INVESTIGATION OF THE ELEMENTAL COMPOSITION OF PLANETARY SURFACES WITH HPGE GAMMA-RAY SPECTROMETERS: SCIENTIFIC AND ENGINEERING ISSUES.

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Introduction: When exposed to cosmic rays, chemical elements in soils and rocks of planetary surfaces uniquely identifiable signatures of energy in the form of gamma rays. Also elements like potassium, uranium, and thorium are naturally radioactive and give off gamma rays as they decay. A gamma ray spectrometer looks at these gamma-rays and allows one to recognize the elements by their specific energy lines and calculate their abundances based on the lines' intensities.

The most advanced type of gamma-ray spectrometers is based on high purity Germanium (HPGe) detectors. The advantage of the high-purity Germanium sensor is that the lines identifying elements are very sharp and therefore the very weak lines could be identified and separated from each other e.g. [1]. However, this type of detectors must be cryogenically cooled during the entire period of operation and they also suffer from cosmic rays [2].
In this paper we give an overview of HPGe spectrometers' design, discuss engineering challenges and their solutions, compare their scientific capabilities with those of scintillator-based spectrometers, present and discuss results of particular scientific missions.

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