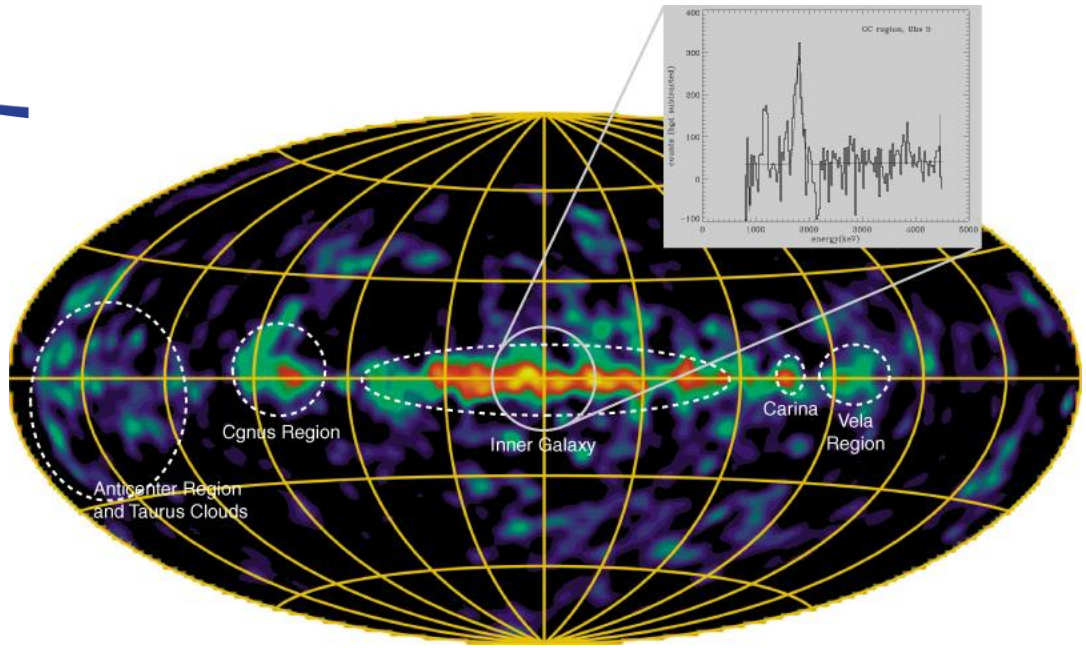


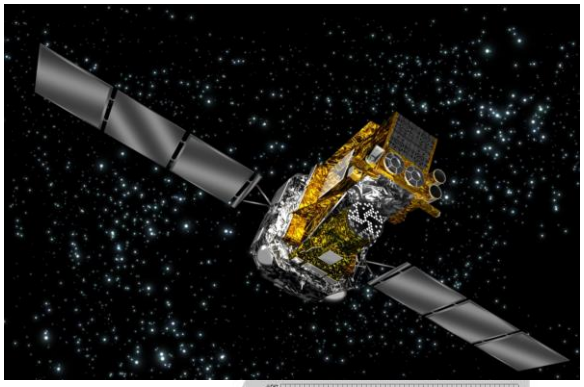
CERN-INTC-2022-035 / INTC-P-406-ADD-1

Silicon strip detector test for ^{26}Al(n, p) and ^{26}Al(n, α) measurements at neutron energies above 150 keV, relevant for ^{26}Al production in massive stars

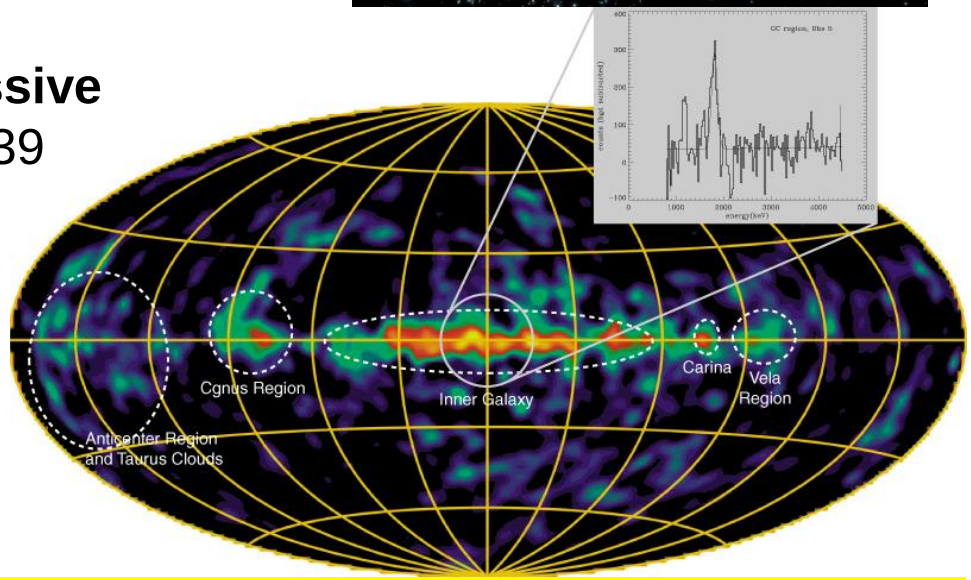
Claudia Lederer-Woods, Peter Black, Thomas Davinson, Nikolay Sosnin, Philip J Woods, and the n_TOF Collaboration

Cosmic γ-ray emitter

Galactic ^{26}Al ($T_{1/2}$~7x10^5 y) can be detected by satellite telescopes via its characteristic γ-ray emission



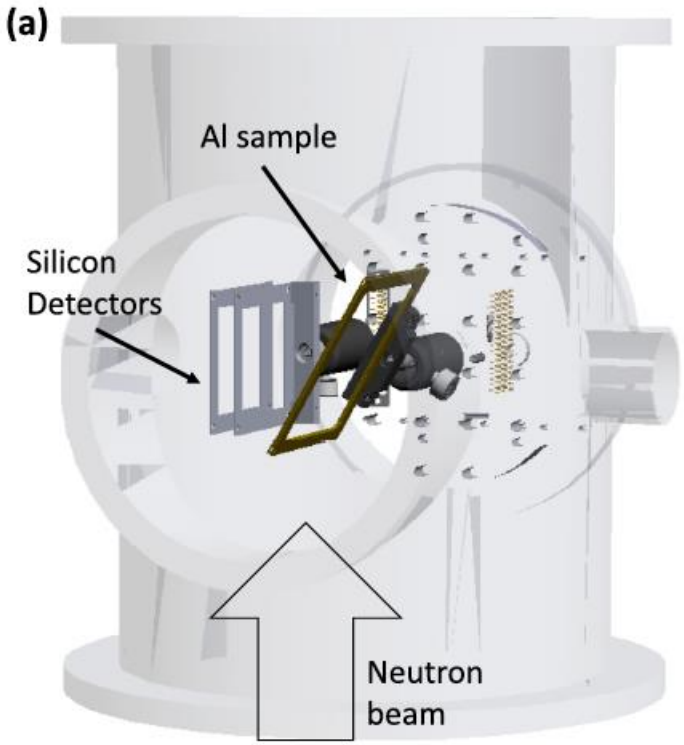
Main Origin of ^{26}Al in massive stars (Diehl et al, Nature 439 (2006))

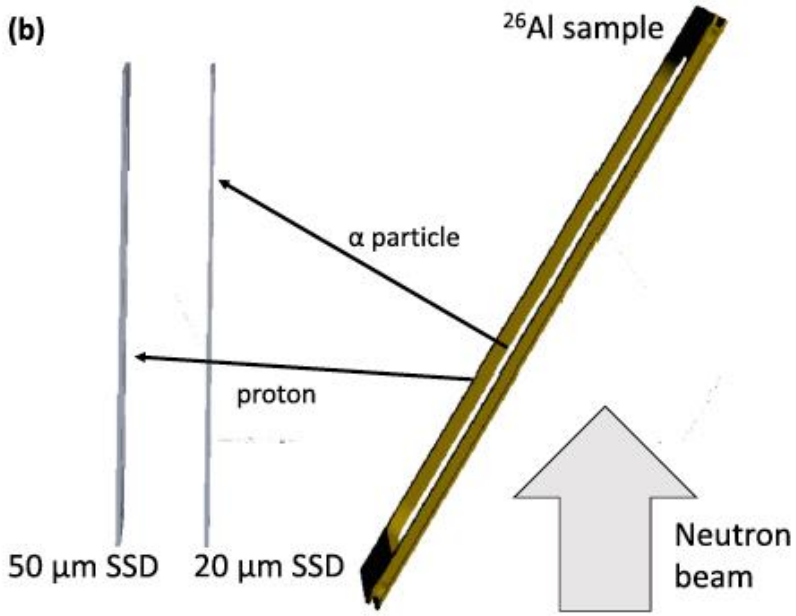


Key nuclear uncertainties for theoretical predictions of abundances: **$^{26}Al(n,p)$** and **$^{26}Al(n,\alpha)$** reaction rates [Iliadis et al., Astrophys. J. Supp. 193, 16 (2011)]

Measurement at n_TOF EAR-2

Detection setup at 2016 measurement at EAR-2

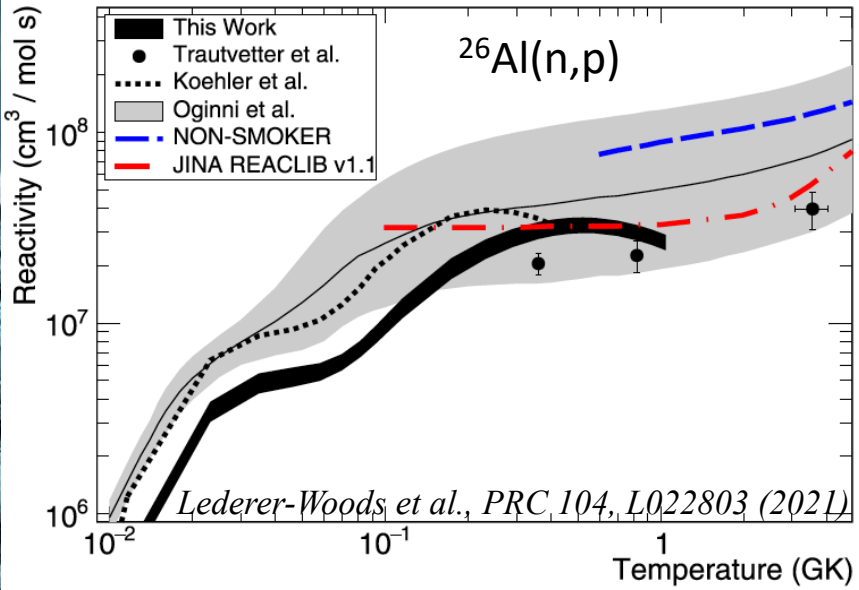




Lederer-Woods et al., PRC 104, L022803 (2021)

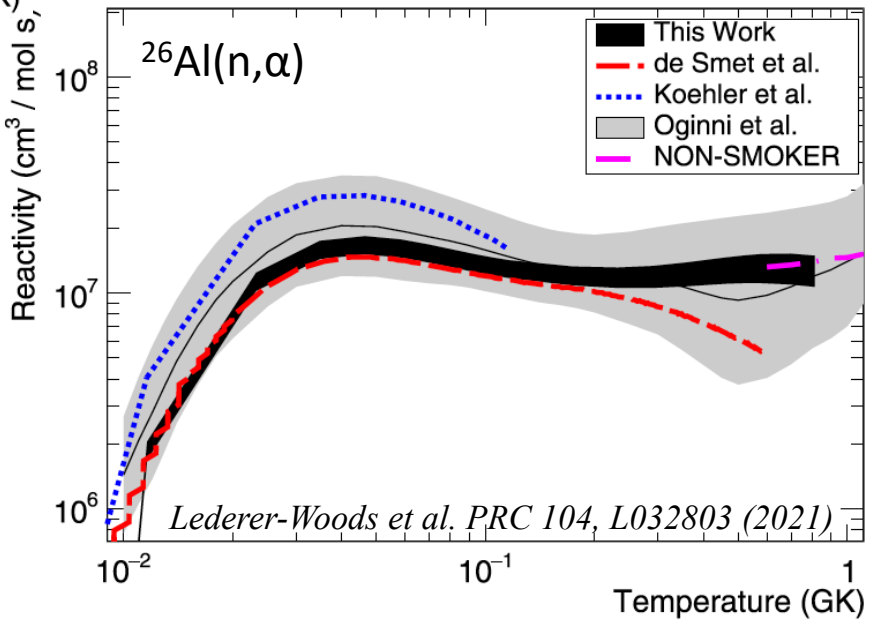
Lederer-Woods et al. PRC 104, L032803 (2021)

Stellar Reaction Rates



- Cross sections measured up to ~150 keV neutron energy, reaction rates reliable up to ~0.5 GK
- Data allow accurate predictions of ^{26}Al destruction in low mass AGB.
- Good agreement with presolar grain abundances using n_TOF data (Battino, Lederer-Woods, et al., submitted to MNRAS)

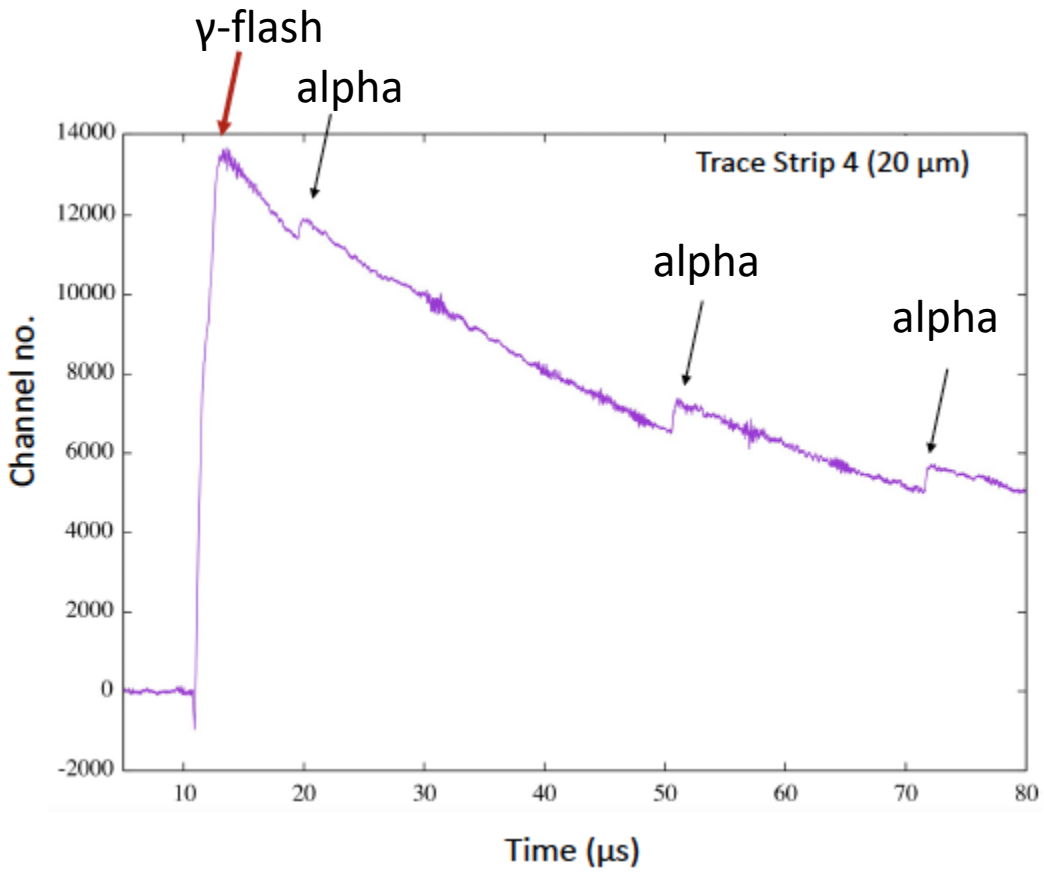
BUT: Battino et al. study found that more accurate data are still needed at high neutron energy, relevant to ^{26}Al abundances in massive stars (T~1GK)



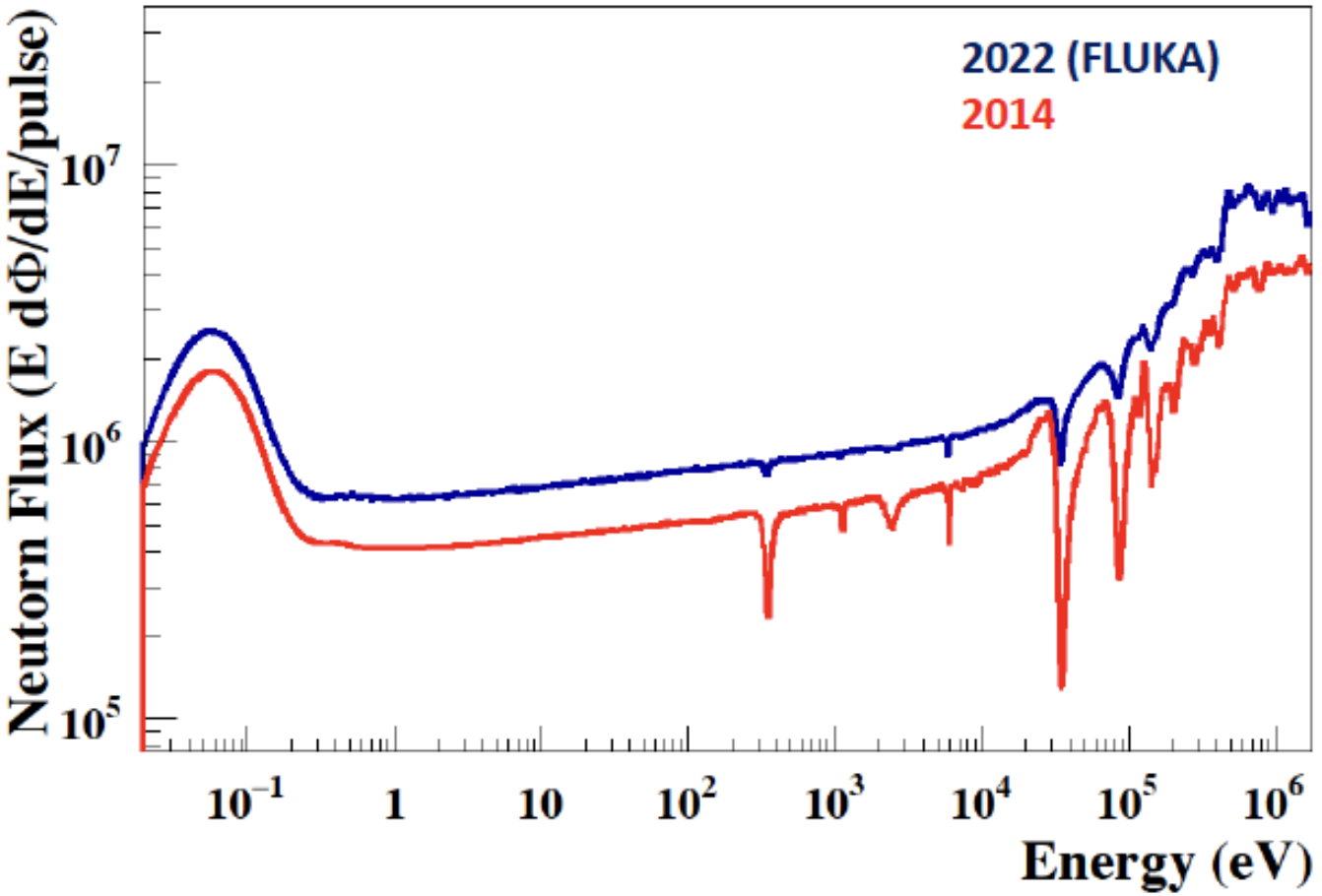
High neutron energy limit

Measurement was performed with a large neutron beam collimation. Therefore, silicon detectors were very close or even intercepting the neutron beam.

Preamplifier trace of one strip of the thin 20 µm silicon detector (thicker detector worse)



New spallation target vs old



Aims

- Neutron flux with new spallation target is higher and has less absorption dips → small beam collimation (which leads to less background from gamma-flash) makes measurement possible
- Plan: test silicon strip detectors of various thicknesses at realistic distances from the neutron beam. Measure well known reactions, i.e. ^{6}Li(n,t) and^{10}B(n,α) in addition to empty chamber.
- If energy range can be extended: submit another proposal for a new measurement at n_TOF EAR-2 in 2023.

Beam time request: 1x10^{17} protons