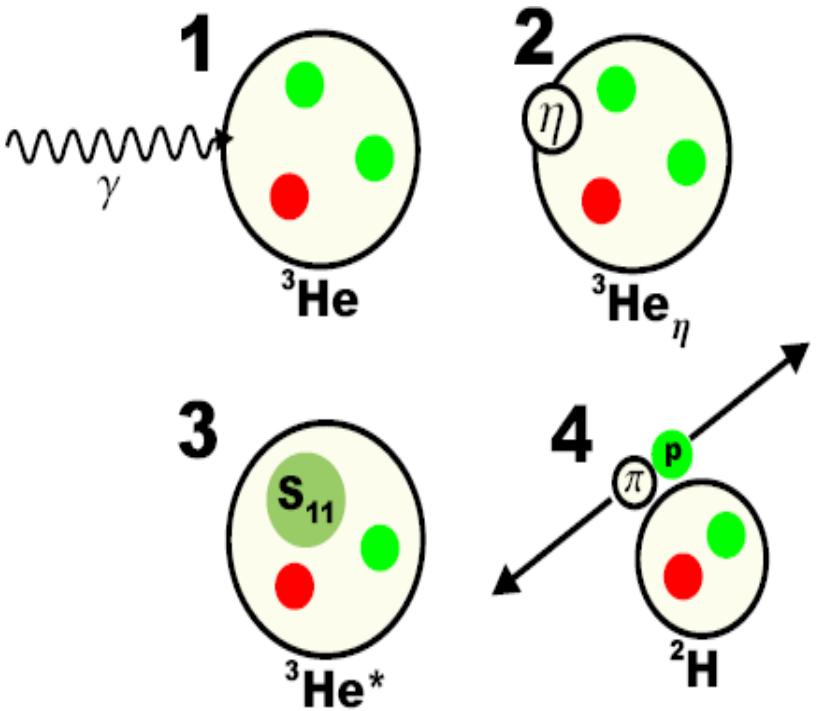
	Mass	Life time	decay modes
η	547,30 MeV	$5{,}6{,}10^{-19}$s	γγ 39,3% $3\pi^0$ 32,2% $\pi^+\pi^-\pi^0$ 23% $\pi^+\pi^-\gamma$ 4,75%

Search for such a bound state in ^{3}He :

$\gamma + {}^3\mathrm{He} \longrightarrow {}^3\mathrm{He}_\eta \longrightarrow \eta + {}^3\mathrm{He}$

Further clue of this bound states

Research of a bound state of the eta in the nucleus

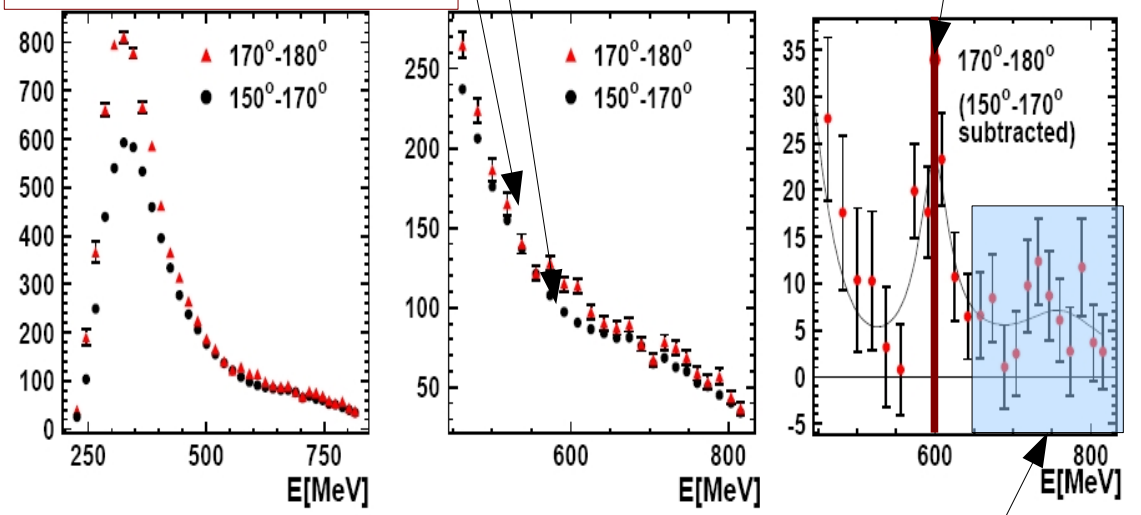


Schematic illustration of the photoproduction of η mesic nuclei which forms an S_{11} resonance and decays into a back to back π_0-proton emission

eta-photoproduction threshold in He3

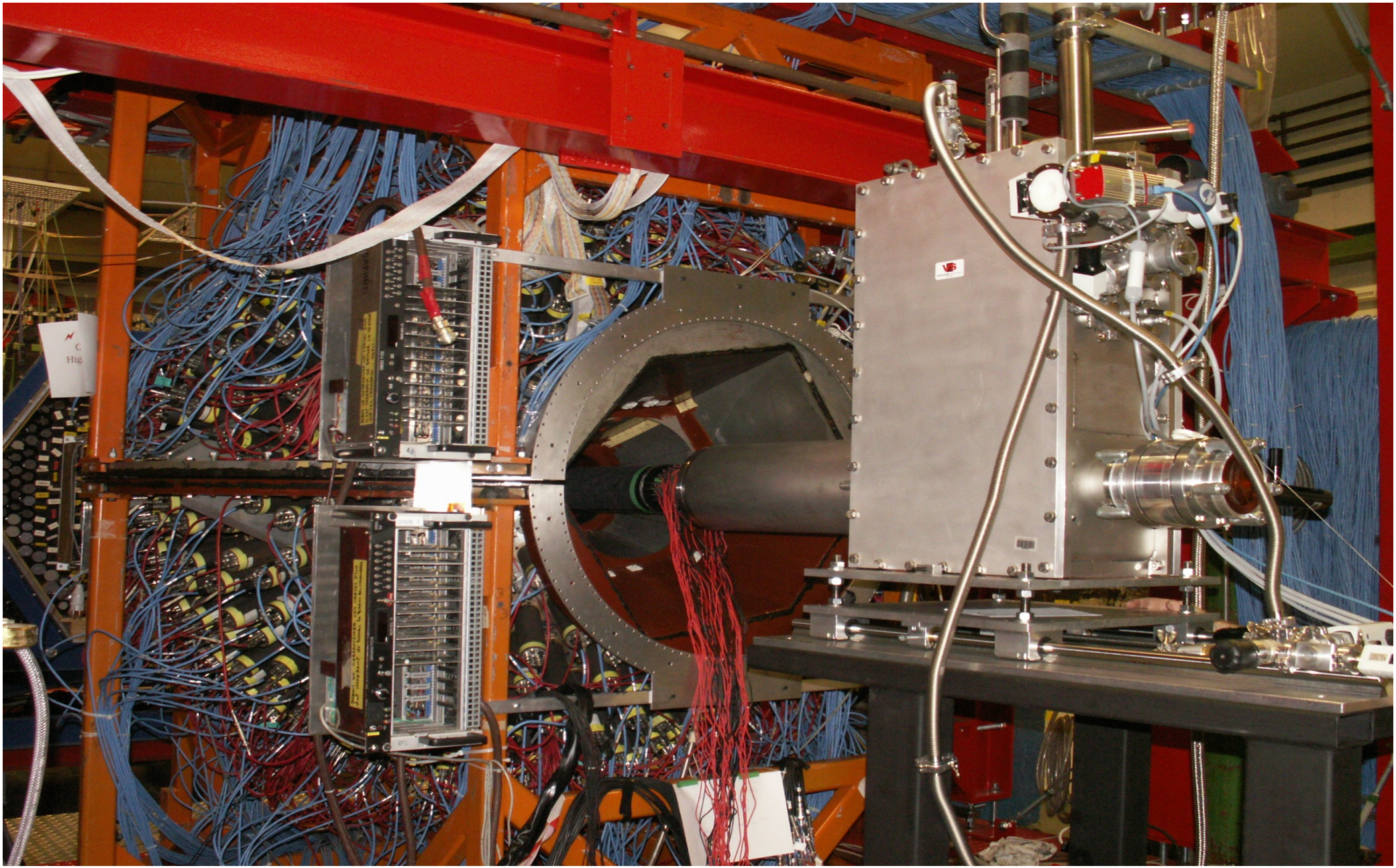
Opening angle of 160°-170° for π_0-proton production

Opening angle of 170°-180°for π_0-proton production



The error bar needs to be reduced , so we have to improve the condition of the experiment

EXPERIMENT SET-UP



Overview of the expected statistic

~ 225 Hours of data (Full target measurement)

~ 35 Hours of empty target measurement

-Veto and microscope are calibrated

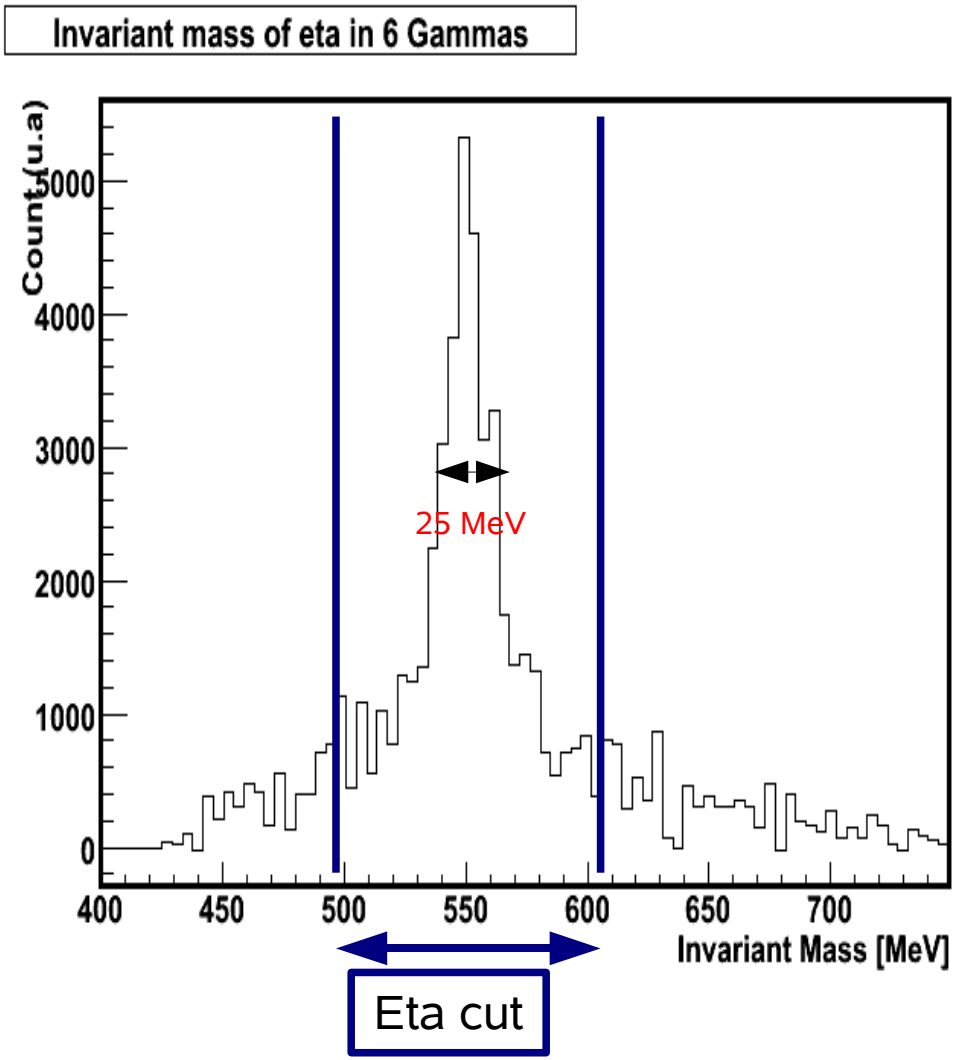
-Tagging efficiency were taken ~ every 2 days

~ 10^6 etas via the decay $\eta \rightarrow \gamma\gamma$
~ 200000 etas via the decay $\eta \rightarrow 3\pi_0 \rightarrow 6\gamma$

Gamma INVARIANT MASS

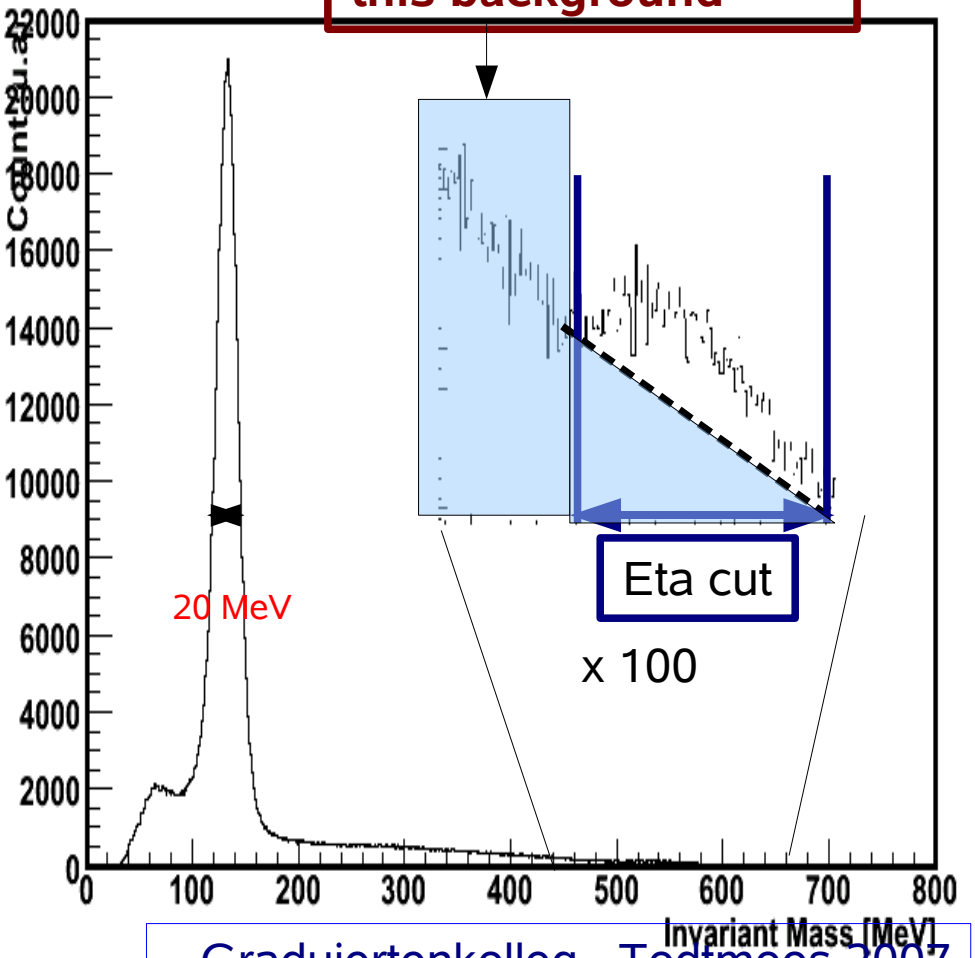
Eta Mass : 547.3 MeV

$\eta \rightarrow 3\pi_0$



$\eta \rightarrow 2\gamma\gamma$

We need to remove this background



Coincidence analysis

t0 : time of the tagged electron

B

e-

electron beam

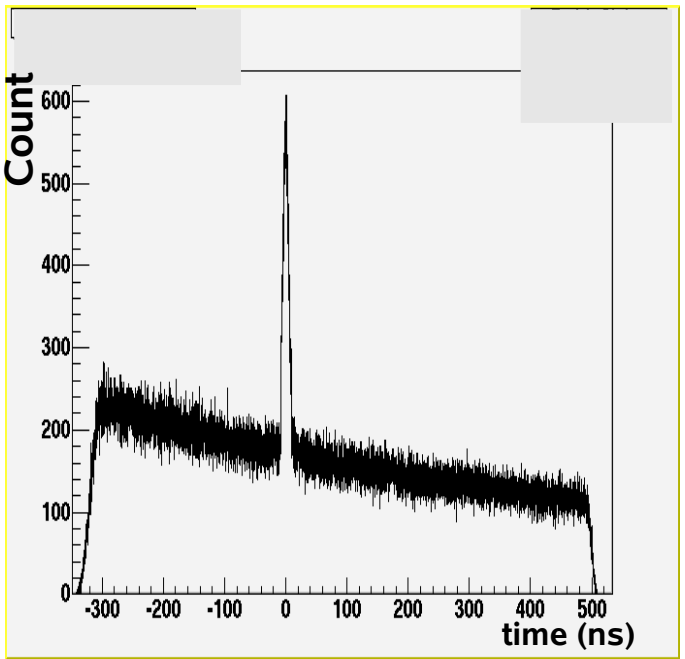
γ beam

t1 : time of detected particle

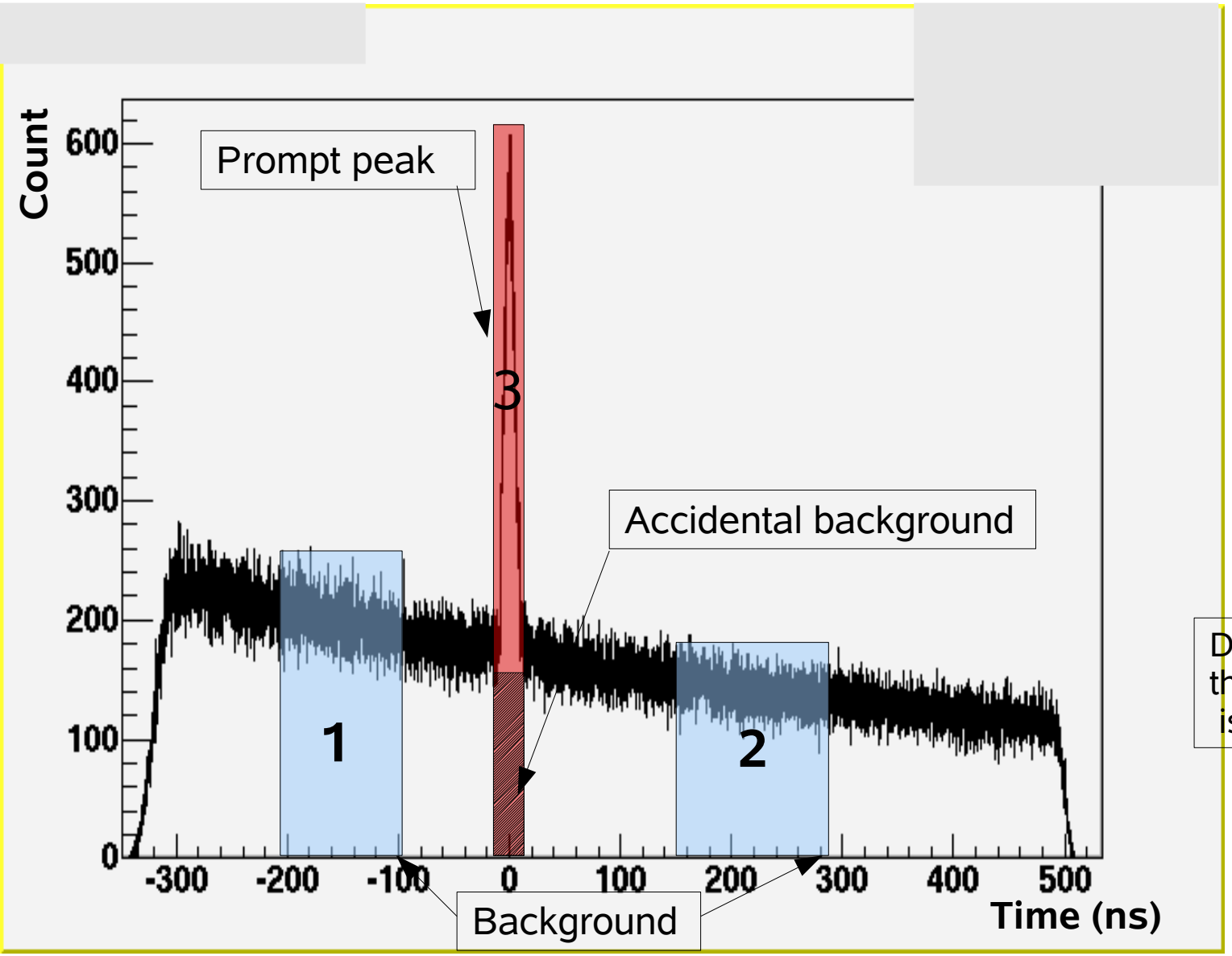
L^3He target

Detector set up

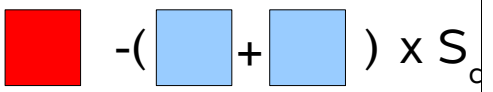
Time of flight : $\Delta T_{tof} = t1 - t0$



Good event selection



Good event =



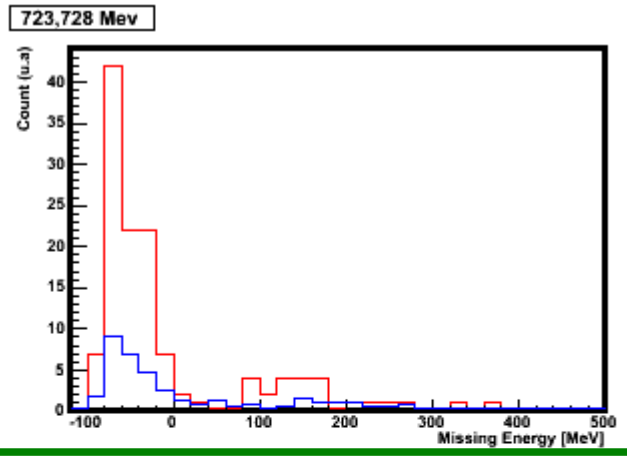
Where Sc is the scaling factor of background

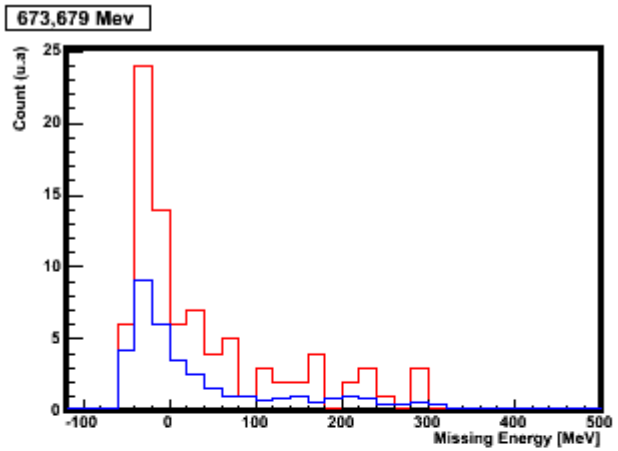
Difficult to determine because the shape of the tagger spectra is not flat,

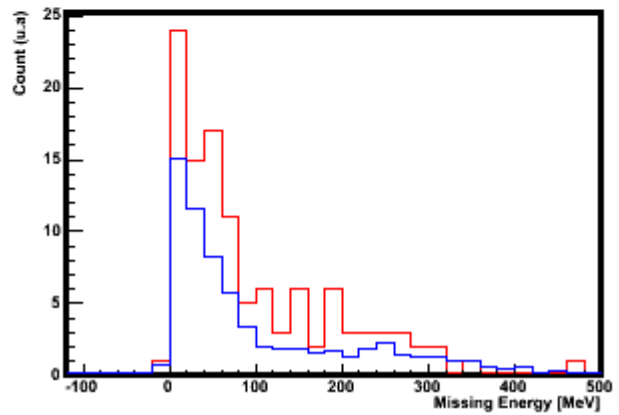
Missing energy spectra

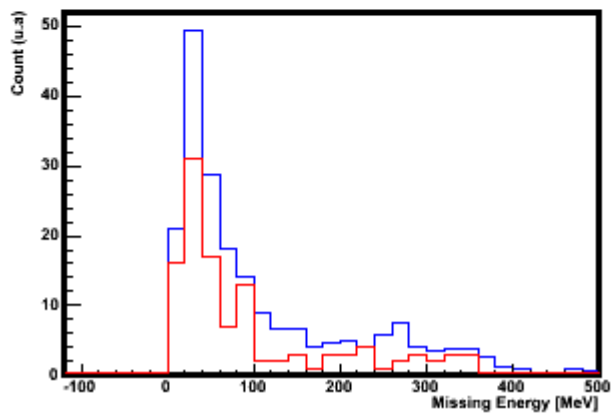
Background

Prompt peak









Missing energy is calculated as :

$$E_{miss} = E^{meas}_{\eta} - E^{calc}_{\eta}$$

Where $E^{meas}_{\eta} = \gamma.(E^{lab}_{\eta} - p.\beta.\cos(\theta))$

$$E^{calc}_{\eta} = \frac{(s + m^2_{\eta} - m^2_{3He})}{2\sqrt{s}}$$

A lot of background needs to be removed -> High dependence of scaling factor.

Missing energy at coherent threshold (600,7 MeV)

Missing energy spectra for different energy bins

Outlook ...

-Solving the random subtraction problem

-A rough time calibration.

-We have to do effort on the tagger calibration

-Put the high resolution microscope production

-Plot the first excitation function

-Detect the proton with the forward detector

-Try to plot excitation function