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Author: Dr. Michael Holik
Institute of Experimental and Applied Physics, Czech Technical University in Prague, Czech Republic

Dr. Robert Filgas
Czech Technical University In Prague (CTU), Czech Republic
Mr. Milan Malich
Czech Technical University In Prague (CTU), Czech Republic
Mr. Farid Ahmadov
Azerbaijan National Academy of Sciences, Azerbaijan
Dr. Gadir Ahmadov
Azerbaijan
Mr. Ondrej Urban
University of West Bohemia, Czech Republic
Mr. Ondrej Pavlas
Institute of Experimental and Applied Physics, Czech Technical University in Prague, Czech Republic
Dr. Azer Sadigov
Azerbaijan

THE HARDGAMM SPECTROMETER PAYLOAD FOR EXTRA-TERRESTRIAL SEARCHING FOR HYDROGEN PRESENCE AND OTHER CONSTITUENTS OF INTEREST APPLYING NON-INVASIVE METHOD OF CHARACTERISTIC GAMMA PHOTON DETECTION

Abstract

Neutron and γ-ray spectrometers are used in state of-the-art planetary research for studying the elemental composition of planets and small bodies of the solar system. Instead of looking for water itself, a suite of instruments will look for gamma rays emitted by hydrogen. Knowing well the energies of characteristic gamma photons allows us to recognize the presence of hydrogen or other constituents of interest. Hence, having a gamma spectrometer payload is important to analyze gamma rays and evaluate the concentrations of hydrogen from the intensities of γ-ray lines to find hydrogen-containing substances, primary water and water ice. The miniaturized electronics occupying a minor portion of a payload while maximizing an active volume filled with a sensitive element allows to achieve high efficiency for the detection of gamma-rays. The presented concept of HardGamm payload integrates a novel MAPD-3NM sensor array (of silicon photomultiplier type) based detector assembled with LaBr3(Ce), BGO and NaI scintillation materials (high-Z and light yield) the combination which already proved to be a very effective and compact size laboratory instrument in gamma spectroscopy. The total number of pixels (974 728 pixels) and high photon detection efficiency (>30%) of the novel MAPD-3NM sensor array allowed getting good energy resolution in energy range of MeVs. The adaptation into the form of HardGamm payload deals with common disadvantages of silicon photomultiplier like detectors to compensate and overcome them in order to design the spectrometer payload capable of operation in harsh conditions of extra-terrestrial mission while keeping sufficient detection performance and energetic resolution for recognition of characteristic gammas, thus to confirm presence of material constituents.