

Accelerator Mass Spectrometry for Nuclear Astrophysics

Development of new experimental techniques for the use at NSL

This new equipment and experimental setup will provide us with exciting new opportunities to study low energy processes typical for main sequence stars and red giants.

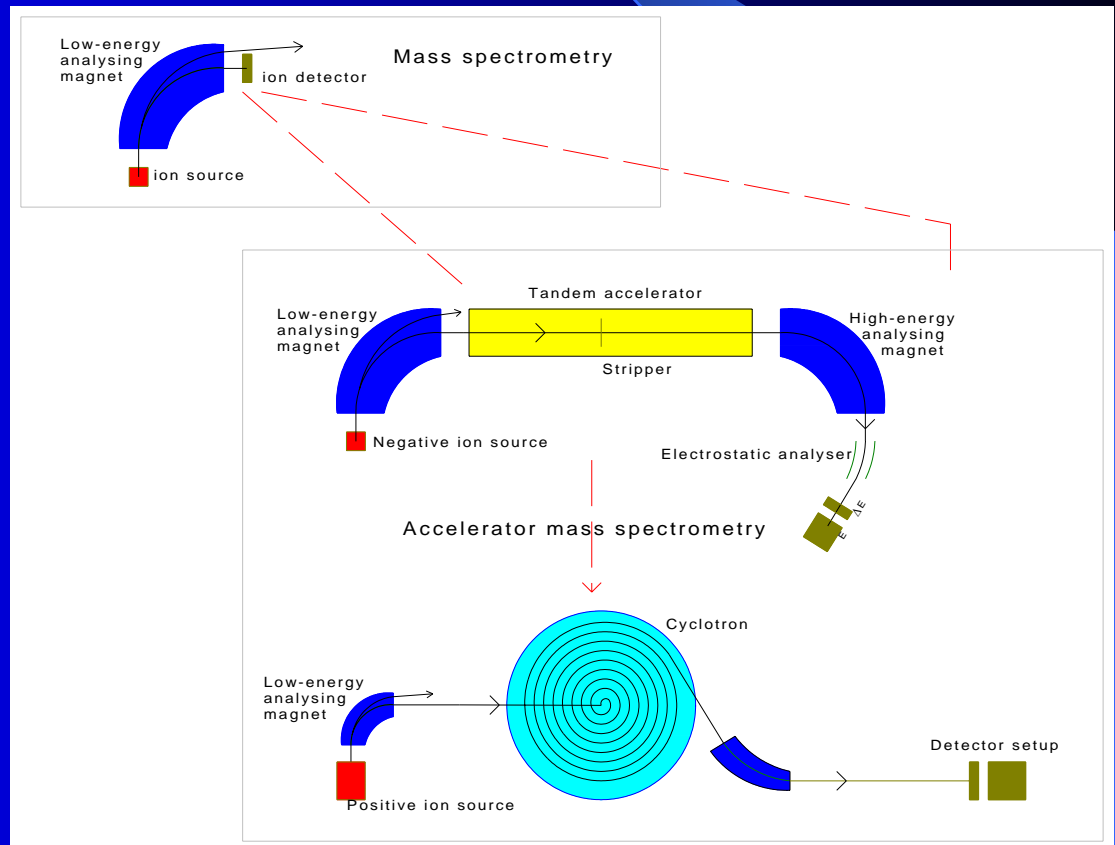


Accelerator Mass spectrometry

A powerful detection technique for

- Environmental physics
- Astrophysics

-



From carbon dating the Ice Man:



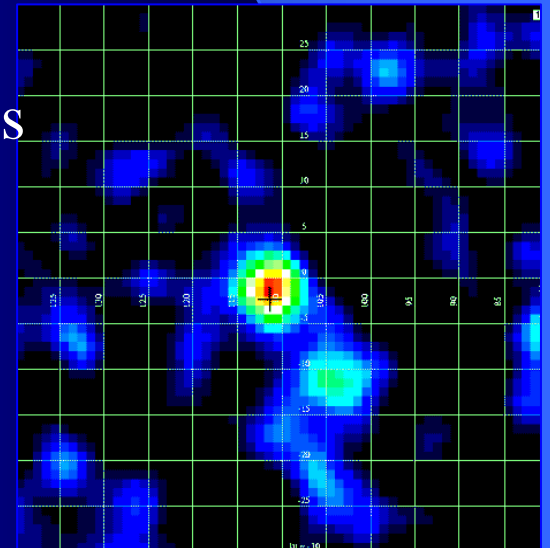
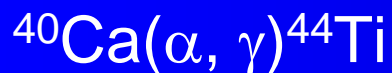
^{14}C age = 5300 years

To nuclear Astrophysics:

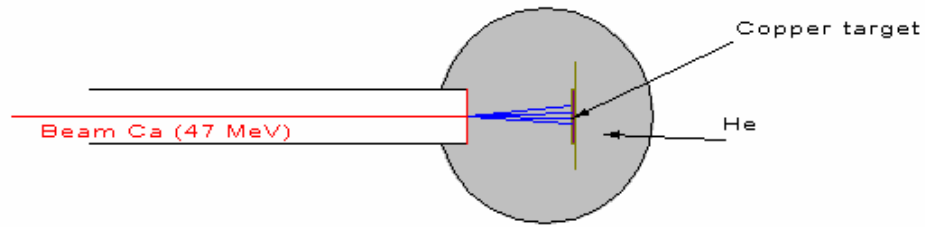
The detection of the decay of ^{44}Ti by Compton gamma-ray obs.

A clear indicator for ongoing ^{44}Ti nucleosynthesis

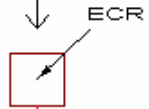
The measurement of the cross-section of the suspected main production channel of ^{44}Ti :



Activation at ATLAS



Low level γ counting

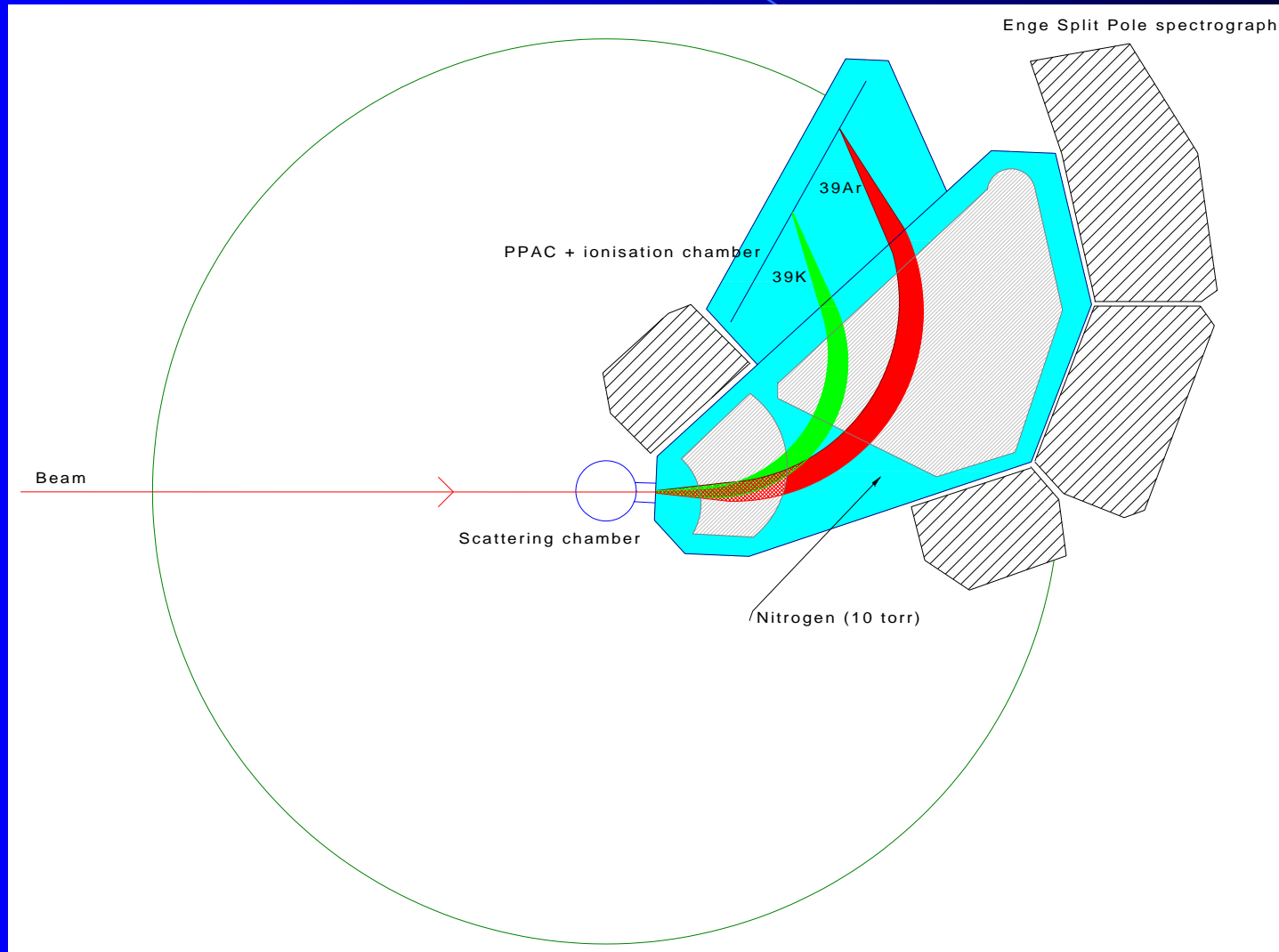


AMS measurement of ^{44}Ti

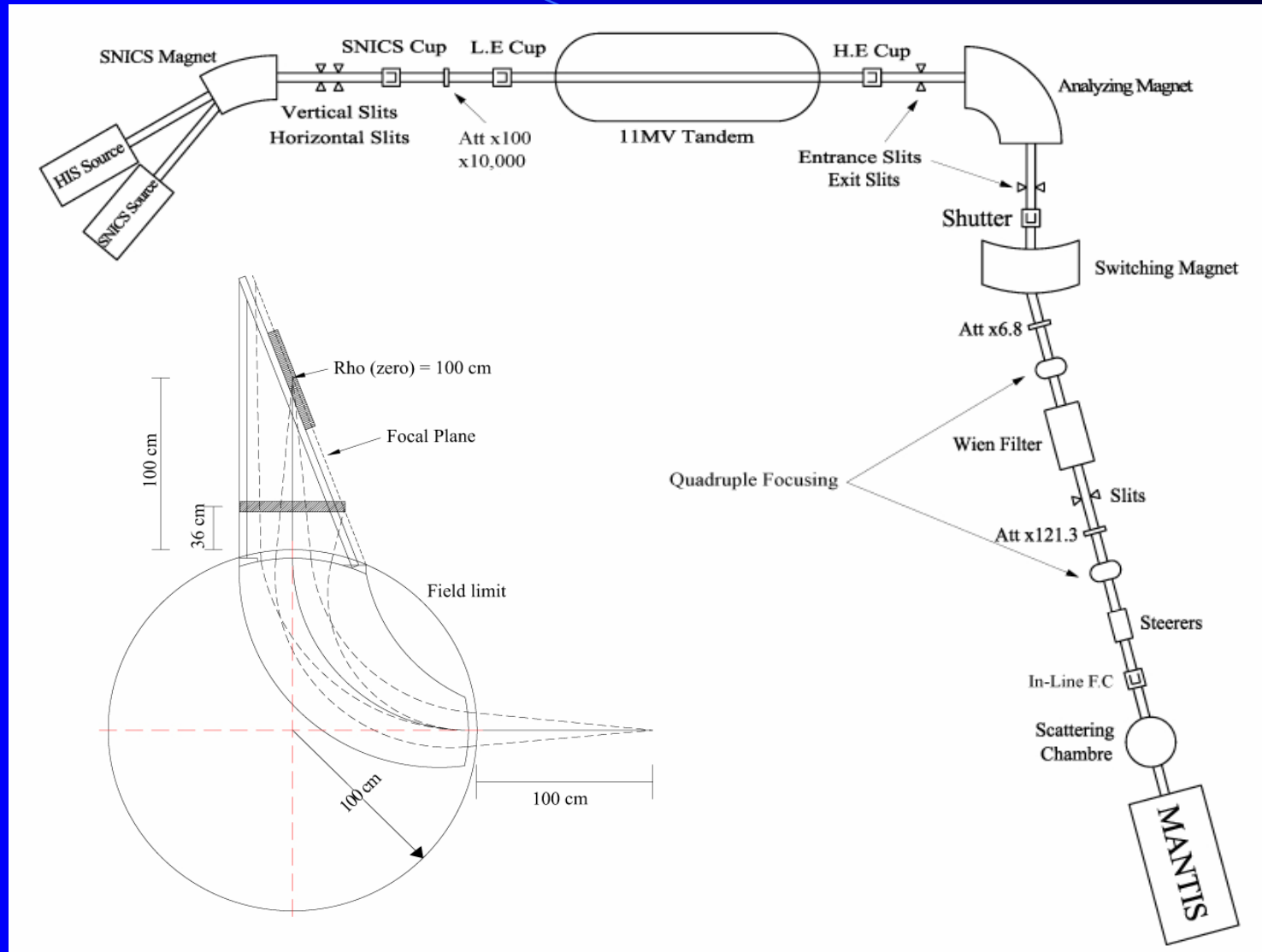


The Gas-filled magnet technique

A powerfull isobar separation technique being developed here at the NSL



Experimental Layout and AMS Facility



NSL Spectrograph upgrade



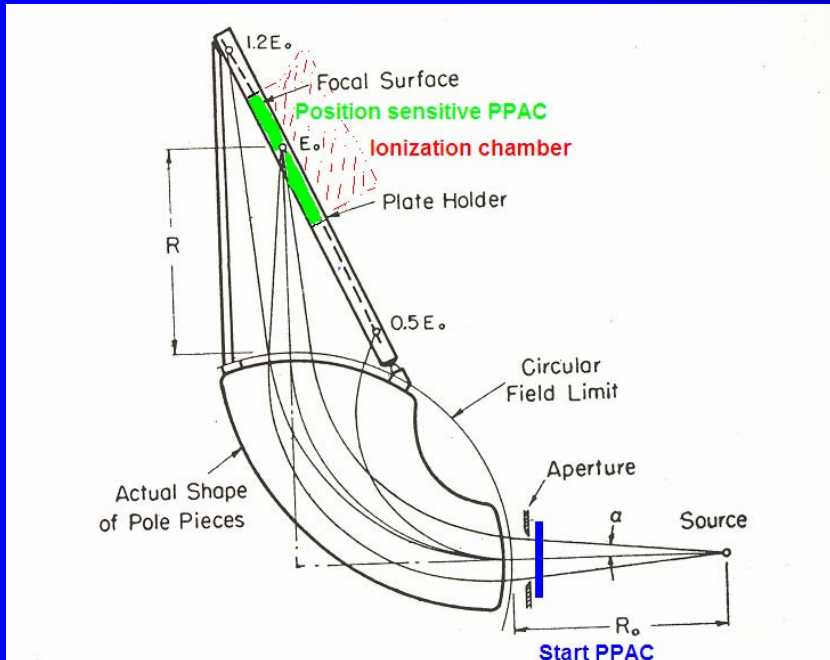
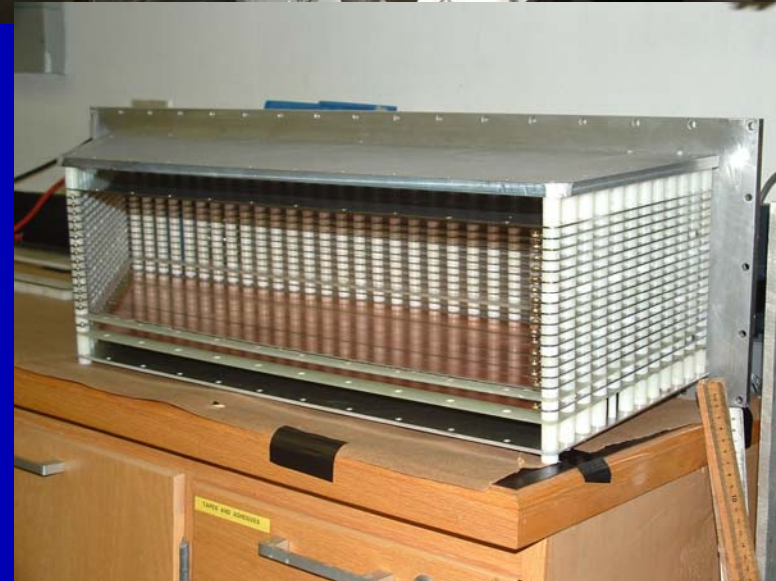
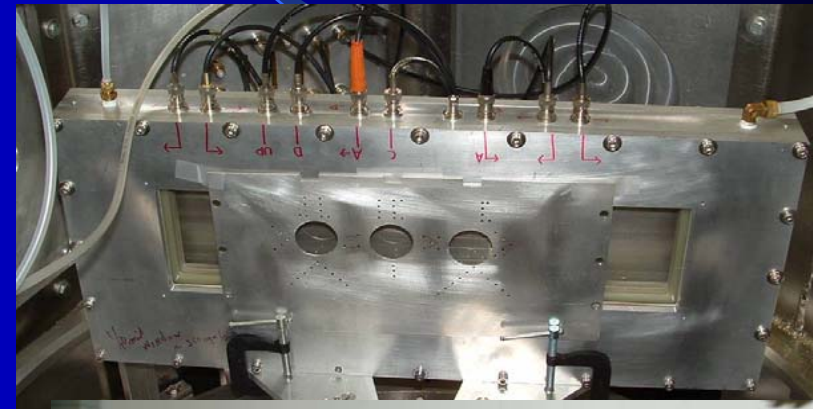
New Focal Plane Detection System

PPAC and Ionisation Chamber (IC) for position and energy determination

Both containing Isobutane gas

Thin Mylar windows, low energy loss

TOF can aid in particle identification



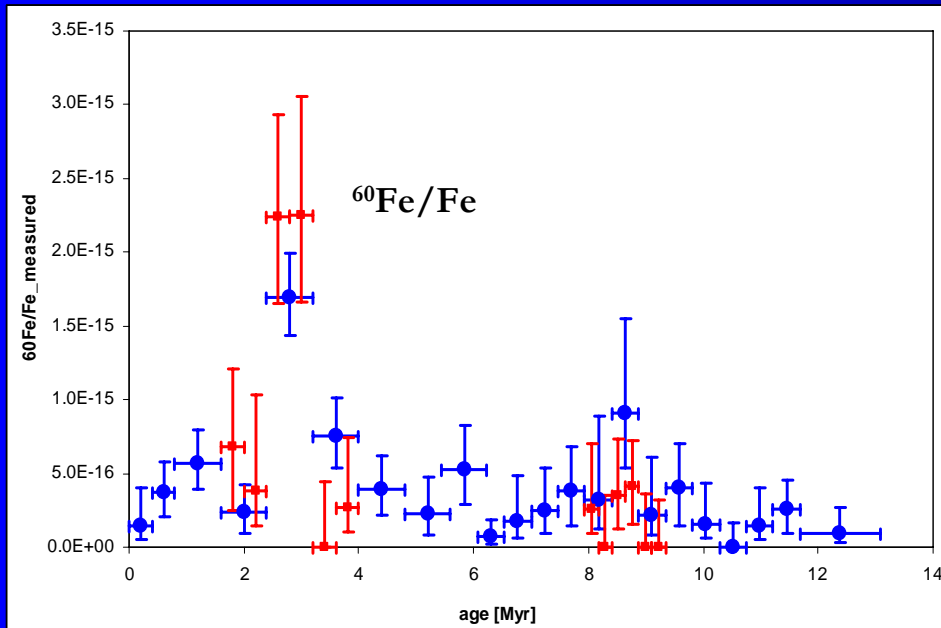
Detector Development

A new focal plane detector for the spectrograph is currently being tested



Origin of ^{60}Fe in ferromanganese crusts revisited

Recently there has been a renewed interest in ^{60}Fe



K. Knie et al., Phys. Rev. Lett. 93(2004)171103

- The $^{60}\text{Fe}/\text{Fe}$ peak detected by the Munich group still is the only measurement to date (we have access to more sample material).
- Measurement of Helium in that same core show high ^3He concentrations [Basu et al PRL 98, (2007)141103]

- The Munich group measurement needs reconfirmation
- The $t_{1/2}$ of ^{60}Fe needs to be measured to higher precision (currently $\sim 25\%$)

Production of ^{36}Cl

To evaluate the X-wind model we need p, ^3He and α production cross-sections.

Adopted nuclear cross section from Hauser-Feshbach codes

In a first step we will study the $^{36}\text{S}(p, n)^{36}\text{Cl}$ and $^{33}\text{S}(\alpha, p)^{36}\text{Cl}$ reaction at energies $< 10\text{MeV/A}$ and down

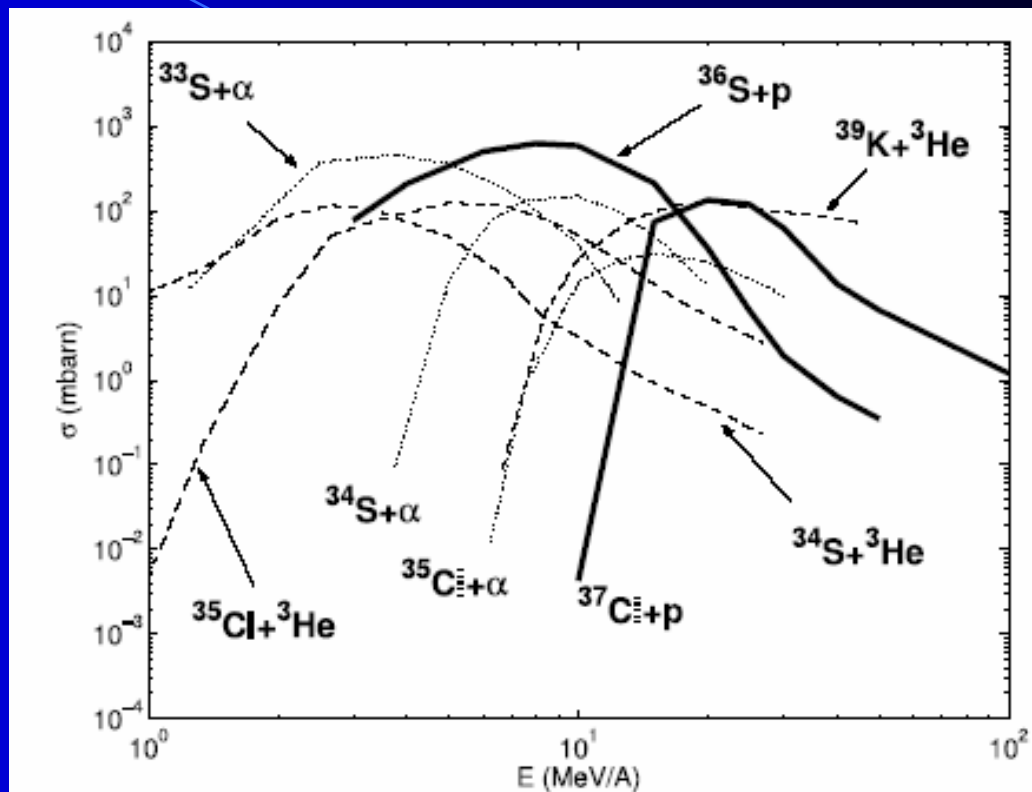


FIG. 2.—Adopted nuclear cross sections for the proton- (*thick line*), α - (*dotted line*), and ^3He -induced (*dashed line*) reactions for the production of ^{36}Cl . The cross sections are based on numerical simulations using fragmentation and Hauser-Feshbach codes. In the absence of experimental data points, the input parameters have been chosen so that the calculations reproduce data obtained for lower and higher masses (e.g., Al, Ca, Fe) for which some data exist.