Precise study of the supernova reaction ^{40}Ca(α,γ)^{44}Ti by activation and in-beam γ-spectroscopy

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The radioactive nuclide ^{44}Ti is believed to be produced in the α-rich freezeout preceding supernova explosions. The γ-rays from its decay have been observed in space-based γ-observatories for the Cassiopeia A and very recently also SN 1987A supernova remnants [1]. The rates of the nuclear reactions governing the production and destruction of ^{44}Ti should therefore be known with high precision [2].

Over the last years there have been various studies of the ^{40}Ca(α,γ)^{44}Ti reaction, which is dominating the ^{44}Ti production in supernovae. Those studies have been performed using in-beam γ-spectroscopy, activation, accelerator mass spectrometry (AMS), and recoil mass spectrometry via inverse kinematics. However, there are still discrepancies in the resulting reaction rates.

Using an α-beam of 1-2 μA intensity the strengths of the strongest ^{40}Ca(α,γ)^{44}Ti resonances from 3.5 to 4.5 MeV laboratory α-energy have been studied by in-beam γ-counting and activation. The samples have been analyzed in the ultra-low-background underground γ-counting facility "Felsenkeller Dresden" (Figure 1). The target stoichiometry has been determined by nuclear reactions and by elastic recoil detection analysis (ERDA). An AMS measurement of the activated samples is in preparation.

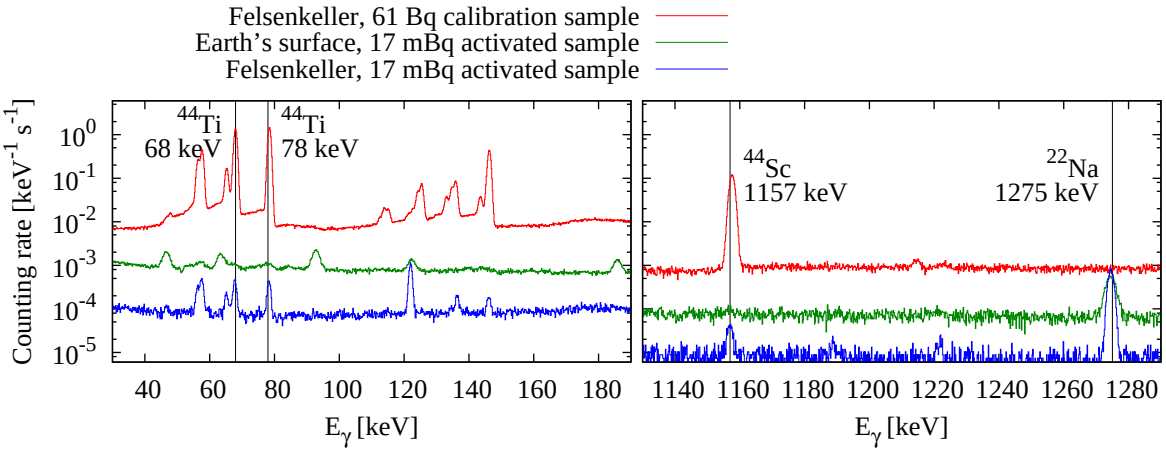

Figure 1: *Spectra of ^{44}Ti samples, measured in a low-background counting facility at the earth's surface and in the ultra-low-background facility Felsenkeller Dresden.*

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[2] L.-S. The, D. D. Clayton, R. Diehl et al., Astron. Astrophys. 450, 1037 (2006).