GAMMA-RAY FLUXES FROM THICK TARGET IRRADIATIONS: EXPERIMENTS AND MONTE CARLO SIMULATIONS. J. Masarik[1], J. Brückner[2], R. C. Reedy[3], and P. Englert[4], [1]Department of Nuclear Physics, Komensky University, Sk-842 48 Bratislava, Slovakia, (e-mail: masarik@fmph.uniba.sk), [2]Max-Planck-Institut fuer Chemie, P.O. Box 3060, D-55020-Mainz, Germany, [3]Institute of Meteoritics, MSC03-2050, Univ. New Mexico, Albuquerque, NM 87131 USA (reedy@cybermesa.com), [4]Office of the Chancellor, Univ. Hawai'i at Ma-noa, Honolulu, HI 96822 USA.

Introduction: The surfaces of planetary bodies are bombarded by cosmic rays. The resulting interactions of the particles are the main sources of gamma rays. These γ rays, which carry information about the nucleus that emitted them, are diagnostic for the composition of the surface material and can be used as an analytical tool [1]. To evaluate the method of planetary gamma-ray spectroscopy, accelerator experiments were carried out.

Thick Target: All four thick targets consisted of three parts: a surface target for the gamma-ray emission, an inner core to stop the primary proton beam, and an iron sleeve to confine secondary particles. The total size was 1.8 x 1.6 x 1.5 m^3. The measured gamma rays originate mainly from near the surface, and therefore the thickness of the surface target was selected to be 40 cm in all four experiments. Target 1 contained basalt blocks; target 2 was made of pure iron; targets 3 and 4 consisted of similar basalt blocks as target 1 plus thin PVC inserts (chlorine, hydrogen, and carbon) and sulfur sheets. Target 3 contained additional sheets of polyethylene plastic, simulating higher water content. For all basalt targets, an inner core of pure basalt and for iron target an inner core of iron was used. More details and the spectrum measured from the iron target are in .

Simulation Method: Our numerical simulations are based on the Los Alamos LAHET Code System (LCS) [2,3], which is a system of general-purpose, continuous-energy, generalized-geometry, time-dependent, off-line-coupled Monte Carlo computer codes that treat the relevant physical processes of particle production and transport. This code system and its application to planetary problems are in more detail discussed in [4,5]. We are not concerned with scattered gamma rays, which contribute to the continuum, but only with those gamma rays that undergo no interactions before they escape from the surface. Therefore, having calculated the production of a particular gamma ray at each distance from the front surface of the thick target, we calculated the flux of gamma rays at a detector located in the front of the thick target, accounting for the attenuation of gamma ray between the location of their creation and detector position.

Conclusions: Comparison of measured and simulated intensities of gamma rays produced by the accelerator beam inside the thick targets prove that gamma-ray spectroscopy can provide accurate information on concentrations of all major and some minor rock forming elements contained in the target composition and can be applied to the study of planetary surfaces.

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