CROSS SECTIONS OF THE PRODUCTION OF HE, NE, AND AR ISOTOPES BY PROTON INDUCED REACTIONS ON IRON AND NICKEL

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Introduction: For proper modeling cosmogenic production rates in terrestrial and extraterrestrial matter the differential particle spectra and the excitation functions for all relevant nuclear reactions have to be known. While calculating differential particle spectra using state-of-the-art Monte Carlo codes is now very reliable, the thus calculated cross sections are accurate within a factor of 2 at best, which is far not sufficient for astrophysical and cosmochemical applications. Therefore, experimental cross sections are still essential for the study of cosmogenic nuclides in meteorites and planetary surfaces. While the cross section database for most of the target elements relevant for stony meteorites and lunar surface rocks is fairly complete by know, which directly translates into reliable model calculations [1,2], the database for Fe and Ni, which are the major elements for the study of iron meteorites, is rather scarce and scattering. In our systematic study of iron meteorites we therefore measured the excitation functions for the production of He, Ne, and Ar isotopes from Fe and Ni from the respective reaction thresholds up to 1.6 GeV. These data are currently used to establish the first set of purely physical model calculations for cosmogenic nuclides in iron meteorites.

Experimental: The cross section database is obtained from 30 irradiation experiments performed between 1993 and 1997 either using the stacked foil-technique or the mini-stack approach. The noble gas isotopic concentrations were measured either in Bern or Bordeaux using static noble gas mass spectrometry. Tritium diffusive losses during irradiation and / or storage have been corrected and new data for the $^{3}H/^{3}He$ branching ratios have been considered [3].

Results: We present consistent excitation functions for the proton-induced production of $^{3,4}He$, $^{21,22}Ne$, and $^{36,38}Ar$ from Fe and Ni from the respective reaction thresholds up to 1.6 GeV. In general our cross sections, where overlapping, reasonably agree with earlier data, e.g. [4,5]. For the production of ^{4}He our data fit well into the systematic expected for evaporation processes. Some of the ^{21}Ne data, however, are compromised by recoil effects from directly neighbored Al monitor foils. For the production of ^{38}Ar from Fe and Ni precise and consistent excitation functions are obtained. For ^{36}Ar, however, the database still (slightly) scatters, because the cross sections are rather low as most of the production on isobar 36 stops at ^{36}Cl. With our new measurements the cross section database for Fe and Ni is fairly complete by now, which enable for the first time detailed studies of cosmogenic production rates in iron meteorites.

References: [1] I. Leya et al. 2000. *MAPS* 35, 259-286. [2] I. Leya et al. 2001, *MAPS* 36, 1547-1561. [3] C.-M. Herbach et al. 2006. *Nucl. Phys.* A765, 426-463. [4] R. Michel et al. 1997. NIMB, 153-193. [5] R.H. Bieri & W. Rutsch 1962. *Compte Rendu de la Reunion de la Society Suisse de Physique* 35, 553-554.