Abstract for 11th Low Cost Planetary Missions Conference
June 9-11, 2015, Berlin, Germany

Miniature Thermopile Imager Performance for Small Body Missions

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Gamma ray spectroscopy (GRS) is an established method to determine the elemental composition of planetary surfaces and atmospheres [1-3]. Orbital missions to planets and asteroids have included gamma ray spectrometers as primary payload instruments. The compositional data has provided new information about a wide variety of geochemical and atmospheric processes. We expect that GRS will be flown on many future missions.

While GRS instrumentation for planetary science is mature, a portion of this technology has been outmoded due to the fast pace of developments in other fields. The technology gap is largest for scintillators, which fill a niche for planetary applications requiring rugged, compact, low-power, low-cost sensors operated at ambient temperature. For example, LaBr3 provides higher resolution than previously flown scintillators; however, self-activity (radiolanthanum) obscures planetary gamma ray emissions below about 3 MeV. A high-resolution scintillator capable of measuring lower energy gamma rays (e.g. from K and Th) is needed.

We are developing a GRS based on strontium-iodide (SrI2), a very bright, new scintillator [5,6]. SrI2 will provide a factor of two to four times better energy resolution than scintillators with flight heritage. Measurement of many more elements will be enabled with improved resolution, leading to improved geochemical characterization. Large, single crystals of SrI2 can be grown, simplifying implementation compared to arrays envisioned for other sensor technologies (CdZnTe) [7]. Low cost, high energy resolution, solid-state read out, absence of self-activity, and the potential for size scalability make SrI2 the best choice amongst competing scintillators such as CeBr3 and LaBr3.

Low-cost, compact, high-performance GRS instruments using SrI2 can be deployed on CubeSats, orbiters, atmospheric probes, landers and rovers in support of mission concepts outlined in the Decadal Survey. The technology can be used for Discovery missions to targets small and large in the inner and outer solar system. The proposed Pandora Discovery mission [8], plans to deploy a GRS instrument on a nanolander as a technology demonstration for in situ geochemical characterization of a selected landing site on Phobos. GRS can provide landing-site geochemical context for New Frontiers sample return missions to a comet and the lunar South Pole-Aitken basin. GRS can also obtain chemical data during flybys, in orbit and in situ for a Trojan Tour and Rendezvous mission. Including a SrI2 GRS on the Venus In Situ Explorer would significantly improve existing measurements of K/Th.

References: [1] Prettyman, T.H. (2014), in Encyclopedia of the Solar System ISBN:9780124158450. [2] Hasebe, N. et al. (2008), ASR, 42, 323. [3] Zhu, M.-H. et al. (2013), Scientific Reports, doi:10.1038/srep01611. [4] Goldsten, J. (2007), Space Sci. Rev. 131, 339. [5] Cherepy, N.J. et al. (2008), Appl. Phys.Lett. 92, 083508. [6] Prettyman, T. H. et al. (2015), 46th LPSC #2826. [6] Prettyman T.H. et al. (2011), Space Sci. Rev. 163, 371. [7] Raymond et al. (2015),