**Gamma-ray spectrometer**

A spectrometer (or spectroscope) is an apparatus used to measure a spectrum i.e. a graph that shows intensity as a function of wavelength, energy, mass etc. One can choose from one of the many different kinds of spectrometers depending of course on what he/she actually wants to detect and study. In our project, we are interested in gamma-ray spectrometers.

Gamma-rays (and neutrons) are produced by the interaction of galactic cosmic rays and the surface of airless bodies (such as asteroids) and planets with thin atmospheres (e.g. Mars). Furthermore, all natural solar system materials contain long-lived radioelements (e.g., potassium, thorium, and uranium) that are an additional source of characteristic gamma-rays. By detecting them, one can determine the concentration of a number of important, rock-forming elements, including oxygen, magnesium, silicon, iron, gold and crystals like diamonds [1].

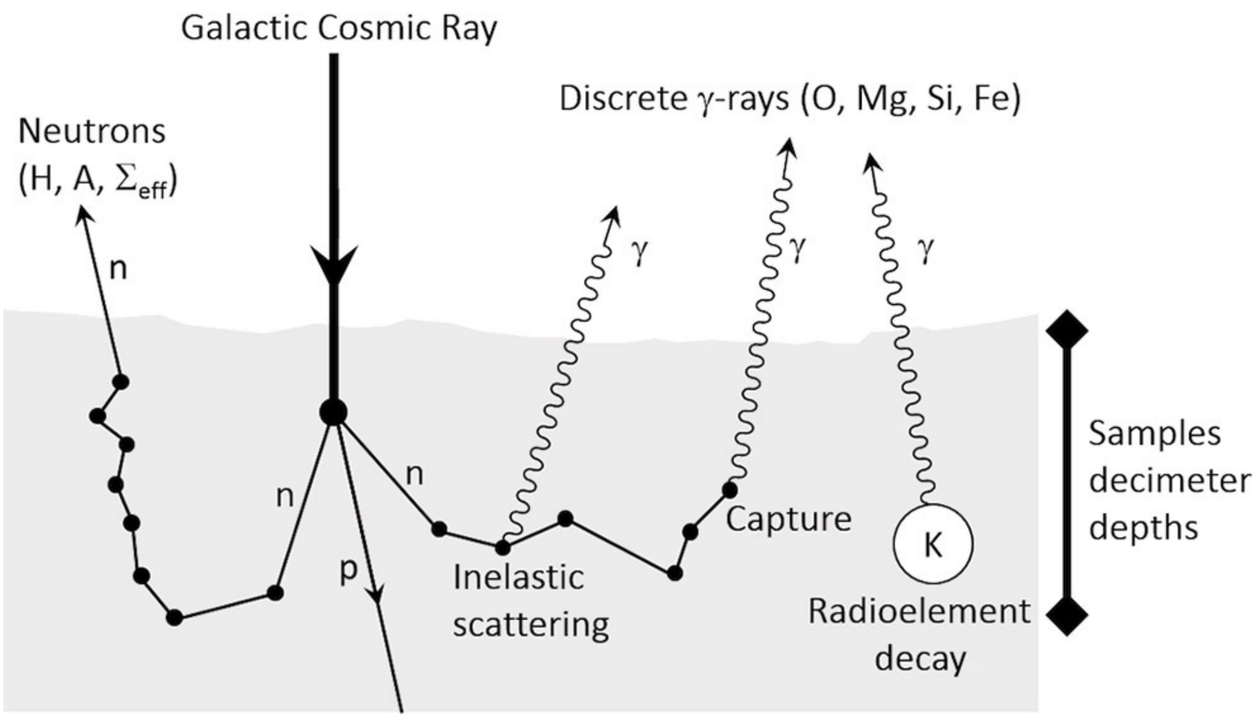


Fig. 1. Cartoon of gamma-ray production processes in the surface of planetary bodies [2].

Gamma-ray spectrometers have already been used successfully in several missions (Moon, Mars, Mercury, Venus, asteroid 4 Vesta and asteroid Eros). They have to be placed either on the surface or in a close-proximity orbit with the body of interest.

For studies that make use of gamma-ray spectrometers, gamma-ray detection efficiency has to be high and the energy resolutions sufficient to distinguish between contributions from different elements. Furthermore, the spectrometers have to be insensitive to radiation damages as well as simple, low-powered and compact.

The "gold standard" for gamma-ray spectroscopy is the high purity germanium (HPGe) detector, already used in the spectrometers flown on the Kaguya, Mars Odyssey, and MESSENGER missions. HPGe can be used to achieve very high spectral resolutions and therefore provide high levels of elemental sensitivity. This benefit however comes with the expense of complexity, cost, and bulk, which are associated with the necessary cryogenic cooling [1].

A recently discovered ultra-bright scintillator material, europium-doped strontium iodide ($SrI_2$), however seems to be more than adequate to do the job of achieving high spectral resolutions and is relatively inexpensive. It also has the advantage of being compact enough as a two-inch diameter right-circular cylinder is suitable for planetary applications. Additionally its light output is well-matched to silicon photomultipliers which are compact and do not require high voltages [2].

All the aforementioned reasons make $SrI_2$, a good choice for planetary gamma-ray instruments. However, it is still required to make extensive testing of this material to demonstrate that $SrI_2$-based instruments can survive a spaceflight. In addition, assessments of radiation-induced backgrounds in the material, as well as its susceptibility to radiation damage, still need to be conducted. If this technology stands up to these tests, it will provide a powerful new tool for gamma-ray spectroscopy. It will be possible to deploy compact, low-power instruments on CubeSats, orbiters, atmospheric probes, landers, and rovers as part of future missions to planets, **asteroids**, and comets. $SrI_2$ technology may also find uses on future manned missions, and their robotic precursors, to nearby asteroids [2].

[1] http://news.vanderbilt.edu/2015/11/new-detector-perfect-for-asteroid-mining/

[2] http://spie.org/newsroom/technical-articles/6162-ultra-bright-scintillators-for-planetary-gamma-ray-spectroscopy?highlight=x2418&ArticleID=x115974