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The physical modeling of the MGNS experiment: the measurement relative intensity of spectral gamma-ray line generated by the neutron capture reaction

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We presents the results of the physical modeling of the Mercury Gamma-ray and Neutron Spectrometer (MGNS) experiment in part of detection of gamma-ray lines generated by the neutron capture reaction. We have described the results of an experimental study of the gamma-radiation of mono-samples, analogues of a planetary substance under the action of a thermal neutron flux. Gamma-ray line was detected by innovative scintillation crystal ermium bromide included in MGNS instrument and HPGe spectrometer.
We developed the laboratory facility with two independent gamma-ray spectrometers for measurements with mono-samples, analogues of planetary regolith. Their composition includes chemical elements, which are the main rock-forming elements of the surface of the Mercury. Based on the results of laboratory experiments, a database of reference gamma-ray lines of the main rock-forming elements was created, which can be identified with a gamma-ray spectrometer based on the CeBr3 scintillation crystal.
The numerical model of the experimental setup was created on the basis of the developed software package. This numerical model has made it possible to calculate the spectral properties of secondary gamma-ray radiation from mono-samples, analogues of planetary regolith. We have demonstrated a good correspondence between numerical calculations and experimental data. Based on this result, specialized software packages will be developed to simulate the conditions of MGNS experiment on the mapping stage. The obtained results will be used in the future for analysis and interpretation of scientific data obtained from the Mercury surface in the space experiments of the MGNS onboard ESA BepiColombo mission.