STRONTIUM-IODIDE: AN ULTRA-BRIGHT SCINTILLATOR FOR PLANETARY GAMMA-RAY SPECTROSCOPY. T. H. Prettyman[1], A. Burger[2], J. L. Lambert[3], J. Castillo-Rogez[3], N. Yamashita[1], [1]Planetary Science Institute (1700 East Fort Lowell, Suite 106, Tucson, AZ 85719, prettyman@psi.edu), [2]Fisk University, Nashville TN, [3]NASA Jet Propulsion Laboratory, California Insitute of Technology, Pasadena, CA.

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

While GRS instrumentation for planetary science is mature, developments in other fields have rendered a portion of the technology obsolete. The technology gap is largest for scintillators, which fill a vital niche for planetary applications that require rugged, compact, low-power, low-cost sensors operated at ambient-temperature. For example, $LaBr_3$ provides higher resolution than previously flown scintillators; however, self-activity (radiolanthanum) obscures planetary gamma ray emissions below about 3 MeV (see Fig. 1). A high-resolution scintillator capable of measuring lower energy gamma rays (e.g. from K and Th) is sought.

To fill the gap, we are developing a GRS based on strontium-iodide (SrI_2), a very bright, new scintillator [2]. SrI_2 will provide a factor of two to four times better energy resolution than scintillators with flight heritage (Table 1). Measurement of many more elements will be enabled with improved resolution, leading to improved geochemical characterization. Large, single crystals of SrI_2 can be grown, simplifying implementation compared to arrays envisioned for other sensor technologies (CdZnTe) [3]. Low cost, high energy resolution, solid-state read out, absence of self-activity, and the potential for size scalability make SrI_2 the best choice amongst competing scintillators (vs. $CeBr_3$ and $LaBr_3$).

We describe the development of low-cost, compact, high-performance GRS instruments, which can be deployed on CubeSats, orbiters, atmospheric probes, landers and rovers in support of mission concepts outlined in the Decadal Survey. The technology will be used for Discovery missions to targets small and large in the inner and outer solar system. GRS can provide landing-site geochemical context for New Frontiers sample return missions to a comet and the lunar South Pole-Aitken basin. Including the GRS on the Venus In Situ Explorer would significantly improve measurements of K/Th, poorly constrained by Venera.

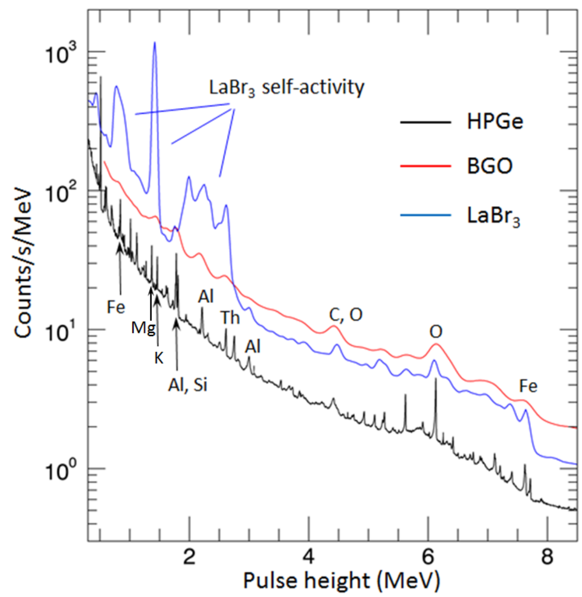

Fig. 1. Comparison of whole Moon gamma ray spectra acquired by Lunar Prospector (BGO, red), Kaguya (HPGe, black), and Change'E-2 ($LaBr_3$, blue) [1].

Table 1. Comparison of selected gamma ray sensor materials for planetary science applications.

Material	Resolution*	Advantages & Limitations	Flight Heritage?
HPGe	0.2-0.6%	Cryogenic cooling	Yes
NaI(Tl)	7-8%	Low resolution	Yes
BGO	9-10%	High efficiecny; low resolution	Yes
$LaBr_3$(Ce)	2.8-3.2%	Self-activity, requires PMT readout	Yes
$CeBr_3$	4%-4.5%	Requires PMT readout	No
SrI_2(Eu)	2.8-3.2%	Amenable to silicon photodetector readout and digital processing	No

*Full-at-half-maximum at 662 keV.

References: [1] Prettyman T. H. (2014), in Encyclopedia of the Solar System ISBN:9780124158450. [2] Cherepy, N. J. et al. (2008), *App. Phys. Lett.*, **92**, 083508. [3] Prettyman T.H. et al. (2011), *Space Sci. Rev.*, *163*, 371-459.