AGU 100 FALL MEETING
Washington, D.C. | 10–14 Dec 2018

P53F-3015: Understanding the nuclear emissions from metal bodies through experiment: Preparation for the Psyche Mission to a metal world

Friday, 14 December 2018
13:40 - 18:00
Convention Ctr - Hall A-C (Poster Hall)

Gamma-ray spectroscopy can be used to determine planetary elemental compositions, providing key information for understanding planet formation and evolution. Orbital gamma-ray measurements have been collected previously from rocky or icy bodies such as Mercury, the Moon, (1) Ceres, (4) Vesta, (433) Eros, and Mars [1-6]. However, we have never visited an all-metal body. Asteroid (16) Psyche is likely dominated by iron-nickel metal [7]: as a result its bulk neutron cross section and resulting nuclear processes should be significantly different from that of the well-studied rocky bodies [8].

Historically, neutron activation measurements have been performed on samples representative of members of the entire iron meteorite library [9]. However, where many of these measurements were done using fission (2 MeV) and thermal neutrons (< 0.25 eV) produced in reactors, our experiments utilize compact neutron generators that emit up to 14.1 MeV neutrons. The nuclear interactions occurring on Psyche are expected to result in significantly higher proportions of fast (> 1 MeV) and high-energy (> 5 MeV) neutrons [8], as compared to rocky bodies. We are interested in characterizing the prompt gamma-rays that are produced from fast neutron inelastic scattering and capture reactions; the interrogating neutrons are produced by galactic cosmic ray protons. The production rates of gamma-rays are needed to calculate relative and absolute abundances of the elements that make up planetary bodies.

We will present results of our systematic experimental study of prompt gamma rays resulting from a variety of different Psyche-specific scenarios. Two meteorites, the Odessa (IAB-MG) iron sample and the Sericho pallasite sample were used in these experiments to represent core-like material and core-mantle mixture material, respectively. This research is being done in order to build an experimentally verified, comprehensive database of expected Psyche gamma-ray emissions and to have a better understanding of the data that will be collected during the mission and what these data may imply about the formation of (16) Psyche.

References: 1. Peplowski et al 2012; 2. Prettyman et al 2006; 3. Prettyman et al 2017; 4. Yamashita et al 2013; 5. Peplowski 2016; 6. Evans et al 2007; 7. Elkins-Tanton et al 2016; 8. Lawrence et al 2017; 9. Wasson et al 1960-2001.

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