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Applying numerical simulations for estimating the spectral density of neutrons in the Martian surface after pulses of DAN irradiation by 14 MeV neutrons.

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Introduction: The Dynamic Albedo of Neutrons (DAN) onboard the Mars Curiosity rover provides measurements of the dynamic albedo of thermal and epithermal neutrons induced by a pulsing generator of fast neutrons.
The DAN instrument consists of neutron pulsing generator (DAN/PNG) electrically and logically combined with neutron detection system (DAN/DE). The major science objective of DAN instrument is to detect and provide a quantitative estimation of the hydrogen in the subsurface layer of Mars.
At the current moment, after 150 solar days on the surface on Mars, DAN has made more than 50 active measurements. Preliminary results show a high variability of neutron signal. From one point of view it could be explained by different amounts of hydrogen in single/double layer model of Martian subsurface (H depth/abundance variability). From another point of view it depends on abundance distribution of other elements with large thermal neutron cross sections, such as Cl and Fe.
In this case it is very important to know how exactly neutrons from PNG interact with soil underneath the rover. Modern calculation facilities let us model that.
Results: Numerical simulation of DAN instrument is based on MCNPX model.
Several thousands cells (cubes with 5cm size) were placed in a model with simple homogeneous layer we used in previous calculations. Total volume they covered is the cube with 6x6 meter square and 3 meter height. Neutron flux as a function of energy and time was measured in each cell, providing a dynamic picture of the moderation of neutrons in the subsurface layer.
The soil was tested with different composition of hydrogen, as moderating nuclei, and Cl and Fe, as absorbing nuclei. By using this result it is possible to estimate the DAN footprint (size of spot on top of the modelling surface which gives a 95% percent of signal); how it depends on energy and time after generator pulse.

References:
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