

東海村

The 10th International Conference
on
Hypernuclear and Strange Particle Physics

HYP-X @J-PARC

<http://www-conf.kek.jp/hyp2009/>
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Tokai, Ibaraki, Japan



Inclusive proton spectra from stopped K- absorption in nuclei with FINUDA

P. Genova (feat. A. Filippi)

INFN PAVIA

on behalf of the FINUDA Collaboration



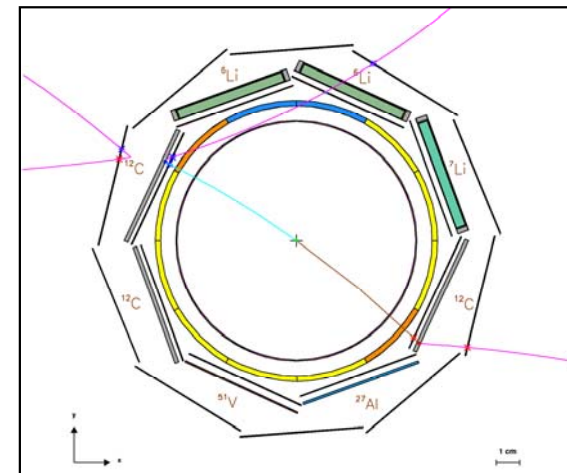
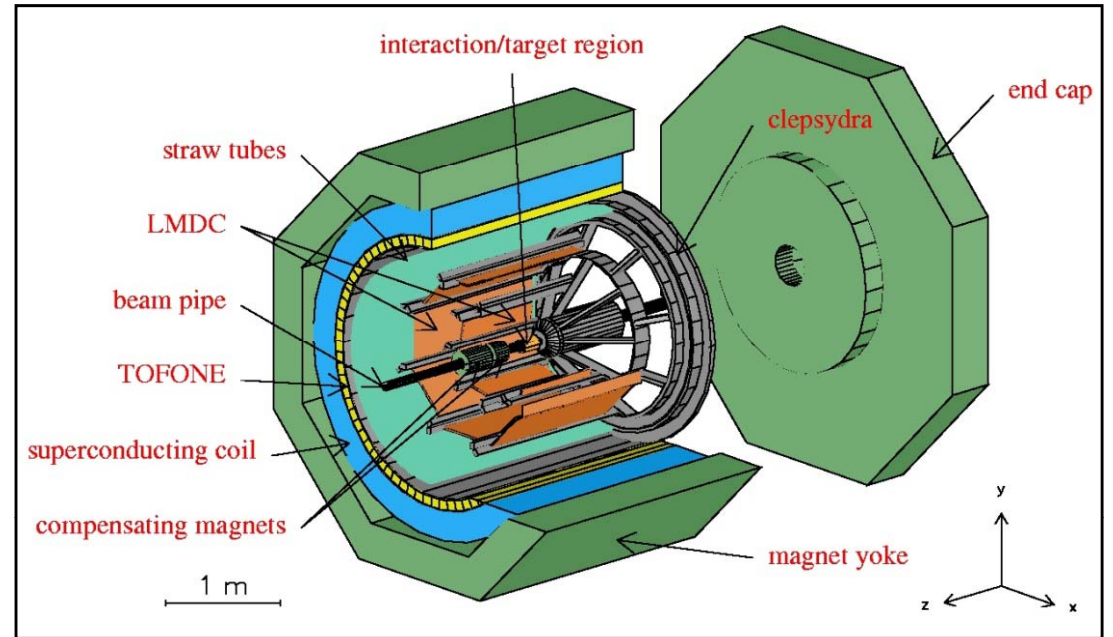
Hosted by Kyoto University, the Global COE Program
"The Next Generation of Physics,
Spun from Universality and Emergence".

Supported by J-PARC and
Japan Society for the Promotion of Science
(JSPS).



The FINUDA Experiment ad DAΦNE

- High resolution and good p.id. magnetic spectrometer, endowed with a set of eight replaceable targets
- Two data takings with two target sets ($\sim 1 \text{ fb}^{-1}$)
 - several elements used, from ${}^6\text{Li}$ to ${}^{51}\text{V}$
 - A systematic high statistics study of some interesting selected reactions may be performed
 - Hints on nuclear structure of the hit nucleus



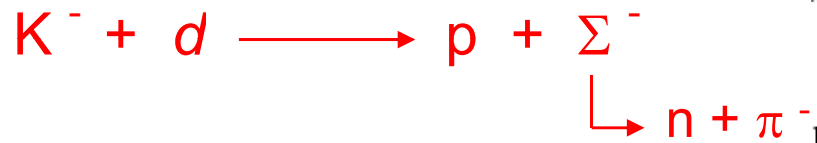
Study of inclusive production of protons following K^-_{stop} absorption by one or many nucleons

First published results (1st data taking): ⁶Li and ¹²C

Nucl Phys A 775 (2006) 35–50

A peak is observed around
500 MeV/c in the ⁶Li
inclusive proton spectrum,
using high quality tracks

This peak can be explained by:



i.e. by the absorption of the
kaon by the quasi-deuteron
subcluster of ⁶Li

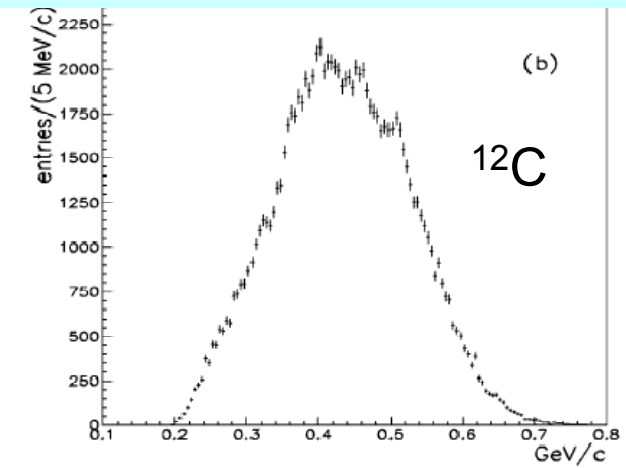
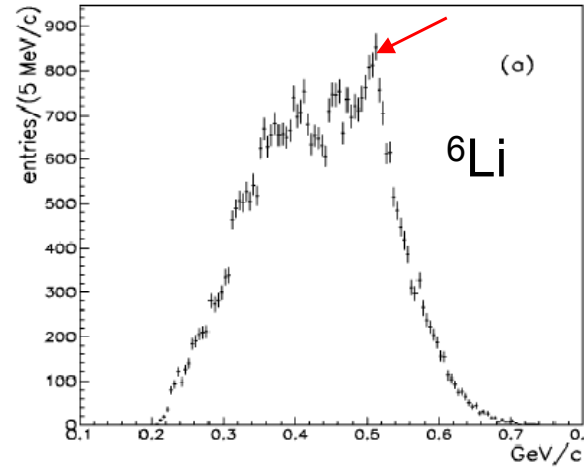


Fig. 1. Inclusive proton spectra measured following the K^- capture at rest from ⁶Li (a) and ¹²C (b).

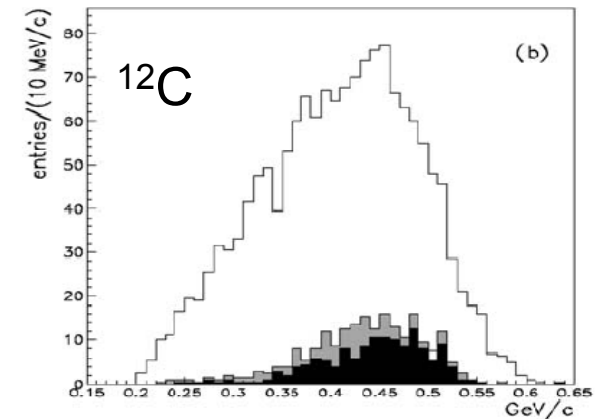
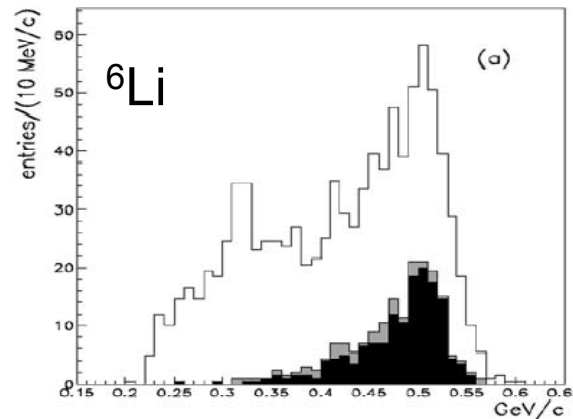
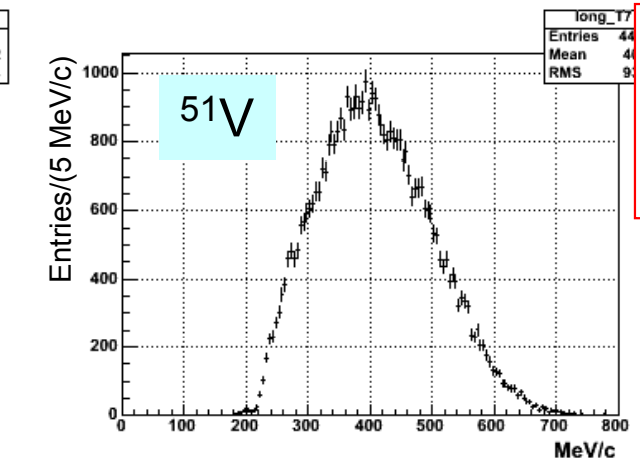
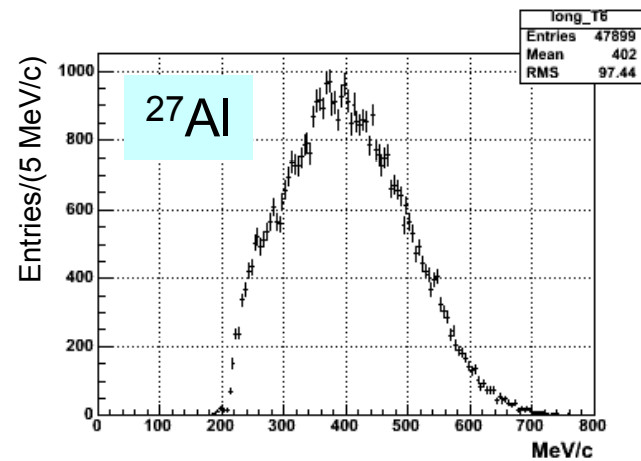
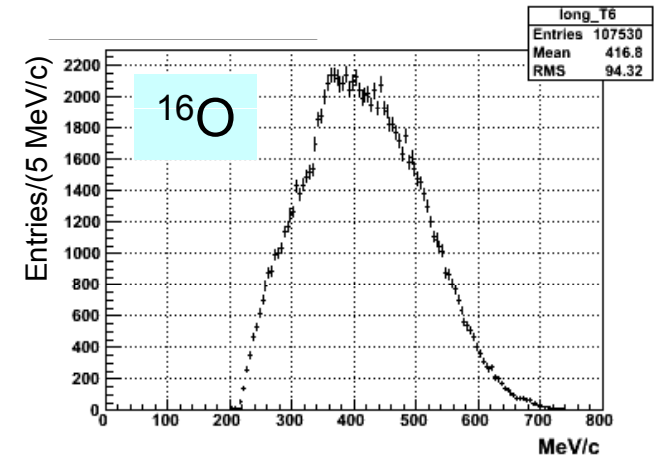
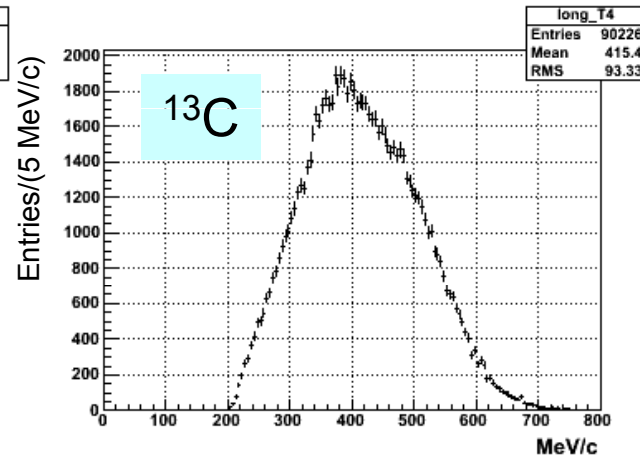
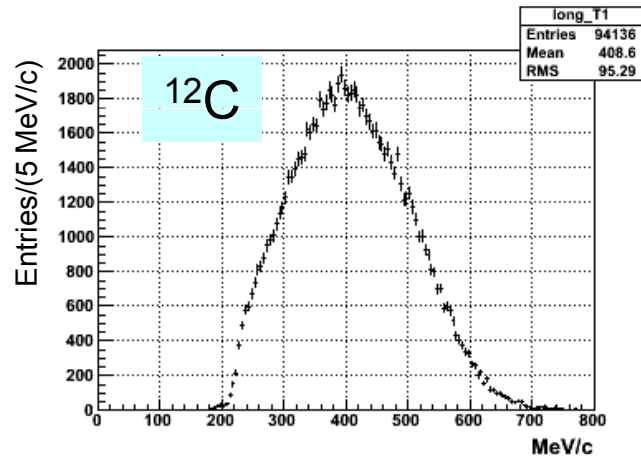
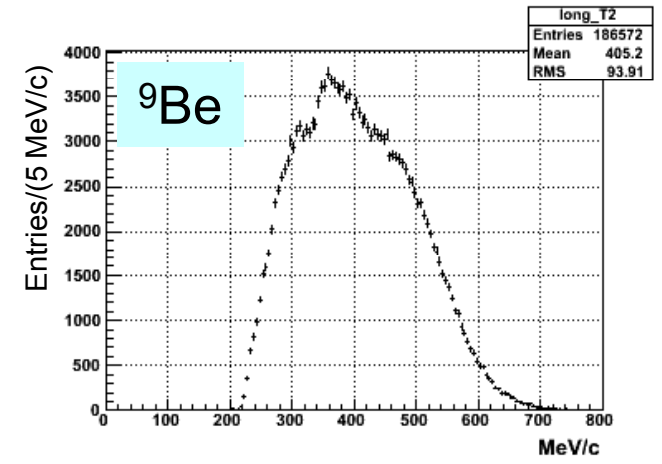
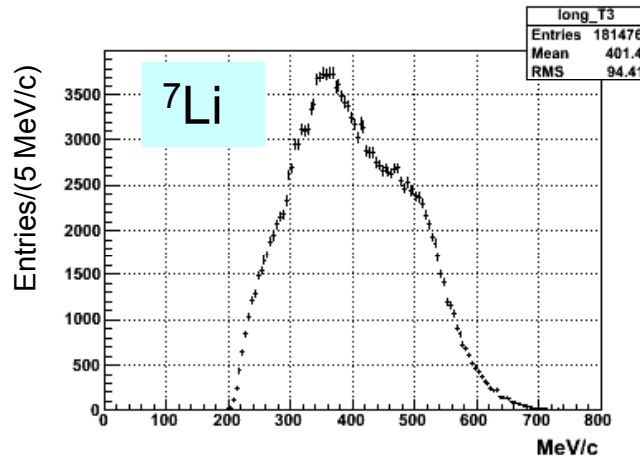
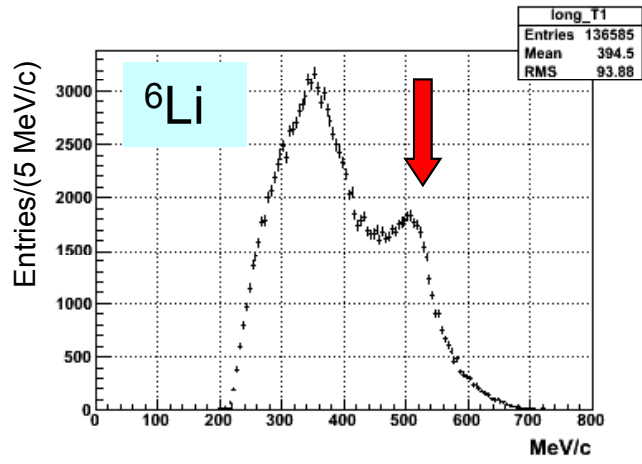


Fig. 5. Momentum spectrum of protons in coincidence with a π^- : (a) ⁶Li, (b) ¹²C. The shaded spectra are obtained with the condition of a π^- momentum larger than 275 MeV/c for ⁶Li and 272 MeV/c for ¹²C. The black spectra are obtained with the further condition of an angular correlation $\cos\theta_{(\pi-p)} < -0.8$.

All FINUDA target materials: inclusive proton momentum



High quality proton tracks,
Clear 510 MeV/c peak in ${}^6\text{Li}$

Not acceptance corrected

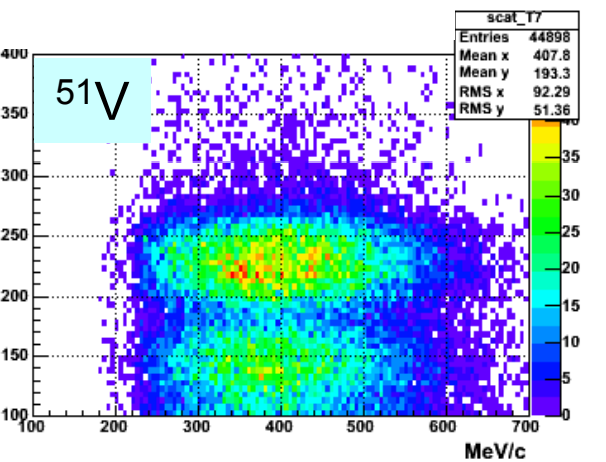
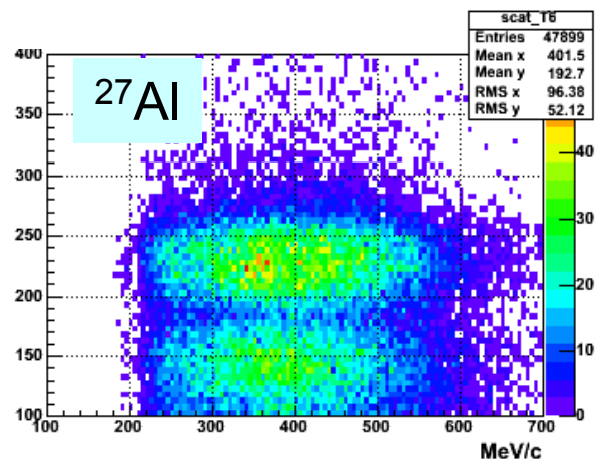
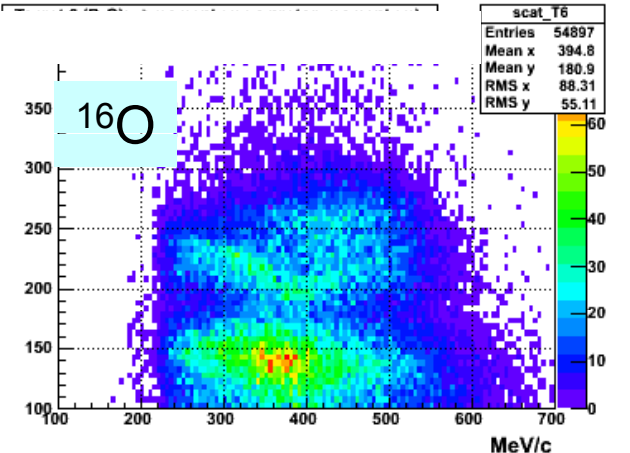
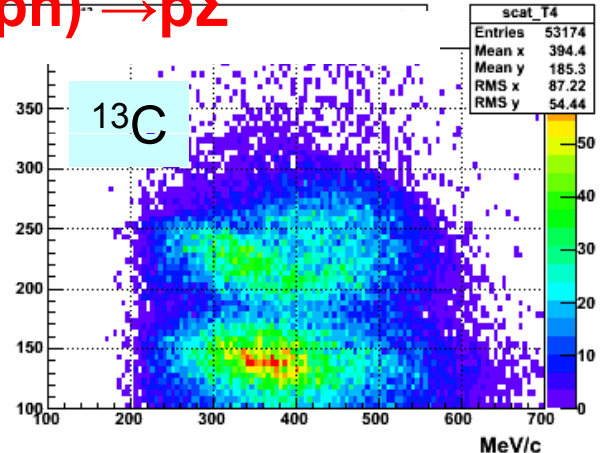
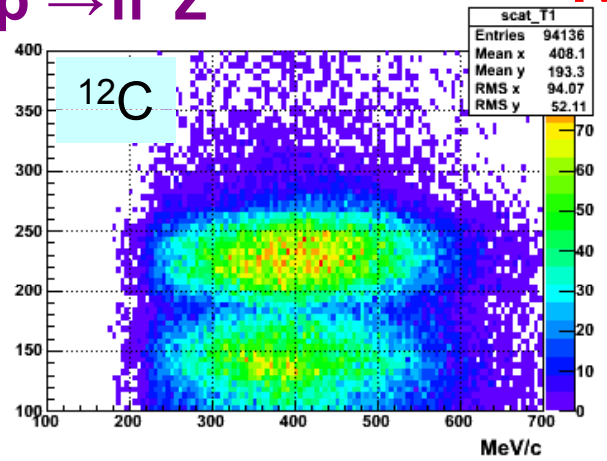
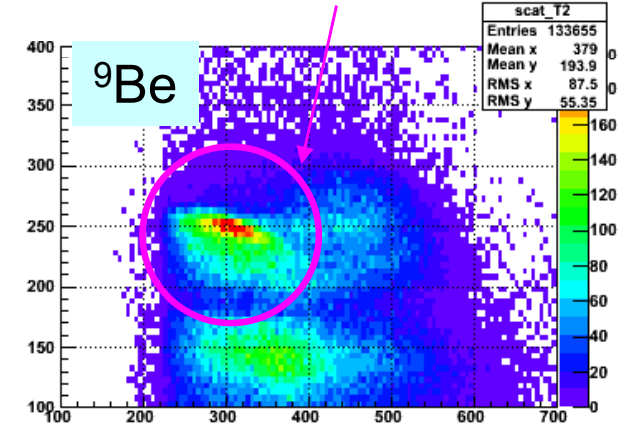
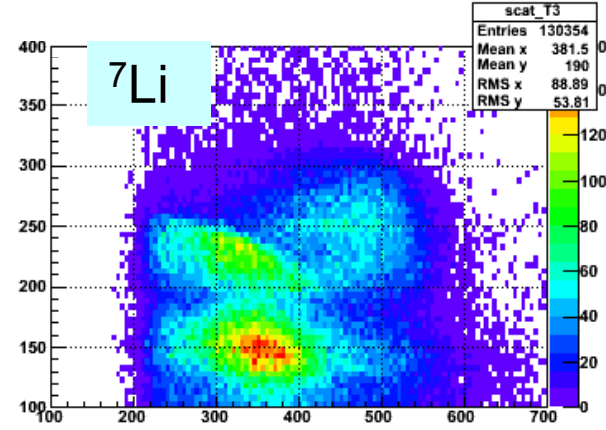
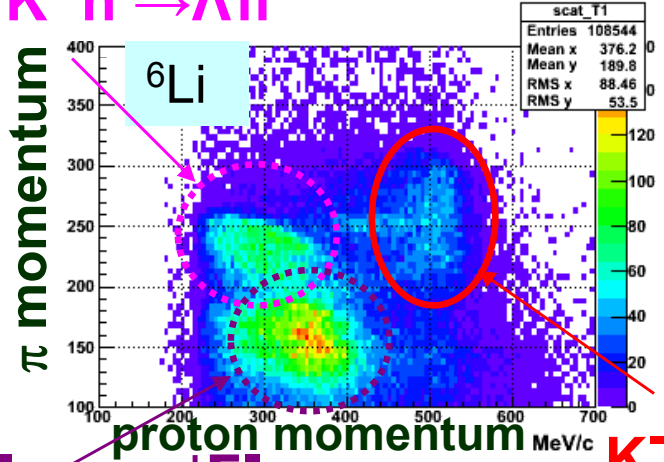
$p - \pi^-$ momentum scatterplots

$K^- n \rightarrow \Lambda \pi^-$

$K^- n \rightarrow \Lambda \pi^-$

$K^- p \rightarrow \pi^+ \Sigma^-$

$K^- (pn) \rightarrow p \Sigma^-$

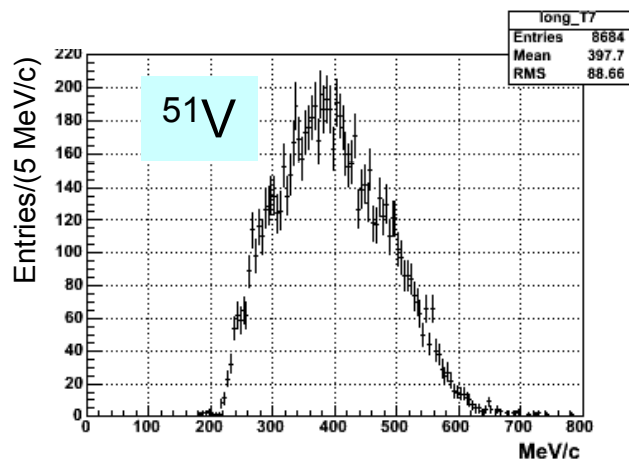
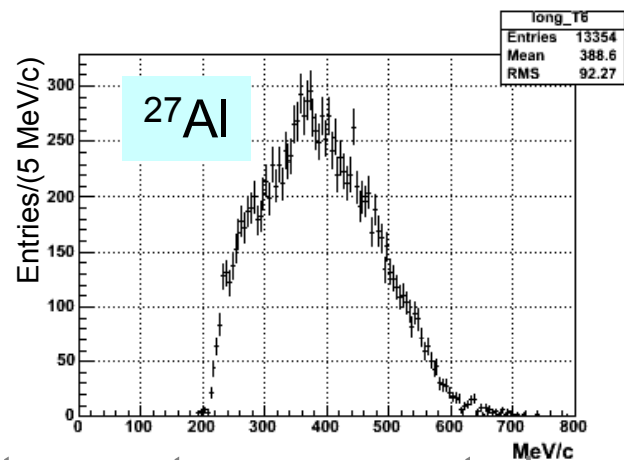
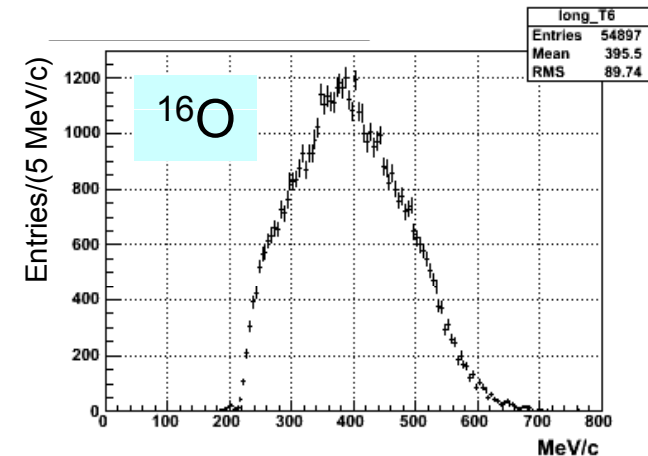
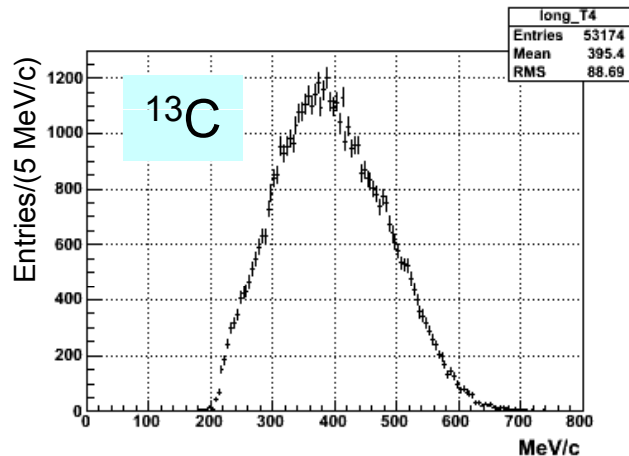
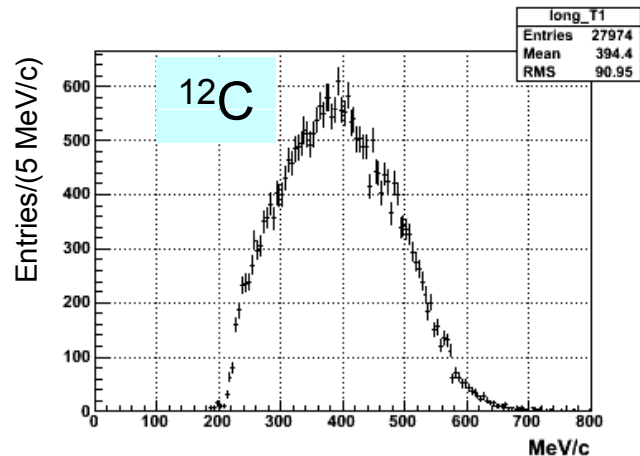
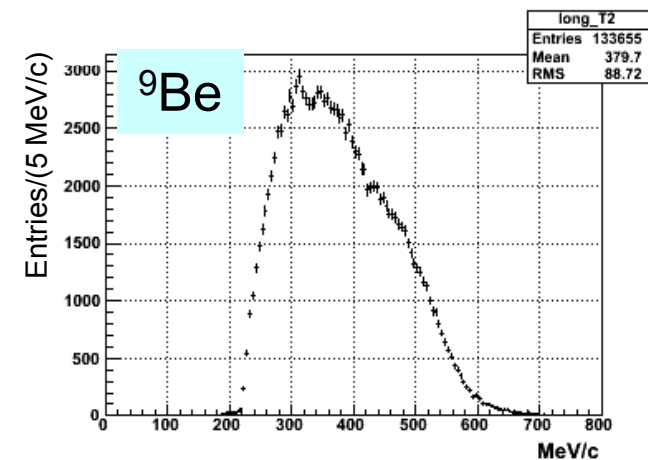
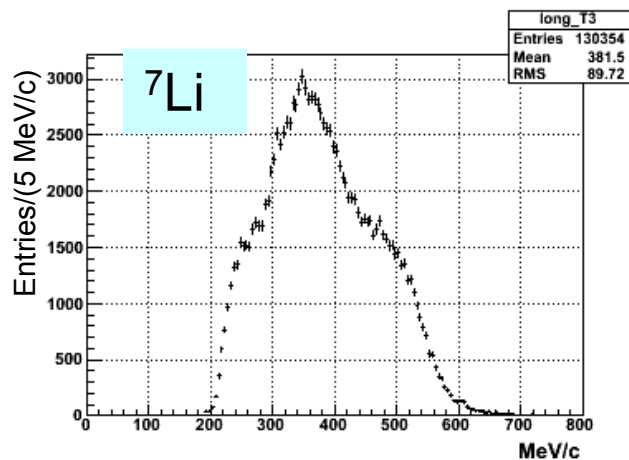
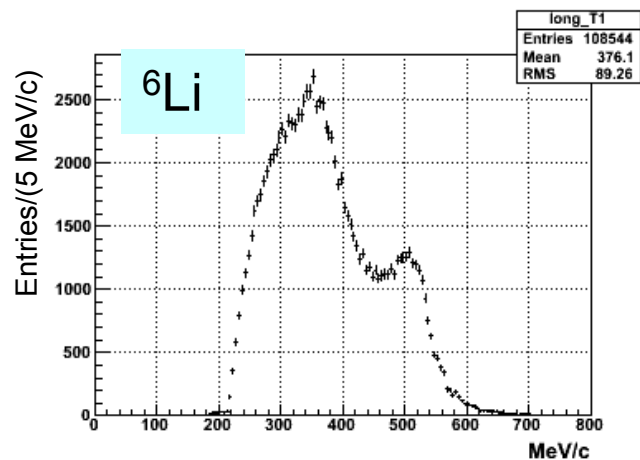


f Event accumulations due to different reactions:

- Σ^\pm and Λ QF production and decays
- Two (and many) body absorptions

Not acceptance corrected

Coincidence with one (and only!) π^-

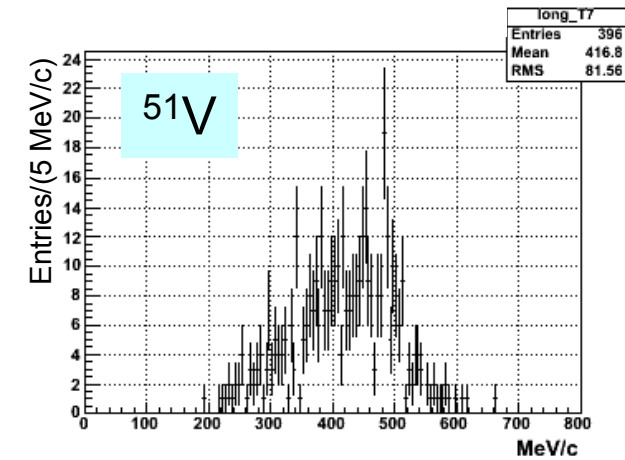
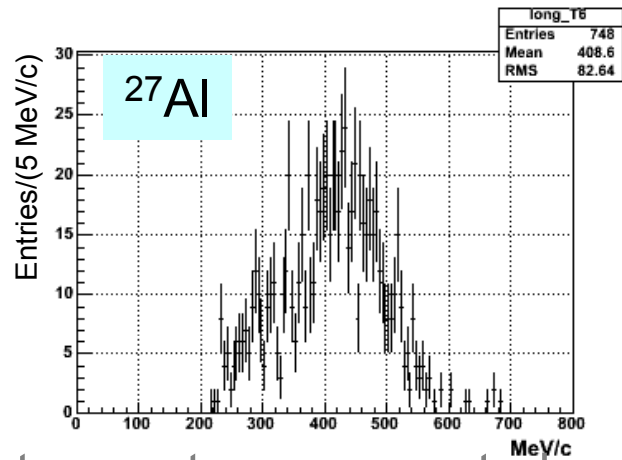
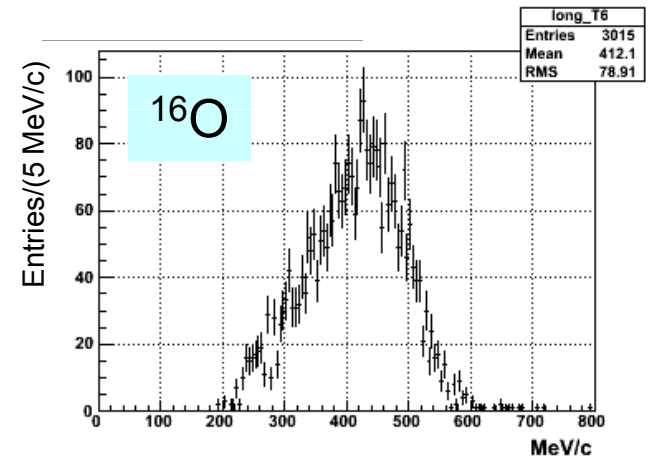
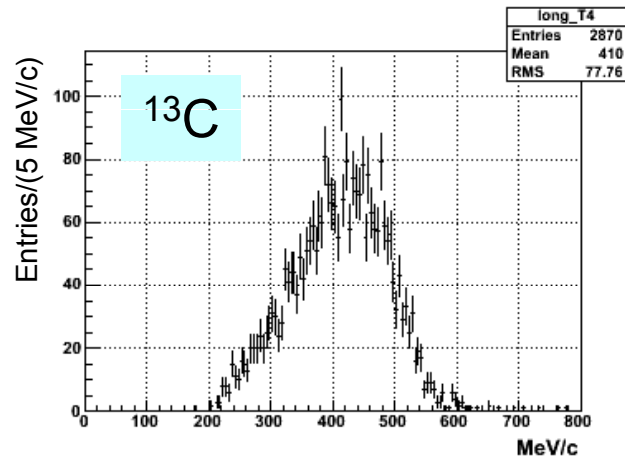
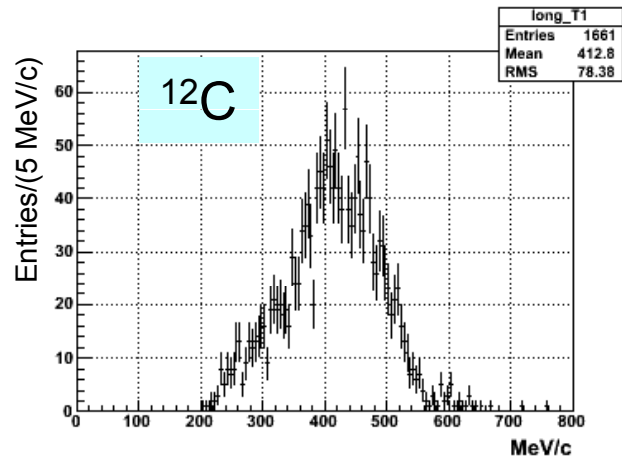
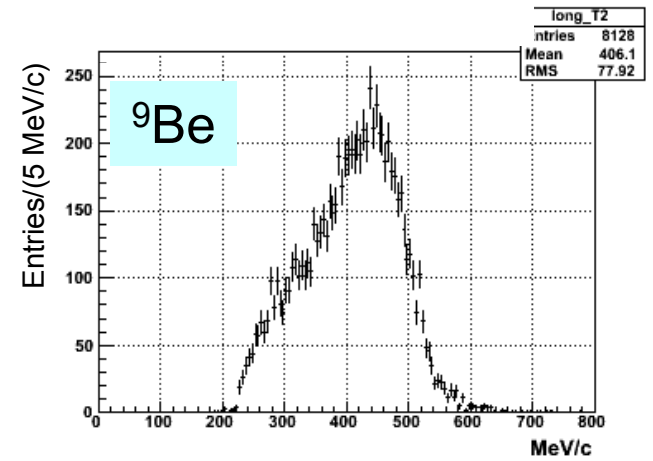
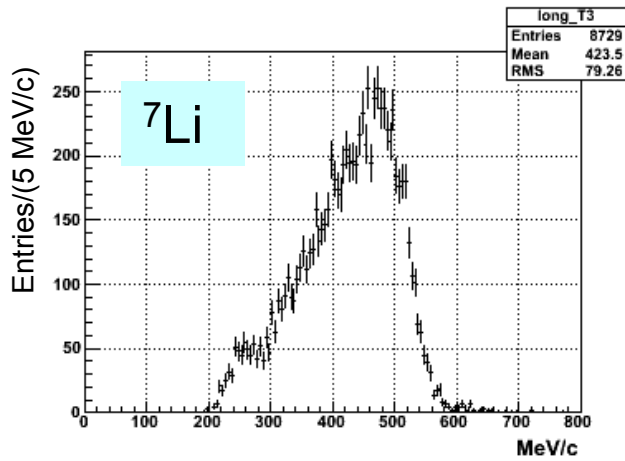
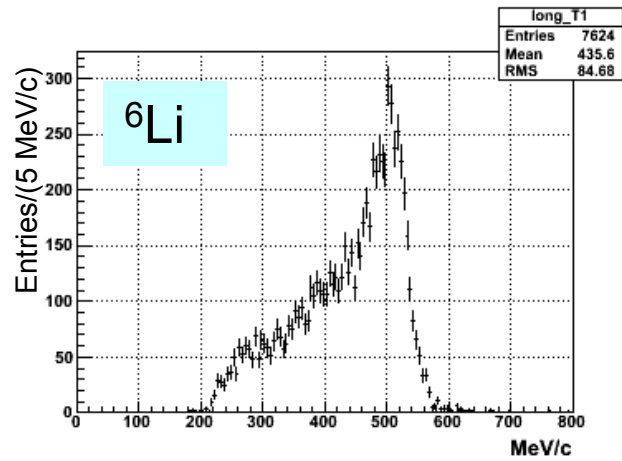


High quality proton tracks
in coincidence with one
negative pion.

- 511 MeV/c peak in ^6Li !
- A knee on ^7Li
- No other hints elsewhere

Not acceptance corrected

Coincidence with high momentum π^-

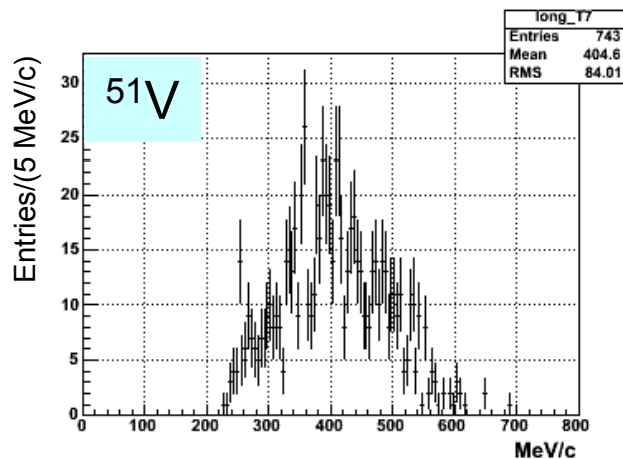
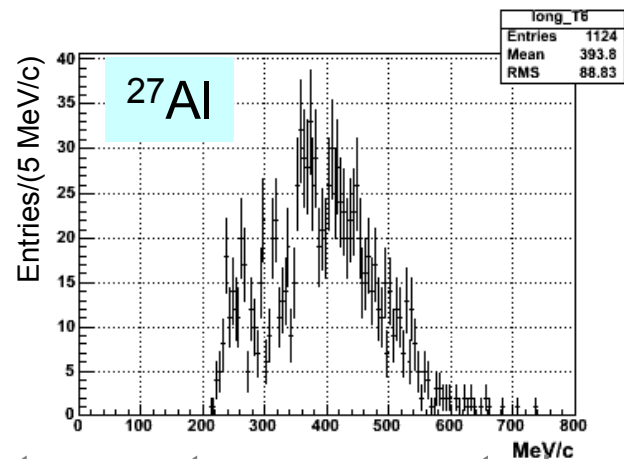
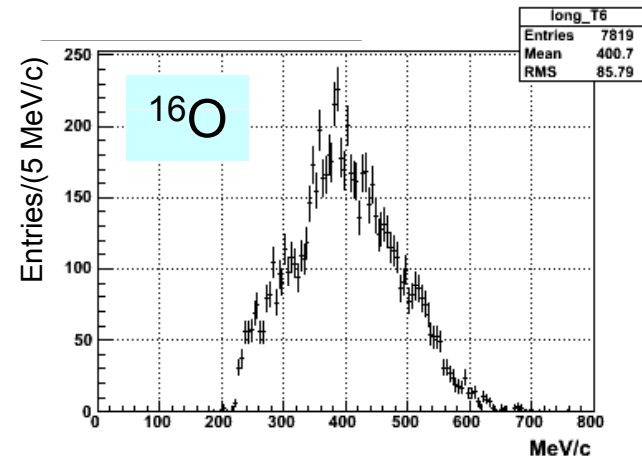
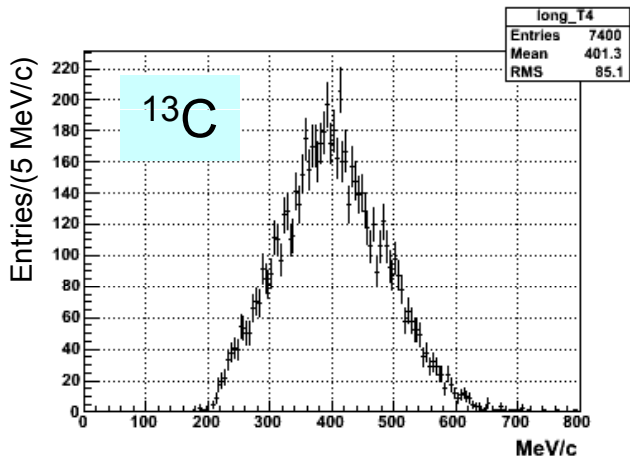
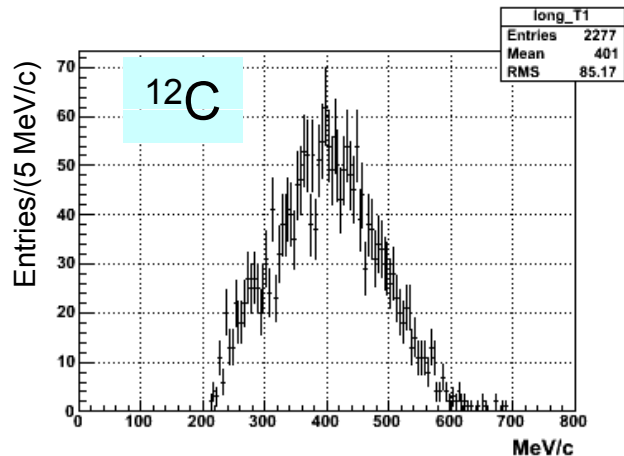
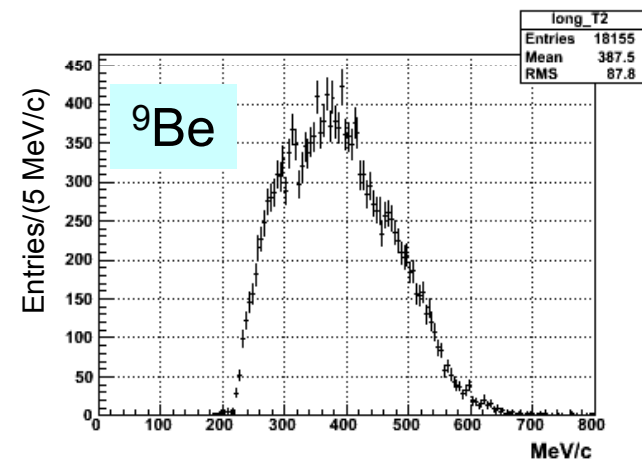
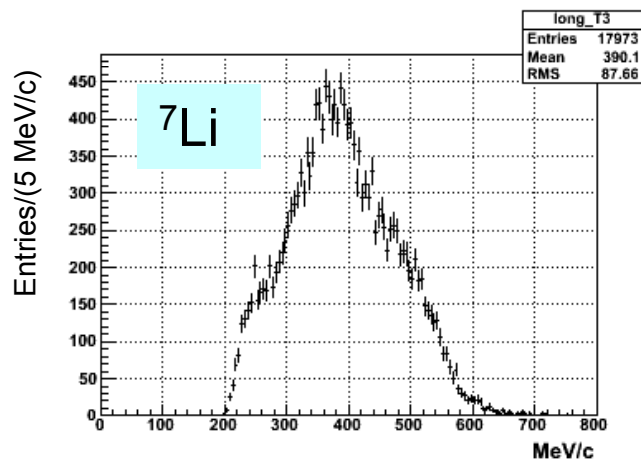
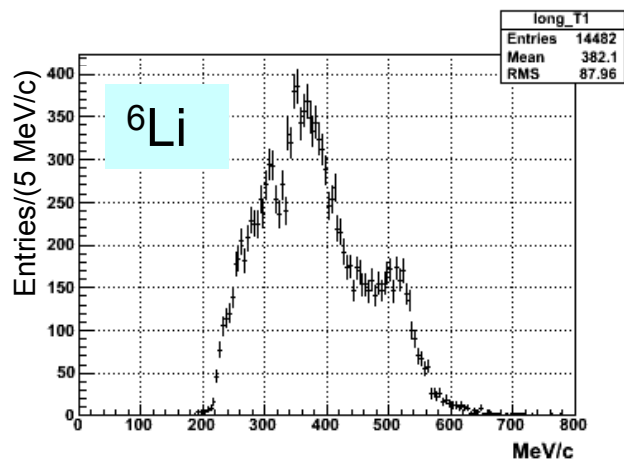


High quality proton tracks,
Fast pion coincidence
 $p(\pi^-) > 275 \text{ MeV/c}$

- Very pronounced peak in ${}^6\text{Li}$
- No structure elsewhere

Not acceptance corrected

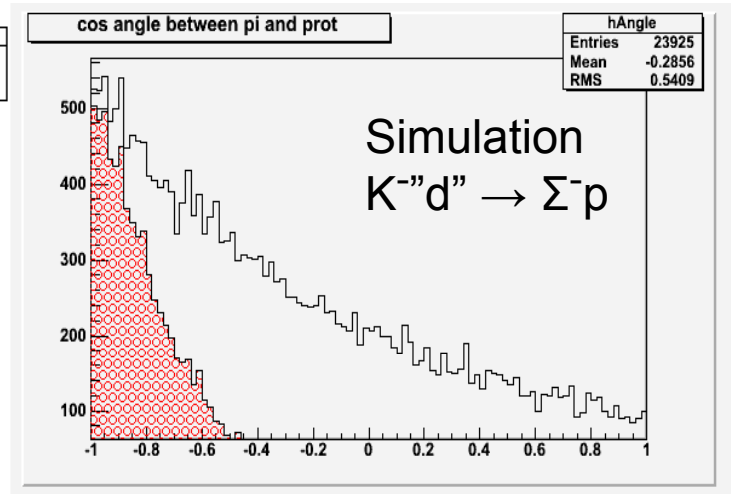
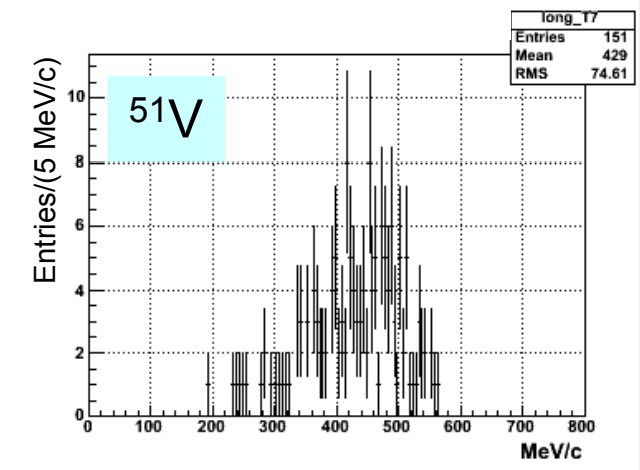
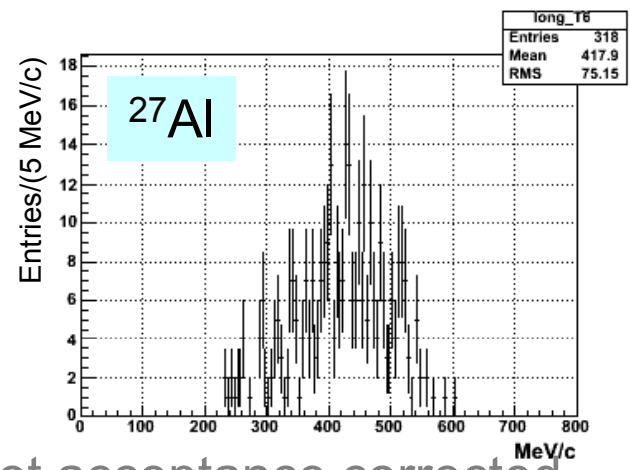
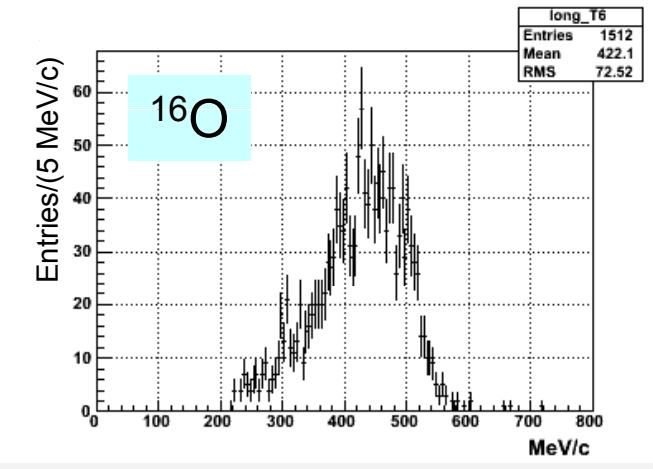
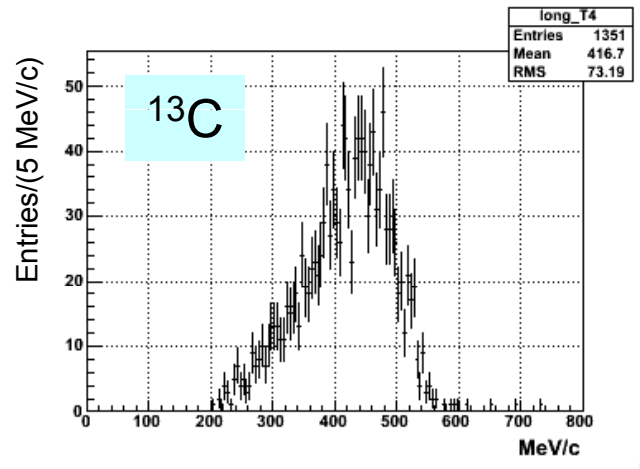
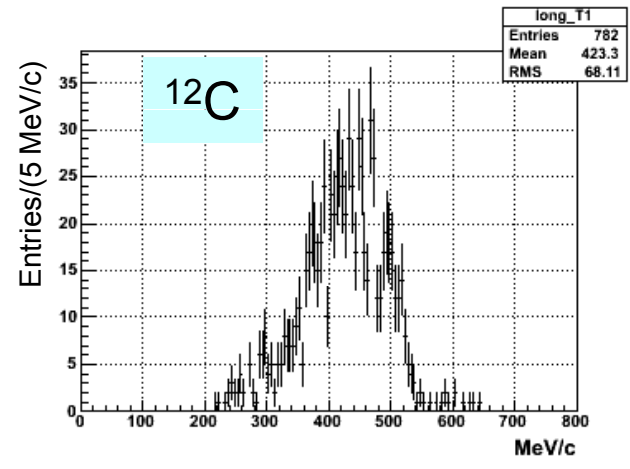
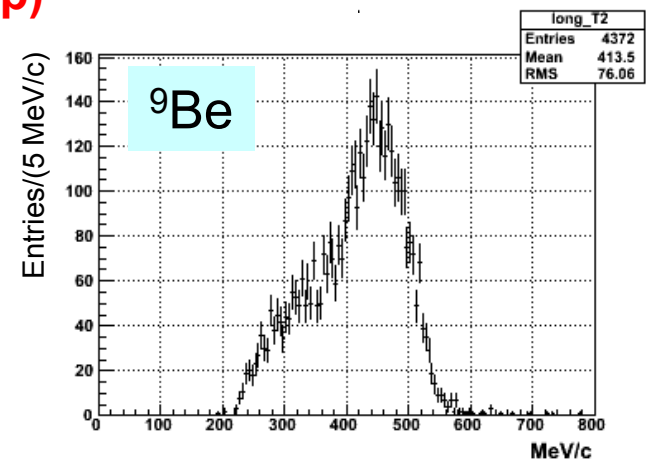
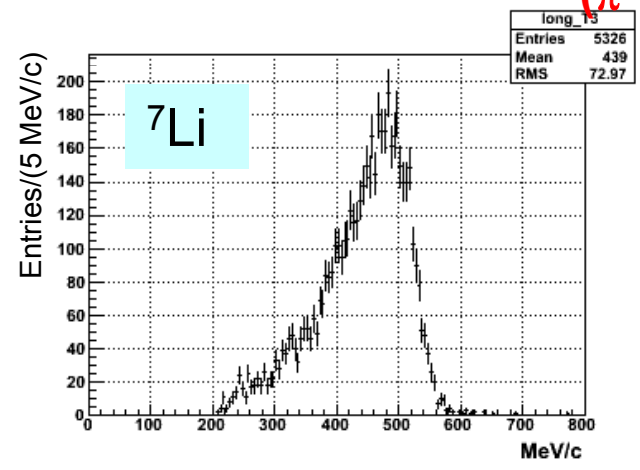
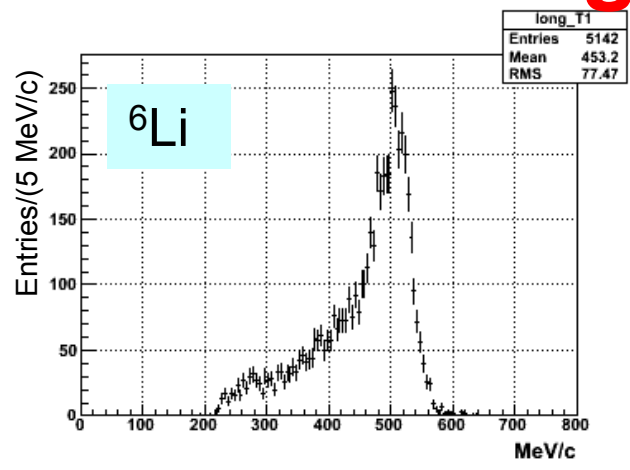
Neutron & pion coincidence



High quality tracks,
one proton required
with one (and only) pion
(any momentum) and one
and only neutron
exclusive proton spectra

Not acceptance corrected

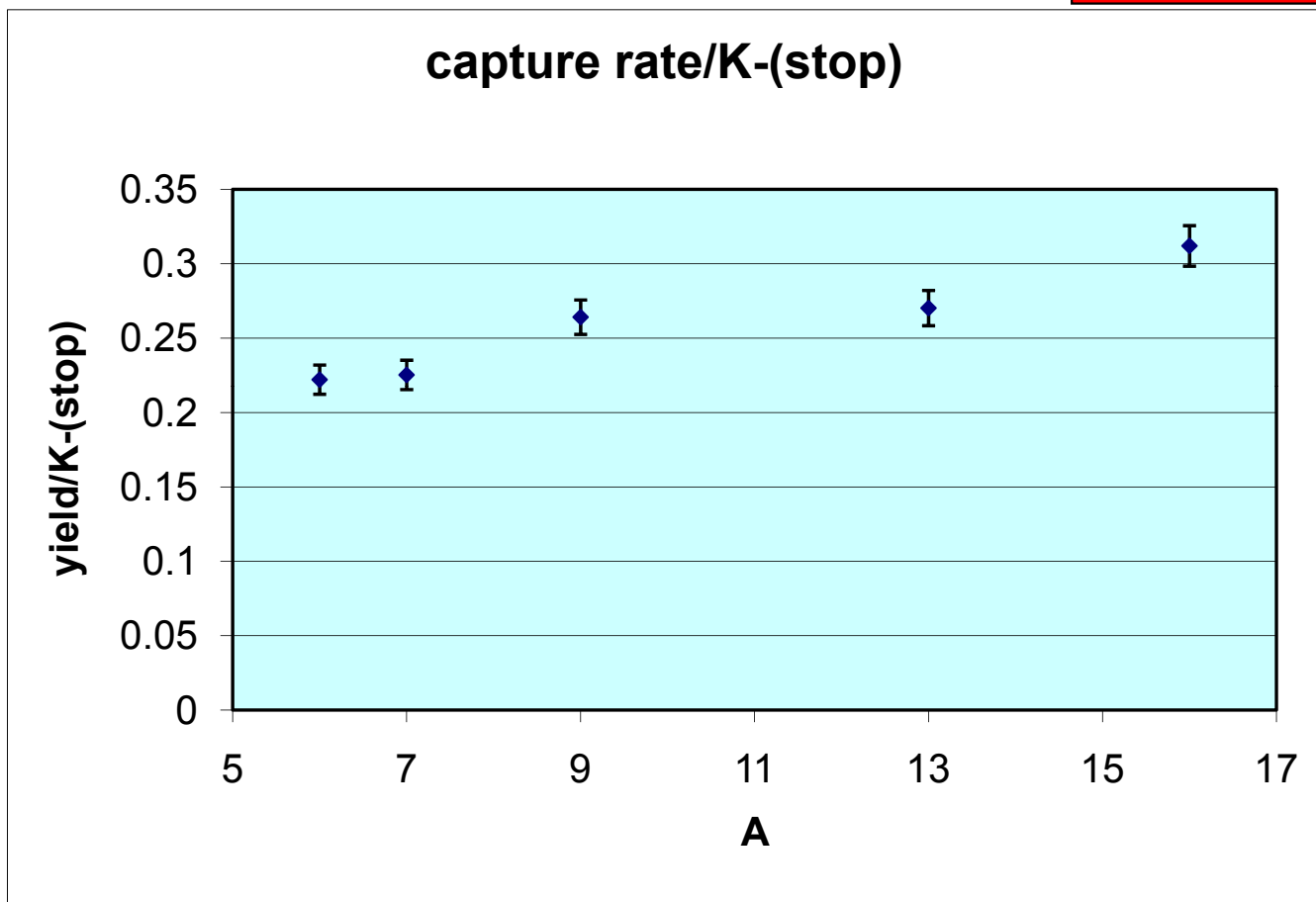
Angular cut: $\cos \theta_{(\pi^- p)} < -0.8$



Not acceptance corrected

Capture rates for proton inclusive production

WORK IN PROGRESS



- Rather few measurements existing, only from bubble chamber experiments from D_2 up to Ne, at the level of 20%
- Rising capture rate as a function on the target mass number \rightarrow surface effect?

Summary and conclusions

- A high statistics systematic survey of the trend of inclusive proton production due to K^- absorption on nuclei over a wide range of mass numbers is performed
 - Main interest: high momentum (>400 MeV/c) region, mainly correlated to many-nucleon absorption and the DBKS search
- Strong dependence of the spectra shape on the nuclear structure of the target
 - Very clean signal of $K^-(2N)$ absorption on ${}^6\text{Li}$: $K^-_{\text{stop}}(pn) \rightarrow \Sigma^- p$
 - Weaker signal from ${}^7\text{Li}$
 - Progressive dilution of the signal with larger mass numbers: stronger effect of FSI's
 - Confirmation of first FINUDA result (2006)
 - Clear indications for a $(\alpha+\alpha+n)$ structure in ${}^9\text{Be}$
- No indication of other monochromatic signals in the spectra
- First systematic evaluation of capture rates over a wide range of nuclear species (work in progress): $25\text{-}30\%/K^-_{\text{stop}}$