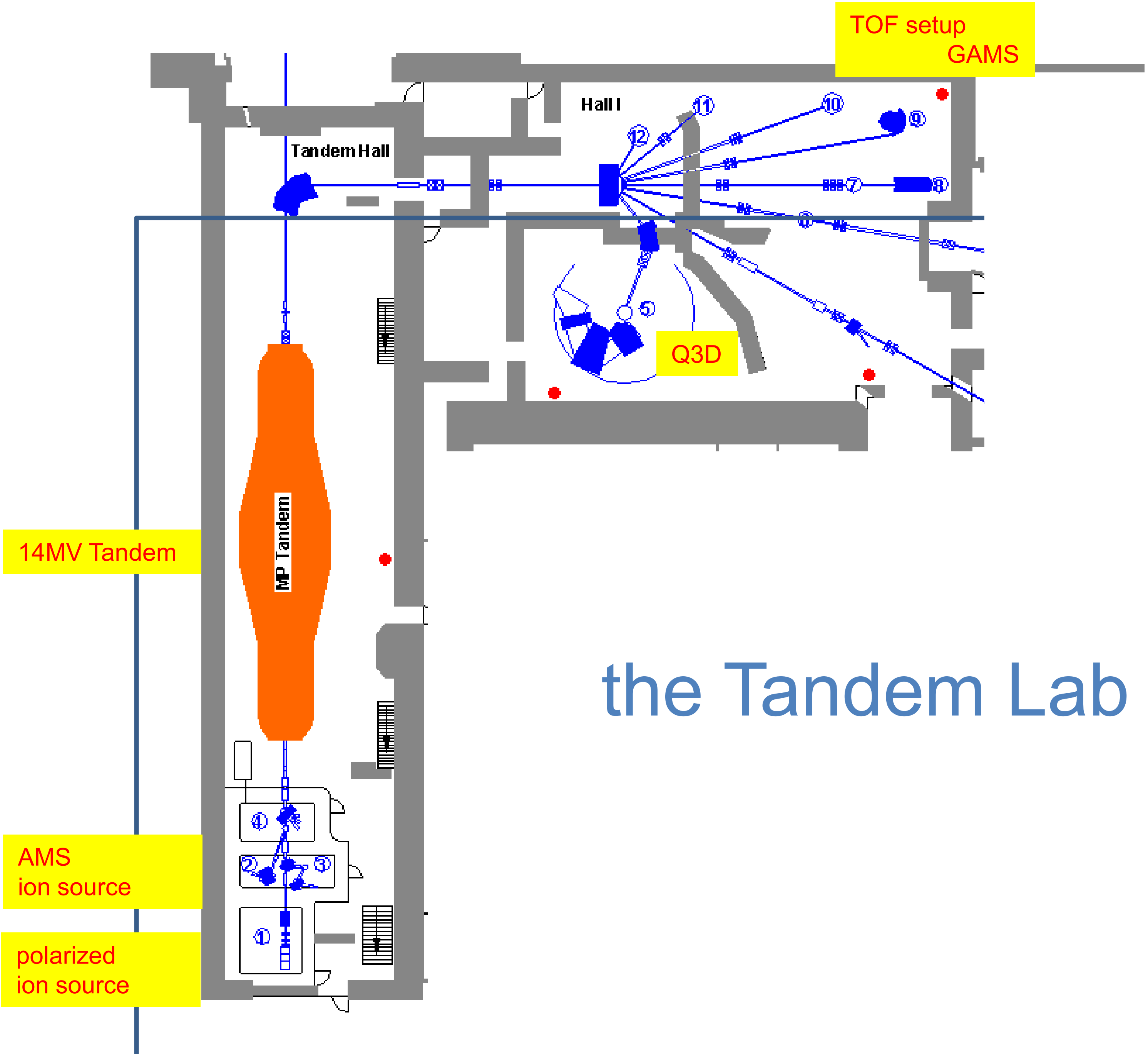
Nuclear Astrophysics at the Munich Tandem

Accelerator Mass Spectrometry

Nuclear Structure Studies with the Q3D Magnetic Spectrograph

Thomas Faestermann



the Tandem Lab

Accelerator Mass Spectrometry

cross section measurements

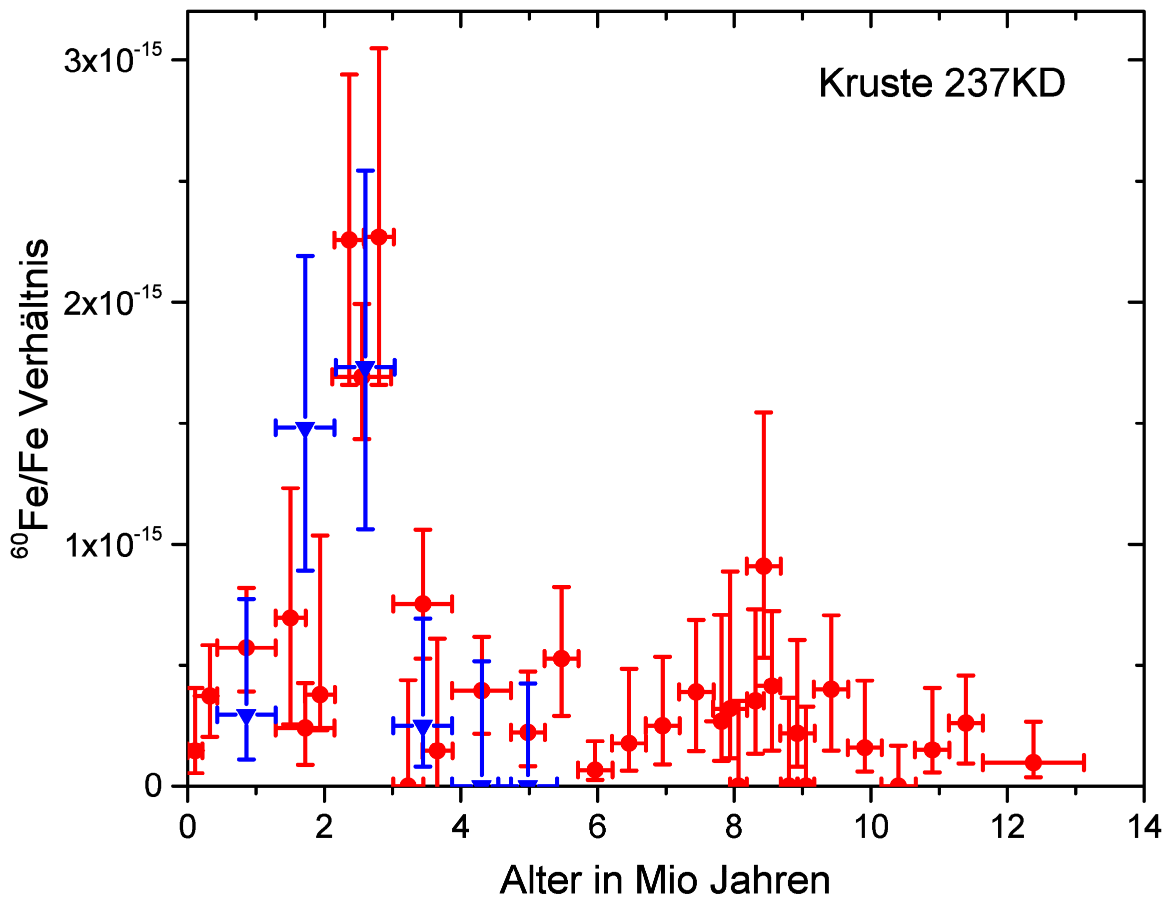
- $^{58}Ni(n,\gamma)^{59}Ni$ Ludwig et al., 2016
- $^{62}Ni(n,\gamma)^{63}Ni$ Dillmann et al., 2010
- $^{78}Se(n,\gamma)^{79}Se$ Dillmann et al., 2010
- $^{92}Zr(n,\gamma)^{93}Zr$ waiting for FRANZ
- $^{64}Ni(\gamma,n)^{63}Ni$ Dillmann et al., 2010
- $^{40}Ca(\alpha,\gamma)^{44}Ti$ Nassar et al., unpubl.

SN produced radionuclides

^{60}Fe in ferromanganese crusts

K. Knie et al. 1999, 2004

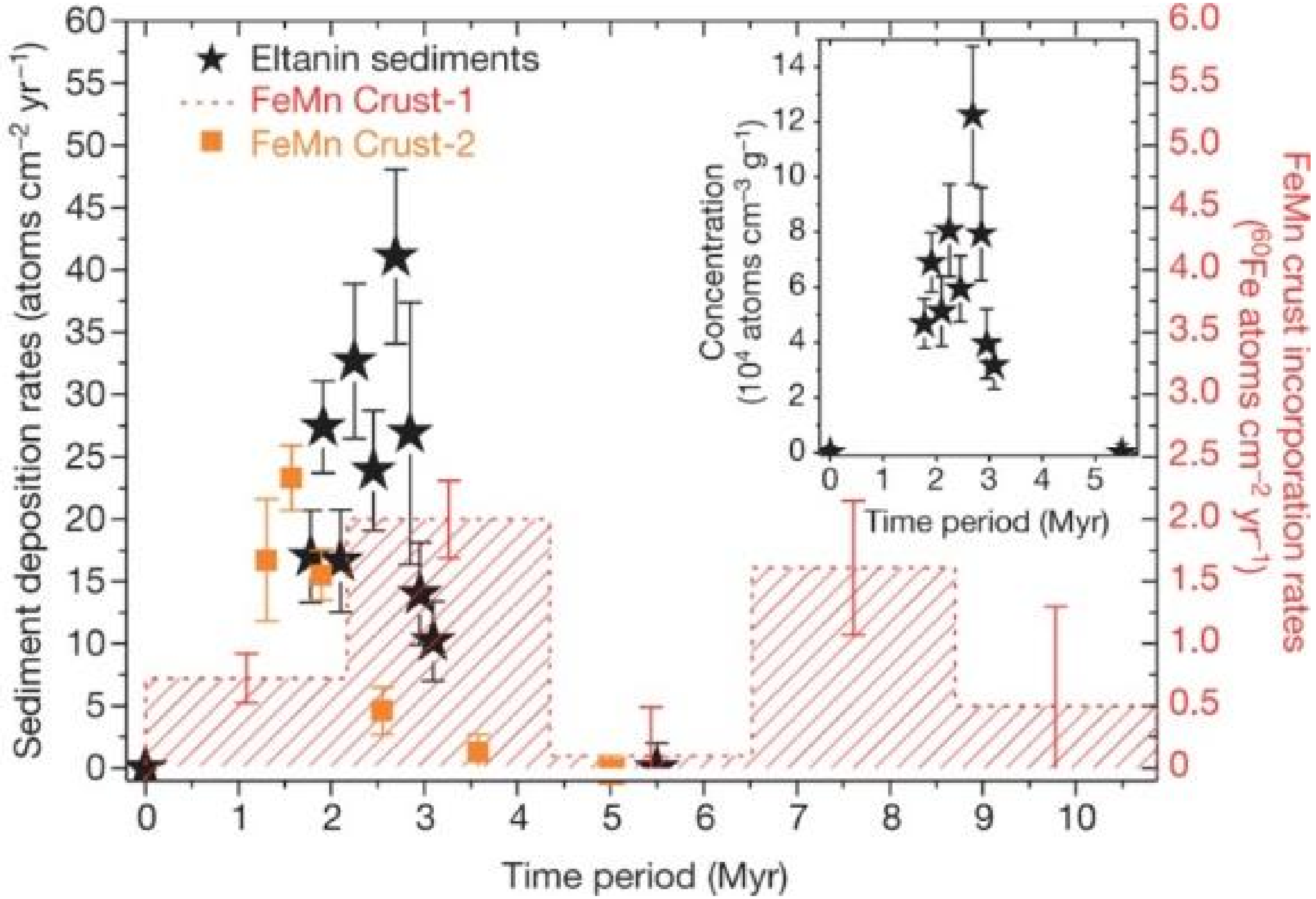
C. Fitoussi et al. 2008



Competition from Canberra

A. Wallner et al., 2016
sediments + crusts

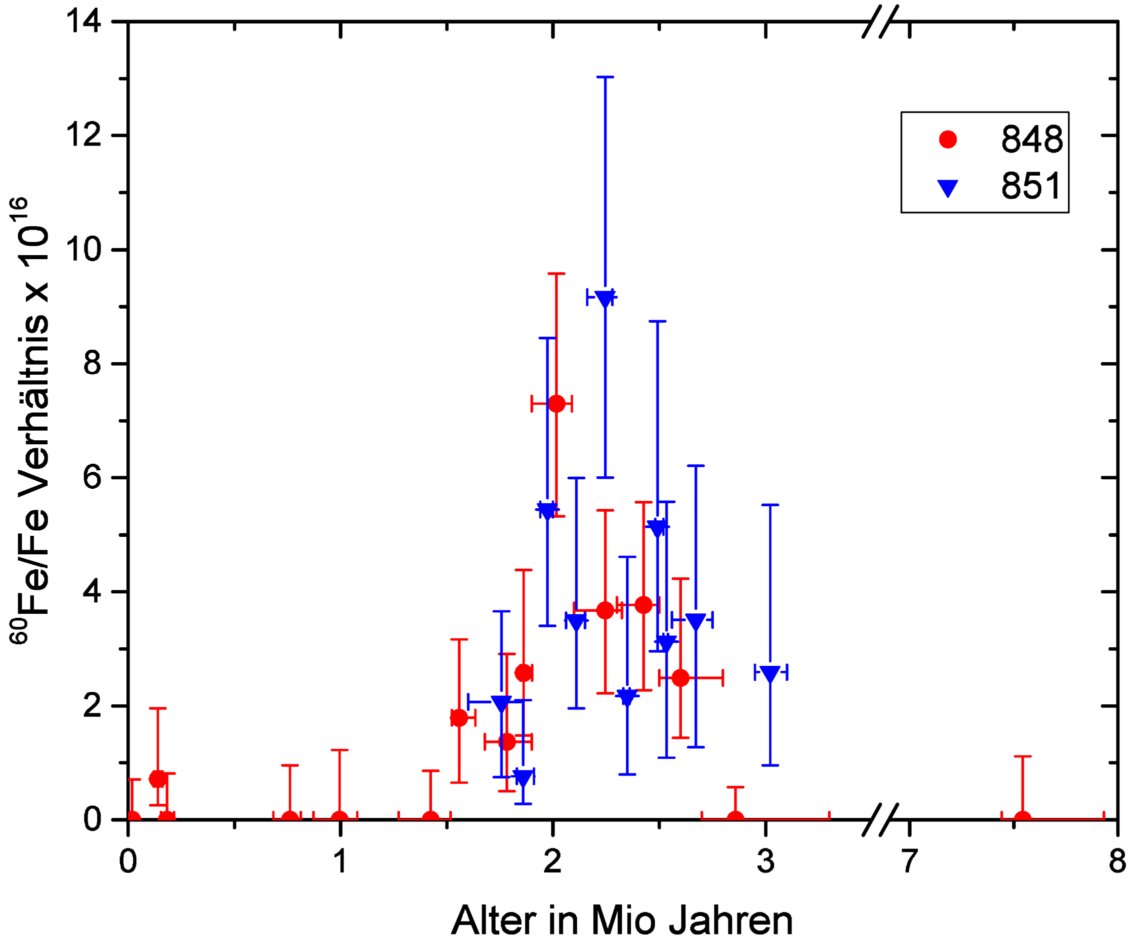
Deposition rates for sediment (150-kyr averaged data) and incorporation rates for two crust samples



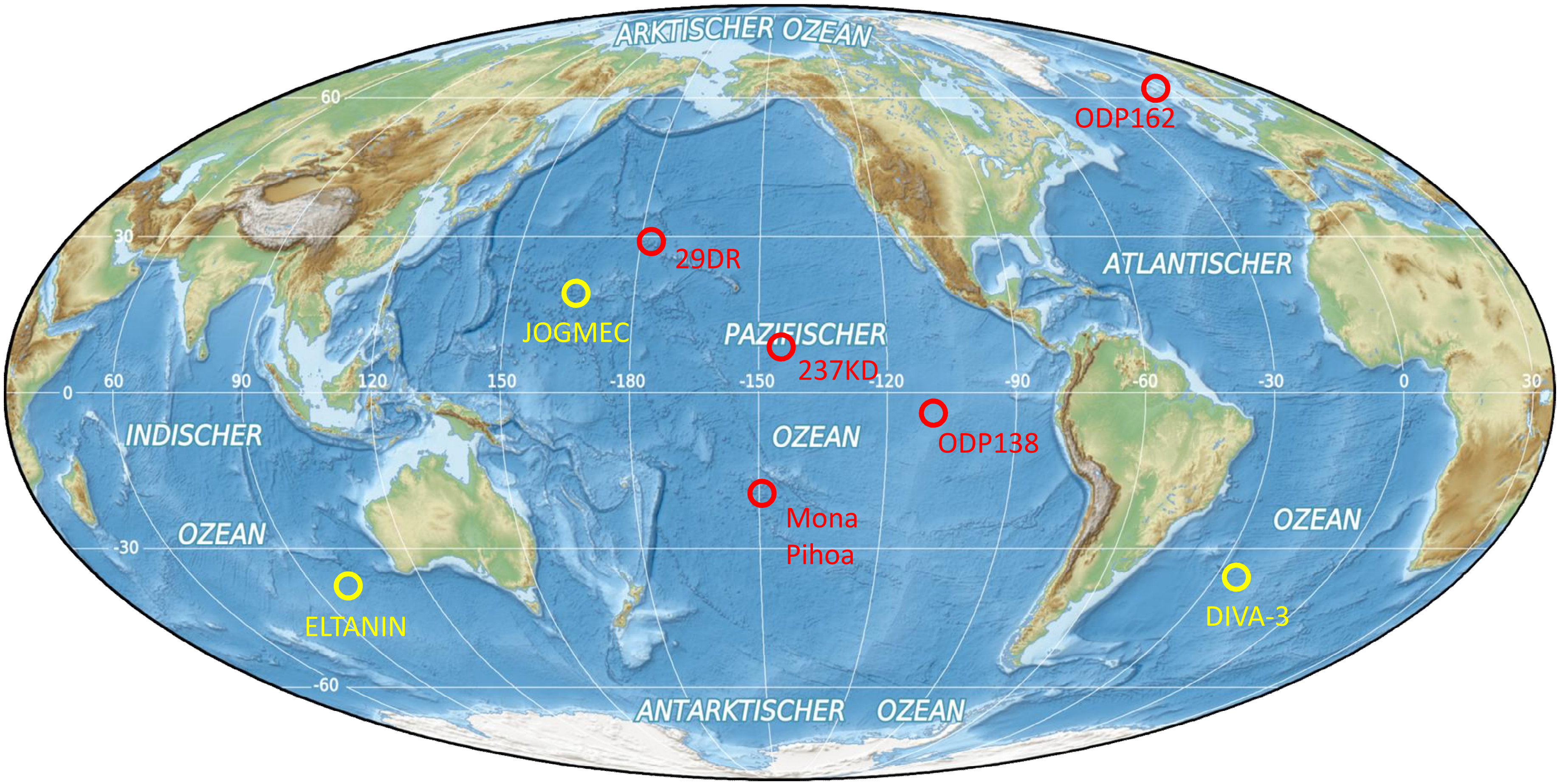
nature

and Munich?

P. Ludwig et al., 2016
Sediments
coll. with S. Bishop



Samples from Earth



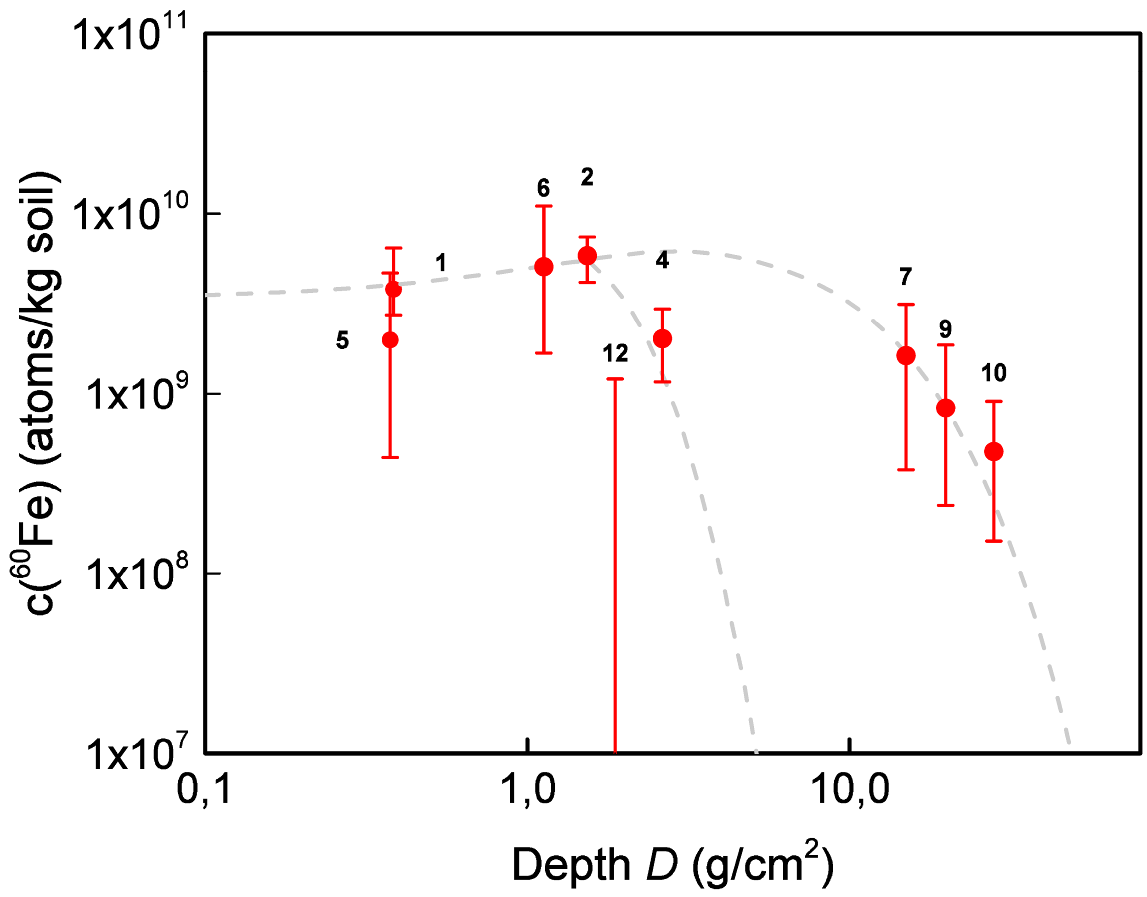
Canberra

Munich

Samples from Moon

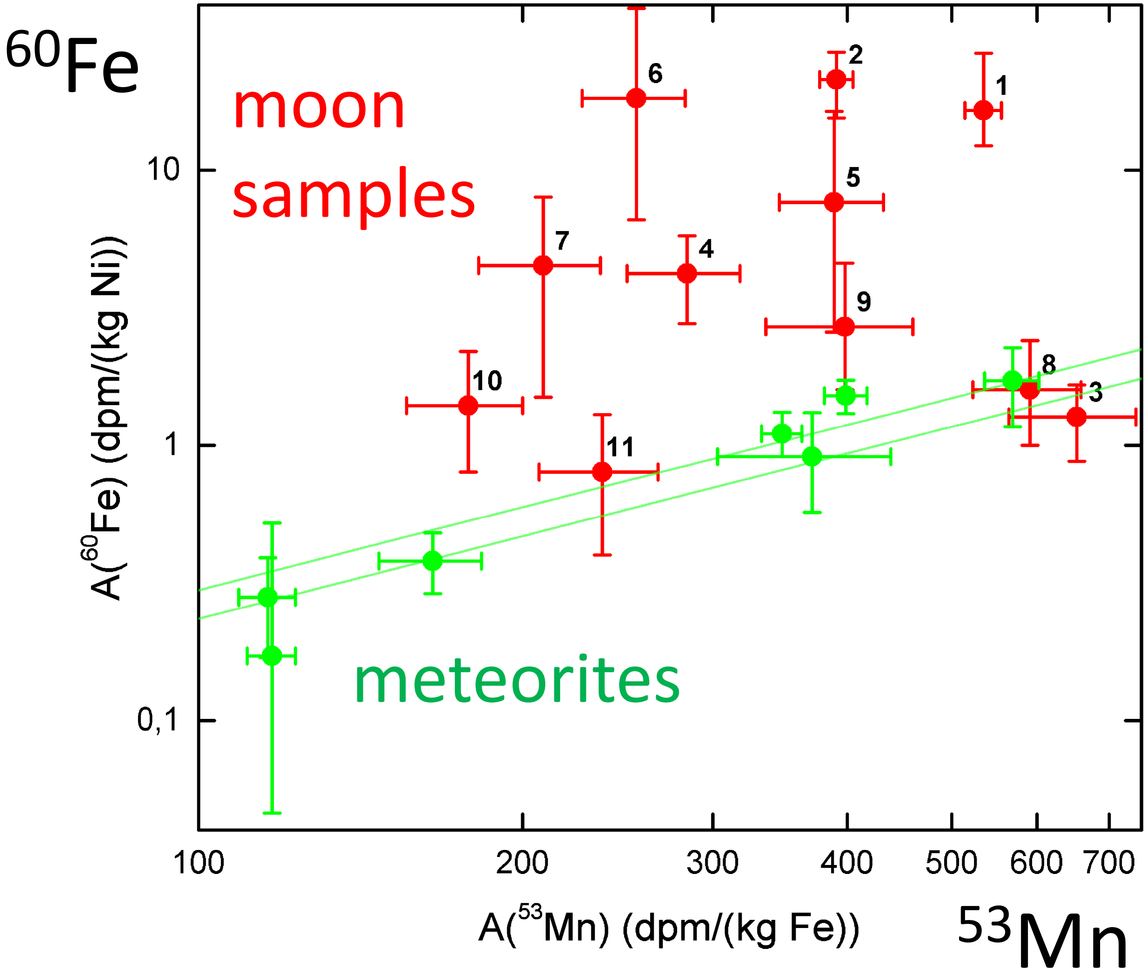
L. Fimiani et al., 2016

depth profile



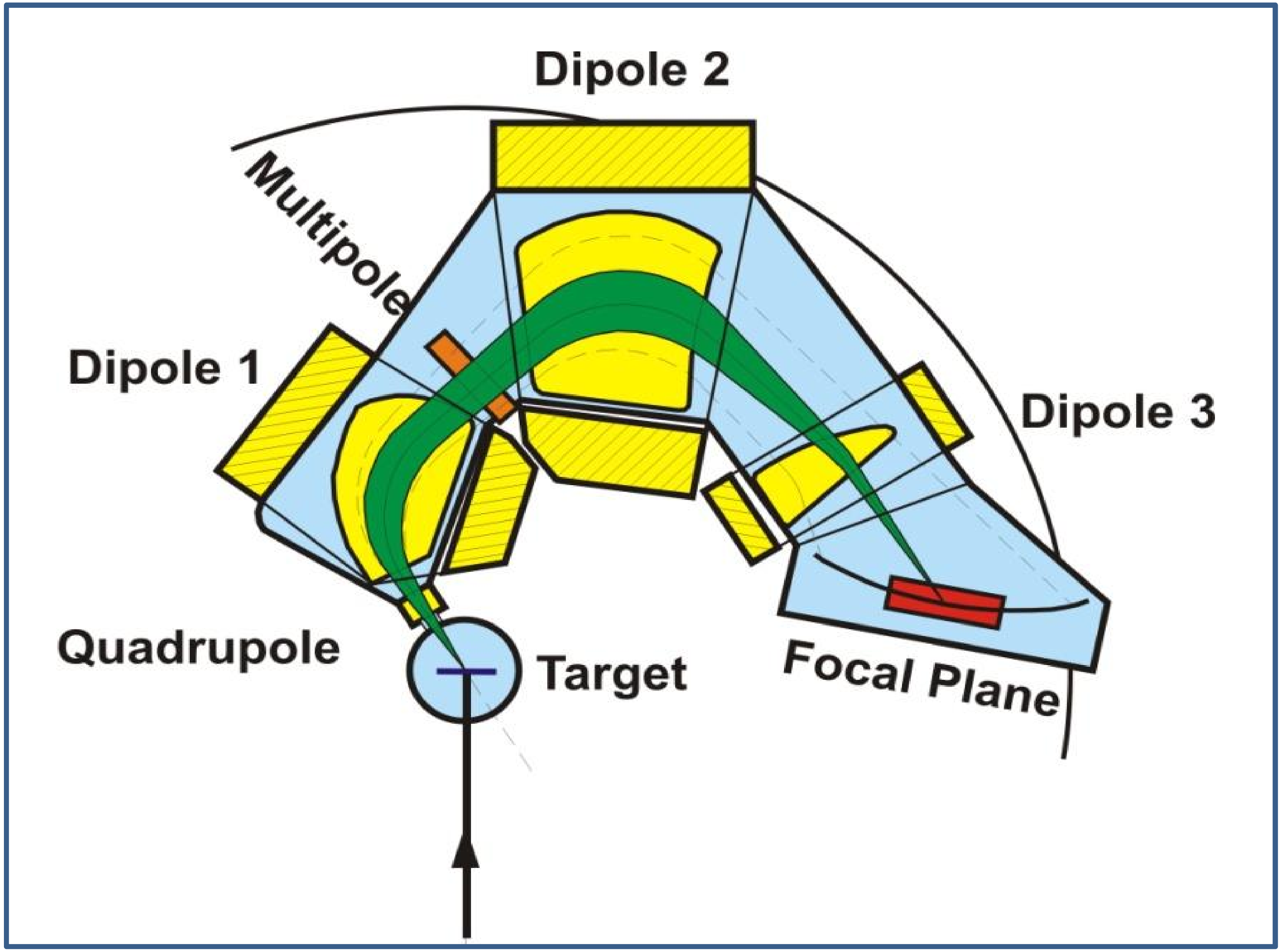
it is not from cosmics !

L. Fimiani et al., 2016



the Q3D

large solid angle, superb resolution: $\delta E/E \approx 2 \cdot 10^{-4}$



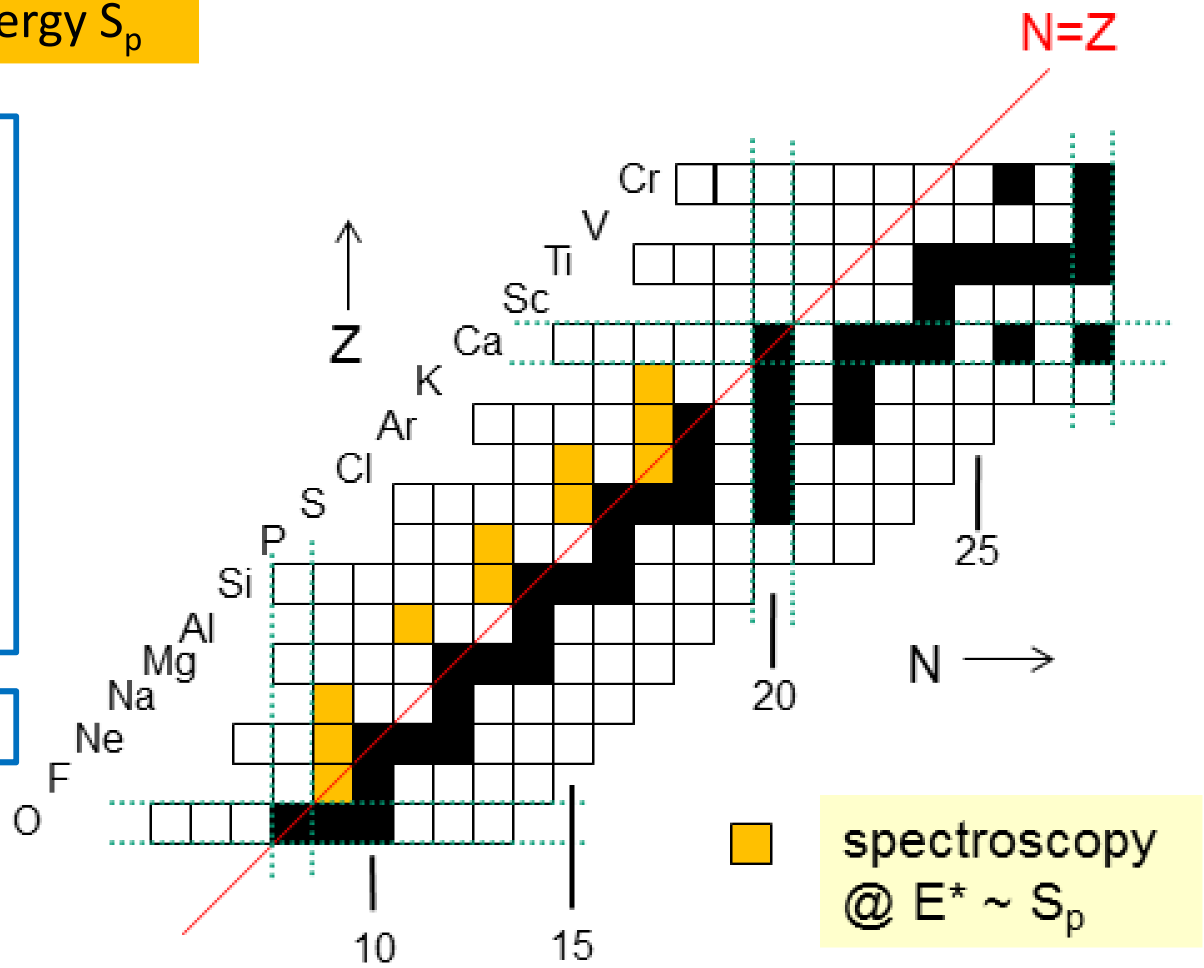
Nuclear structure for astrophysics

for modelling explosive H-burning

we need level properties
near the proton separation energy S_p

Parikh et al: *Phys. Rev. C (2009)*
Wrede et al: *Phys. Rev. C (2010)*
Parikh et al: *Phys. Rev. C (2010)*
Parikh et al: *Phys. Rev. C (2011)*
Parikh et al: *Phys. Rev. C (2011)*
Irvine et al: *Phys. Rev. C (2013)*
Laird et al: *Phys. Rev. Lett. (2013)*
Parikh et al.: *Phys. Lett. B (2014)*
Fry et al: *Phys. Rev. C (2015)*
Parikh et al: *Phys. Rev. C (2015)*

Nsangu et al: *JoP (2016)* ^{21}*Ne*



Q3D

States in ^{19}Ne at the p - threshold

Abundance of ^{18}F in Novae?

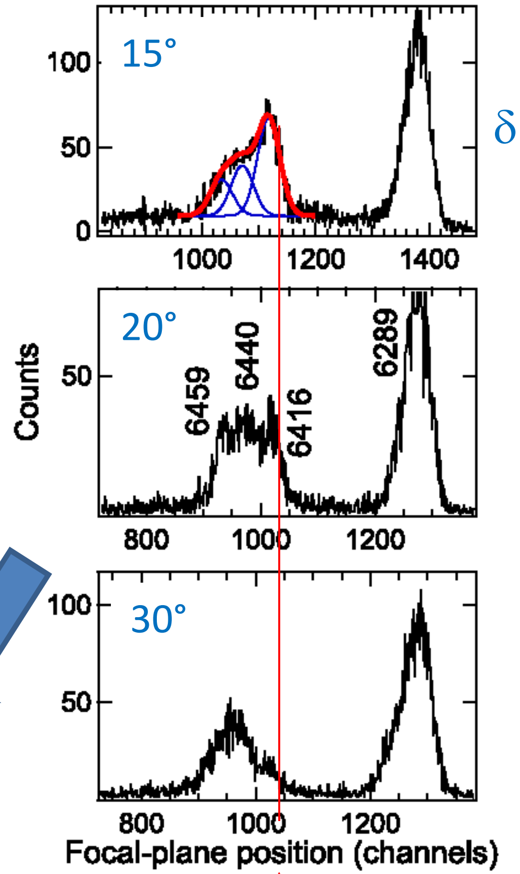
one unknown is the cross section for:

$^{18}F + p \rightarrow {}^{19}Ne^* \rightarrow {}^{15}O + \alpha$

Assumption: $3/2^+$ states just above the p-threshold have strong influence

But, none of the 3 states is compatible with $3/2^+$!!!

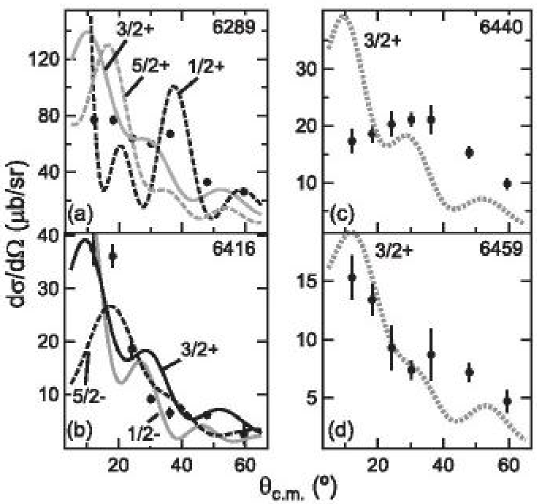
$^{19}F(^3He,t)^{19}Ne$



δE = 14keV (FWHM)

p – threshold
6410 keV

Angular distributions



Laird et al: *Phys. Rev. Lett. (2013)*

Q3D

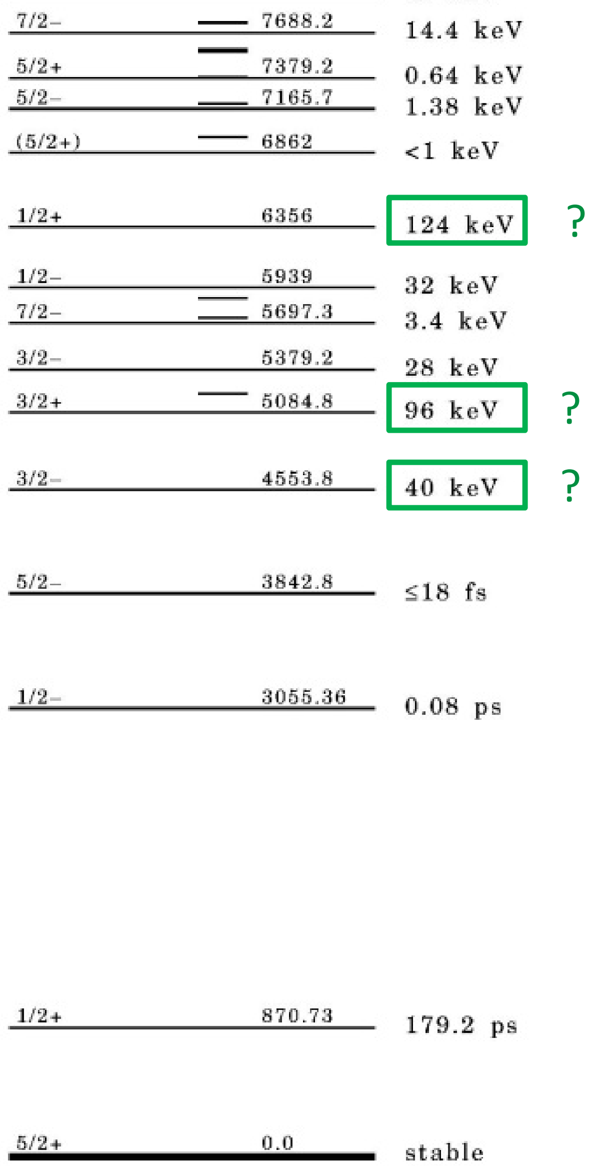
neutron sources for the s-process

$^{22}Ne(\alpha,n)^{25}Mg$
and
$^{13}C(\alpha,n)^{16}O$

n-production
6359
$^{13}C+\alpha$

thresholds

n-poison
4143
$^{16}O+n$



neutron production and destruction depend critically on the resonance energy and width of the states;
there exist quite discrepant values!

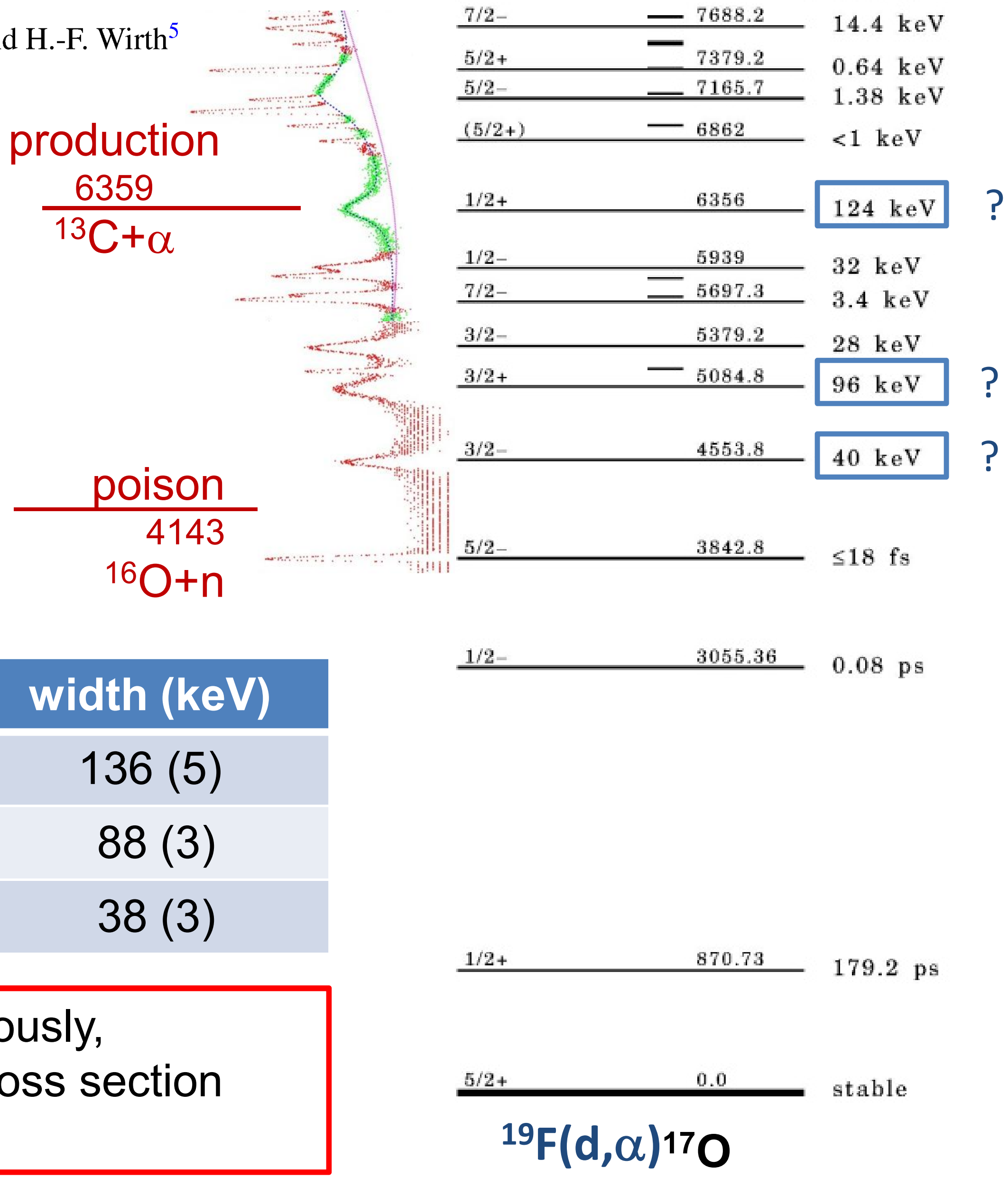
T. Faestermann, P. Mohr, R. Hertenberger, H.F. Wirth; Phys. Rev. C 92 (2015)

^{17}O

neutron sources for the s-process

T. Faestermann,[1,2,*] P. Mohr,[3,4] R. Hertenberger,[2,5] and H.-F. Wirth[5]

PHYSICAL REVIEW C **92**, 052802(R) (2015)

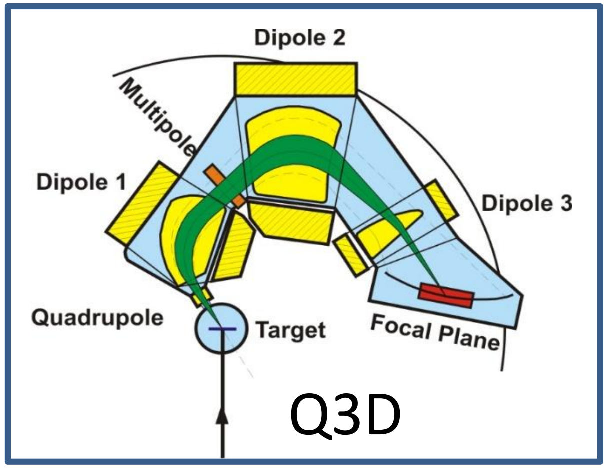


Results:

state	energy (keV)	width (keV)
$1/2^+$	6363.4 (3.1)	136 (5)
$3/2^+$	5084.8 (0.9)	88 (3)
$3/2^-$	4551.4 (0.7)	38 (3)

much more precise than previously,
allows reanalysis of indirect cross section determinations

The Q3D spectrograph at the MLL Tandem

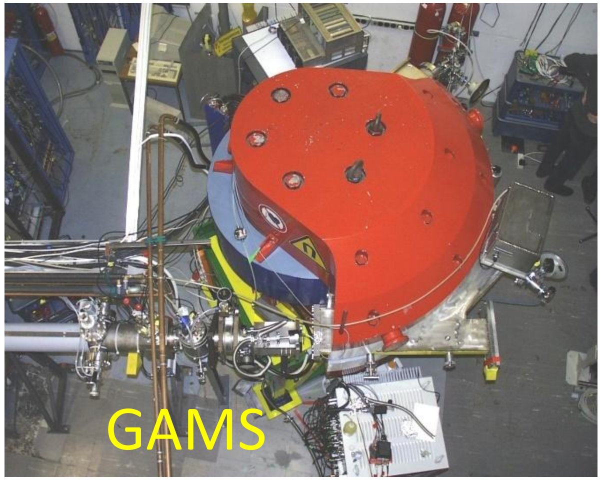


the local group:

H.-F. Wirth	CALA
R. Hertenberger	ATLAS
T. Faestermann	retired

+ many guests

AMS at the MLL Tandem



AMS group:

P. Ludwig	postdoc
G. Korschinek	retired
T. Faestermann	retired

+ master students