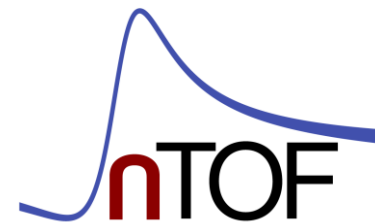


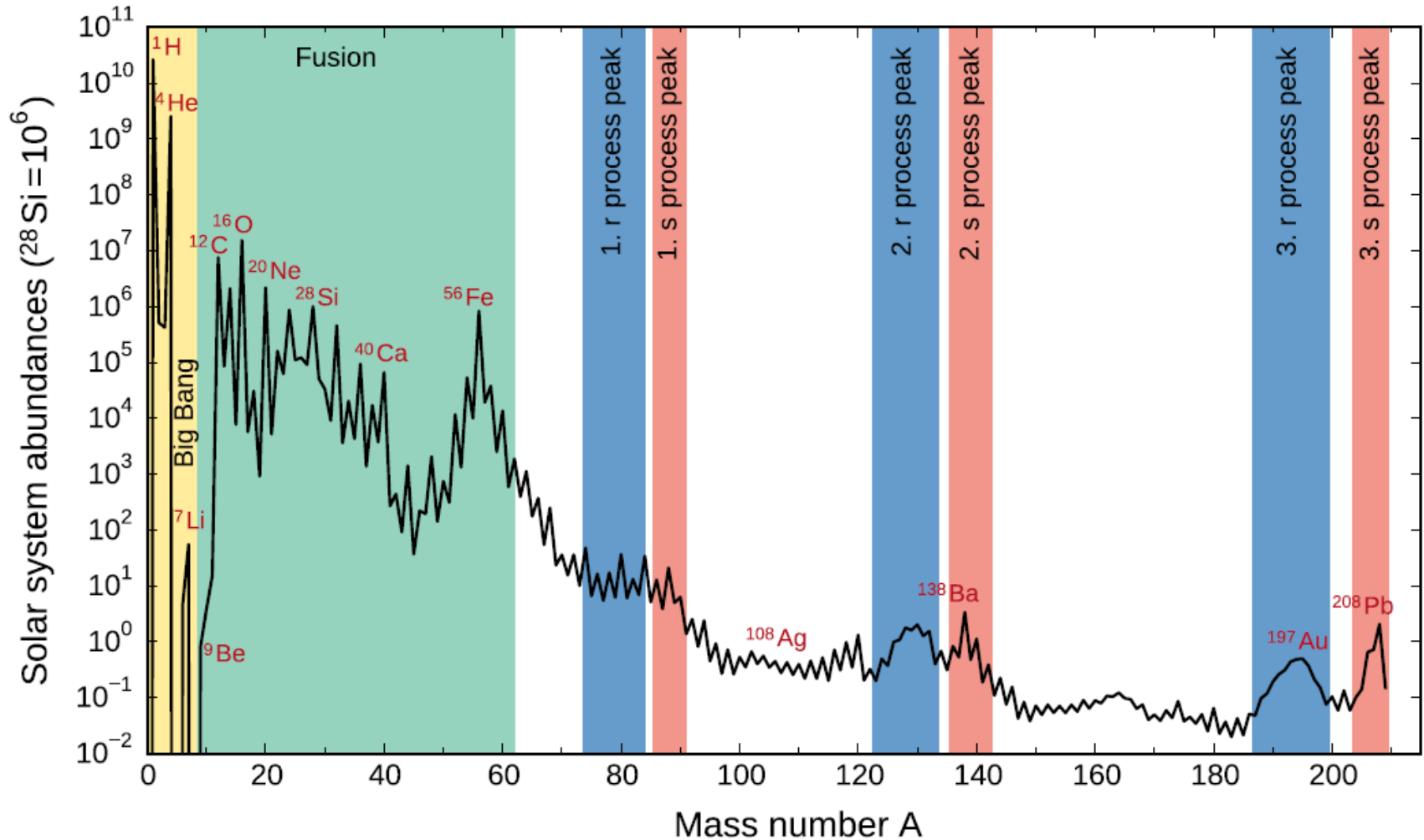
PAUL SCHERRER INSTITUT



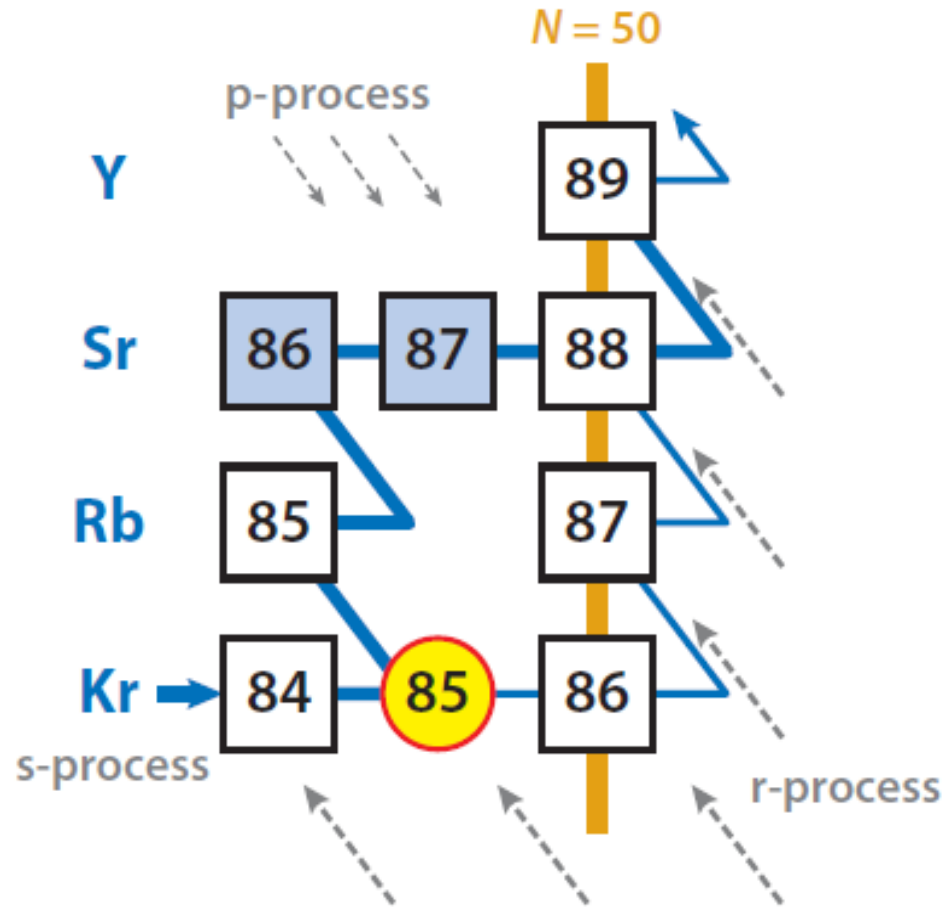
# Measurement of neutron capture cross sections at stellar energies at the n\_TOF NEAR Station

R. Dressler, E. Maugeri, D. Rochmann,  
D. Schumann, Z. Talip,  
M. Barcak, A. Manna, A. Mengoni,  
N. Patronis, E. Stamati,  
and the n\_TOF Collaboration

# Solar System Abundances

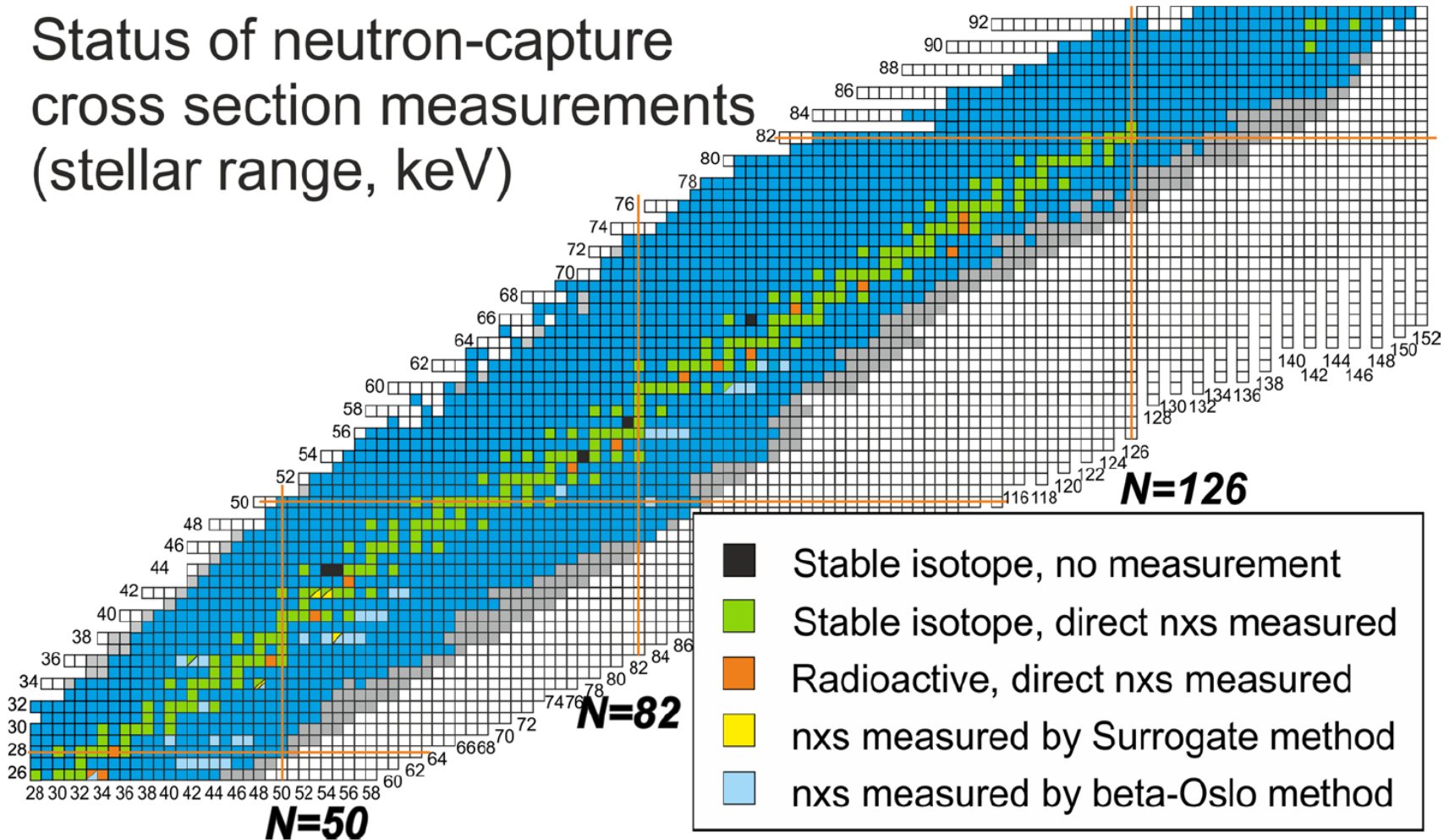


# Nucleosynthesis Mechanisms

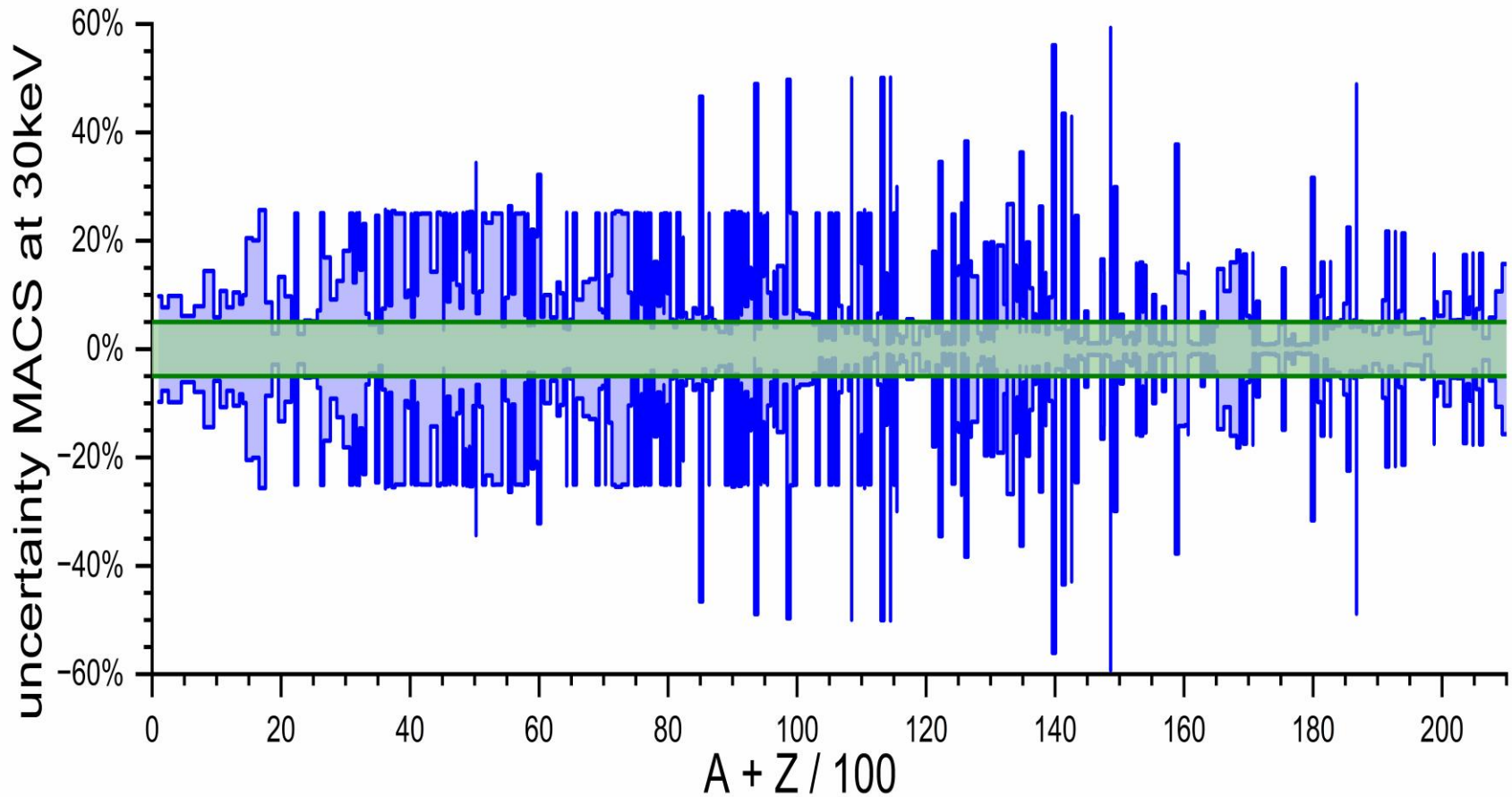


# Status MACS at KADoNiS

Status of neutron-capture cross section measurements  
(stellar range, keV)



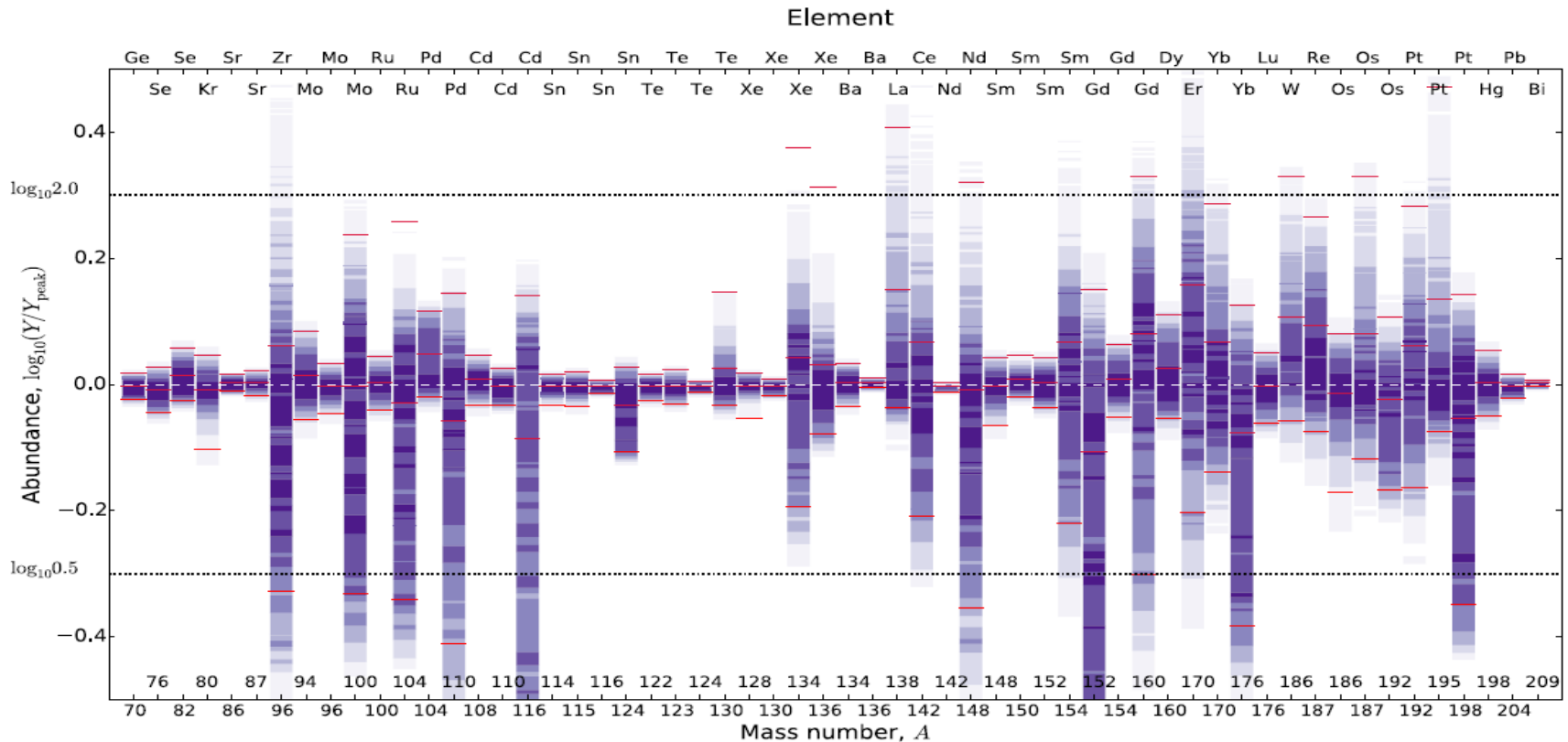
# Uncertainties of MACS in KADoNiS



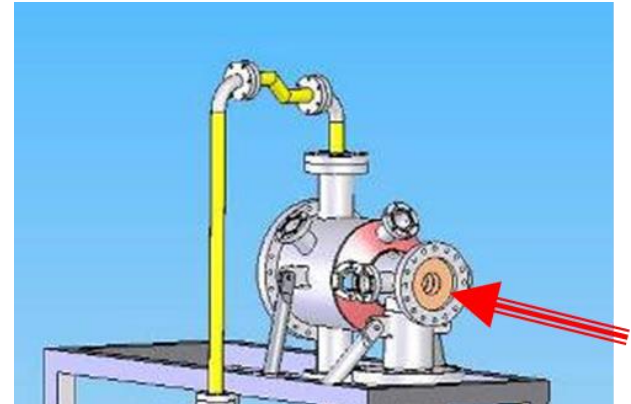
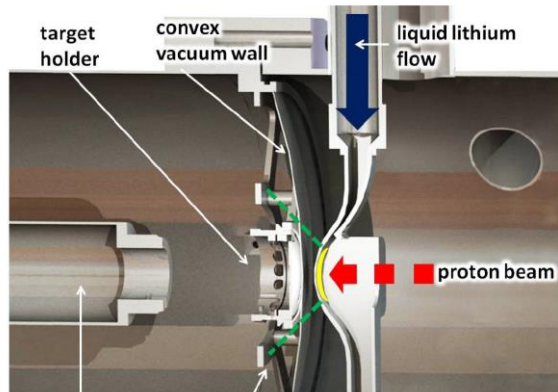
Karlsruhe Astrophysical Database of Nucleosynthesis in Stars (KADoNiS)

<https://exp-astro.physik.uni-frankfurt.de/kadonis1.0/KADoNiS> database

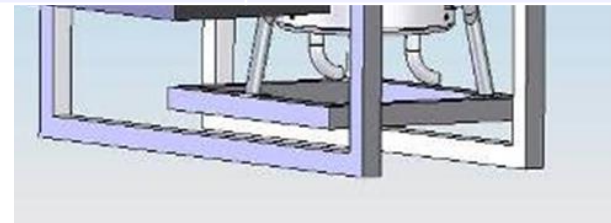
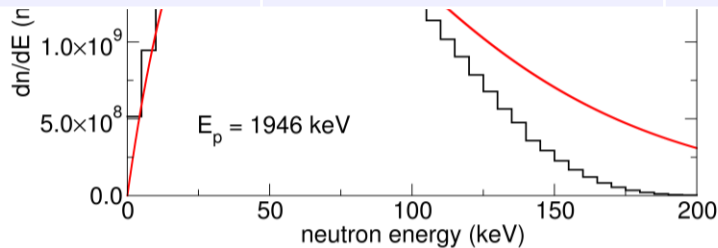
# Uncertainties in s-process Nucleosynthesis in low-mass Stars



# LiLiT Souce at SARAF (Soreq)



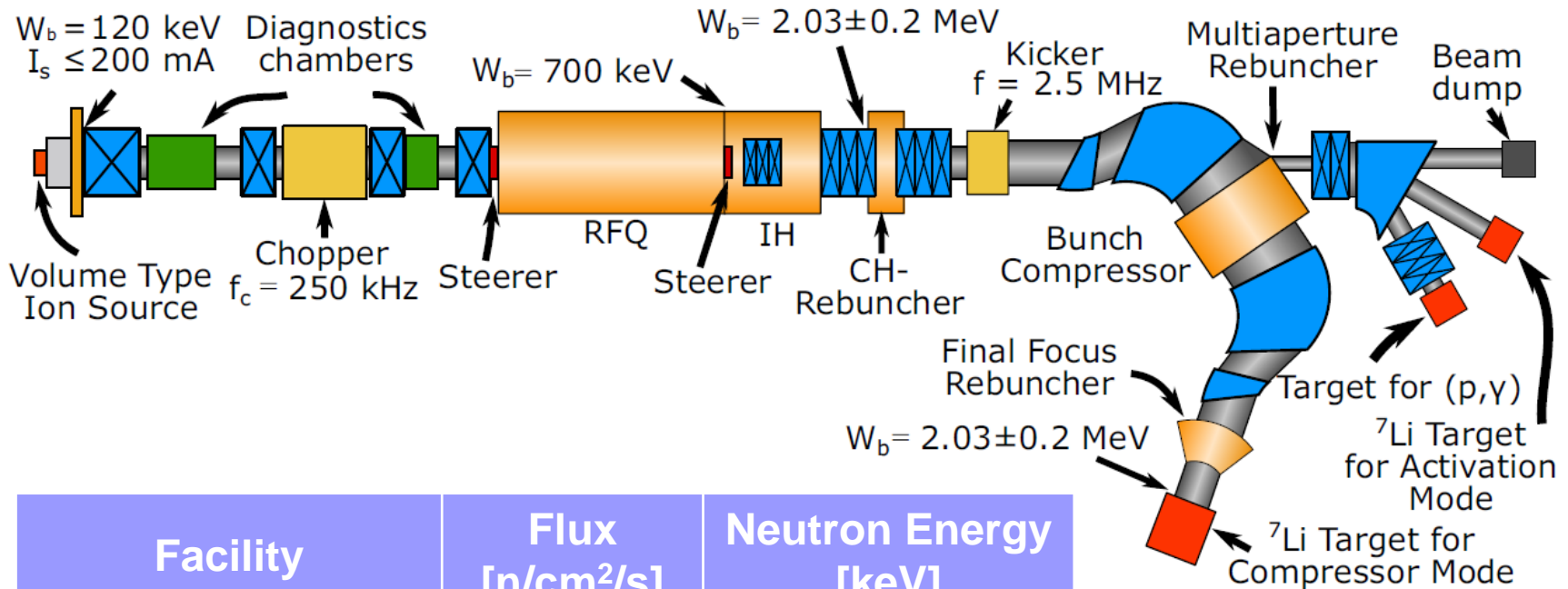
SARAF	Proton Energy [MeV]	Proton Current [mA]	Neutron Energy [MeV]
Phase-I	1.9 - 3.0	10 - 20	0 - 1
Phase-II	20 - 30	1 - 3	1 - 30



M. Friedman, et al.:  
Nucl. Instr. Methods **A 698** (2013) 117

M. Tessler, et al.:  
Phys. Lett. **B 751** (2015) 418

# Frankfurt neutron source FRANZ

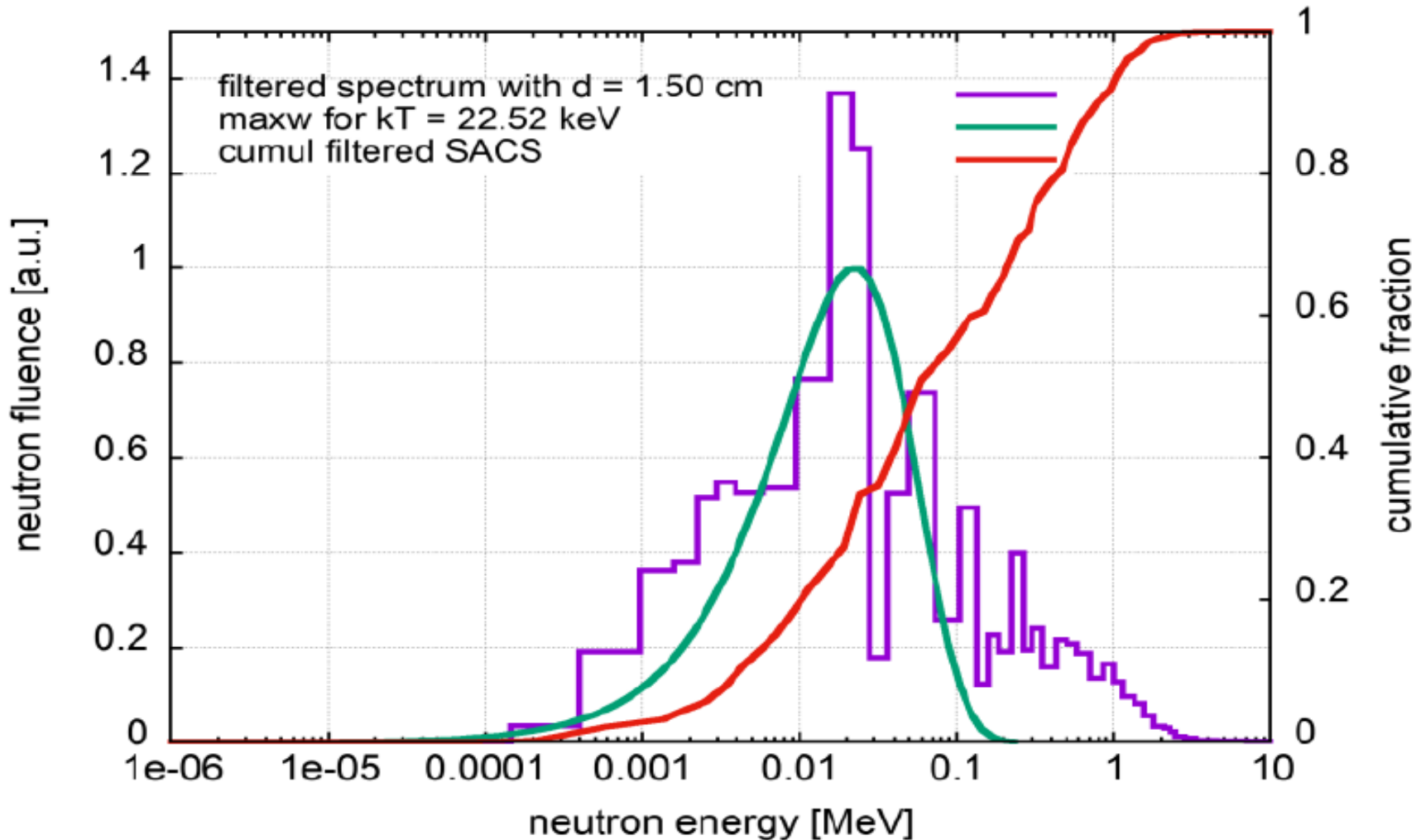


Facility	Flux [n/cm <sup>2</sup> /s]	Neutron Energy [keV]
FZ Karlsruhe	<del>1 × 10<sup>4</sup></del>	<del>0 - 200</del>
LiLiT Phase I	<del>1 × 10<sup>5</sup></del>	<del>1 - 200</del>
FRANZ design	1 × 10 <sup>7</sup>	1 - 200 (500)
a-NEAR @ n_TOF	6 × 10 <sup>7</sup> ???	0.1 - 100

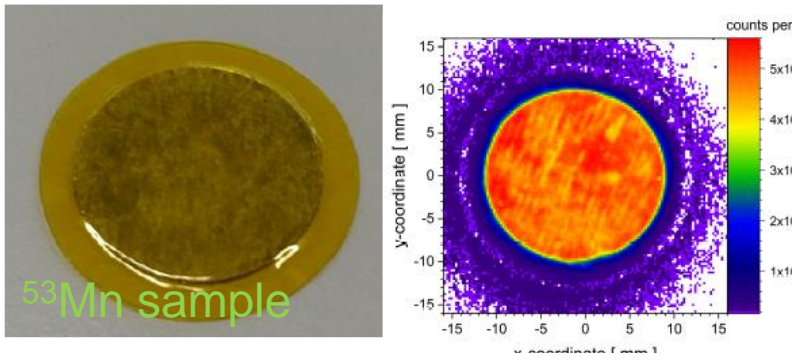


# B<sub>4</sub>C filtered neutron field at NEAR

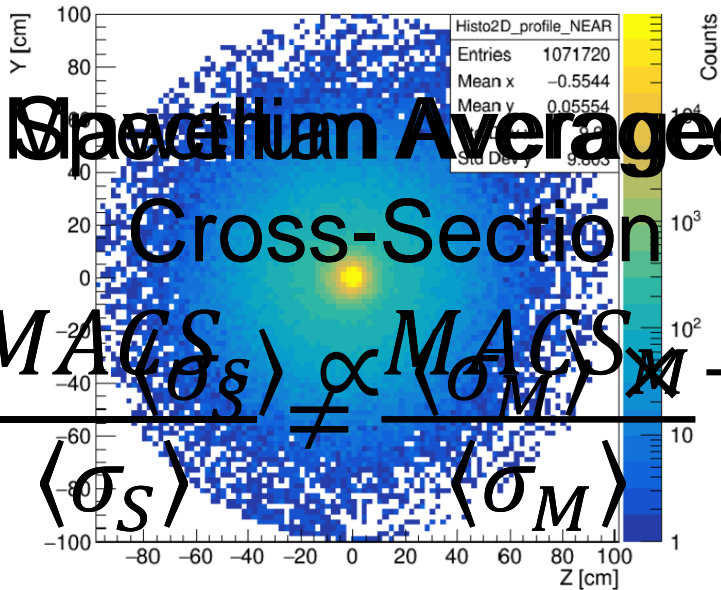
SACS for Au197 (ENDF/B-VIII.0 data)



# Experimental Procedure



ZY distribution 2D NEAR (after collimator)



**Spectrum Averaged**

**Cross-Section**

$$\frac{MACS(\sigma_S)}{\langle \sigma_S \rangle} \neq \frac{MACS(\sigma_M)}{\langle \sigma_M \rangle}$$

$$\frac{E_{OB} A_S}{E_{OB} A_M} \neq const$$



Courtesy for pictures to M.E. Stamati, A. Manna, et al.

# Intention of the Proposal to INTC

- establish and validate a procedure for measurements using moderated neutron fields at the NEAR station (continuation of the proposal INTC-P-623)
- using well-suited isotopes as potential flux monitors
- long enough half-lives of the activation products  
no influence on experiments at EAR-1 and EAR-2
- final goal determination of MACS of  $^{94}\text{Nb}$  and  $^{53}\text{Mn}$  (complementary to INTC-P-577 and INTC-P-408)
- embedded in the nuclear engineering master's program at the EPF-Lausanne and ETH-Zurich

# Envisaged Isotopes for Measurements

isotope	MACS @ 30 keV KADoNiS 1.0	half-life activ. product	expected activity per $10^{18}$ atoms and $10^{18}$ protons
$^{45}\text{Sc}$	61.5(22) mb	83.82 d	0.5 Bq
$^{146}\text{Nd}$	91.2(10) mb	10.98 d	40 Bq
$^{174}\text{Yb}$	151.0(18) mb	4.2 d	350 Bq
$^{180}\text{Hf}$	157.0(20) mb	42.39 d	85 Bq
$^{181}\text{Ta}$	766(15) mb	114.43 d	30 Bq
$^{197}\text{Au}$	613(7) mb	2.69 d	25 kBq
$^{169}\text{Tm}$	1070(65) mb	128.6 d	20 Bq
$^{53}\text{Mn}$	<i>(132 mb) estim.</i>	313 d	2.9 Bq
$^{94}\text{Nb}$	<i>(397 mb) estim.</i>	35 d	100 Bq

# Measurement of neutron capture cross sections at stellar energies at the n\_TOF NEAR Station

- All this is only feasible after installing a neutron moderator at NEAR*
- no ...
  - measurements embedded in ... program at the EPF-Lausanne and ...

Thank you for your attention!