PlanetVac: Sample Acquisition and Delivery System for Instruments and Sample Return.

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Introduction: PlanetVac is a revolutionary technology for acquiring and transferring regolith from the lunar surface to instruments (for in situ analysis) or sample returned container (for sample return missions) [1].

PlanetVac uses robust and dust tolerant pneumatic approach, similar to traditional pneumatic based powder delivery technologies used on earth. The main difference is the sources of gas: PlanetVac uses a standalone gas canister to provide working fluid.

As illustrated by numerous surface missions (Viking, Mars Phoenix, MSL Curiosity, Venera, Luna etc.) sample acquisition and delivery is one of the most difficult aspects of the mission. In fact, several missions (e.g. Venera) did not meet their scientific goals because of sample delivery system failure, while other missions (e.g. Phoenix) had not utilized the entire instrument suite because of difficulty in sample delivery.

The technology has been demonstrated on reduced gravity flights at lunar gravity and vacuum. The technology has been demonstrated in delivering samples (fines as well as rocklets) to various instrument cups [3]. The technology has also been demonstrated on actual lander: Masten Xombie during tests in Mojave, CA [2].

PlanetVac spacecraft accommodation: PlanetVac, in the base scenario, is attached to a footpad (or footpads if more than one PlanetVac is used) of a lander and is connected to instruments or sample return containers via a pneumatic transfer hose. Hence the exact location of the instruments and sample container is irrelevant since the transfer hose can be routed around other systems. The sample is acquired within seconds, with virtually no power. The only command is a signal to open gas valve connected to a tank.

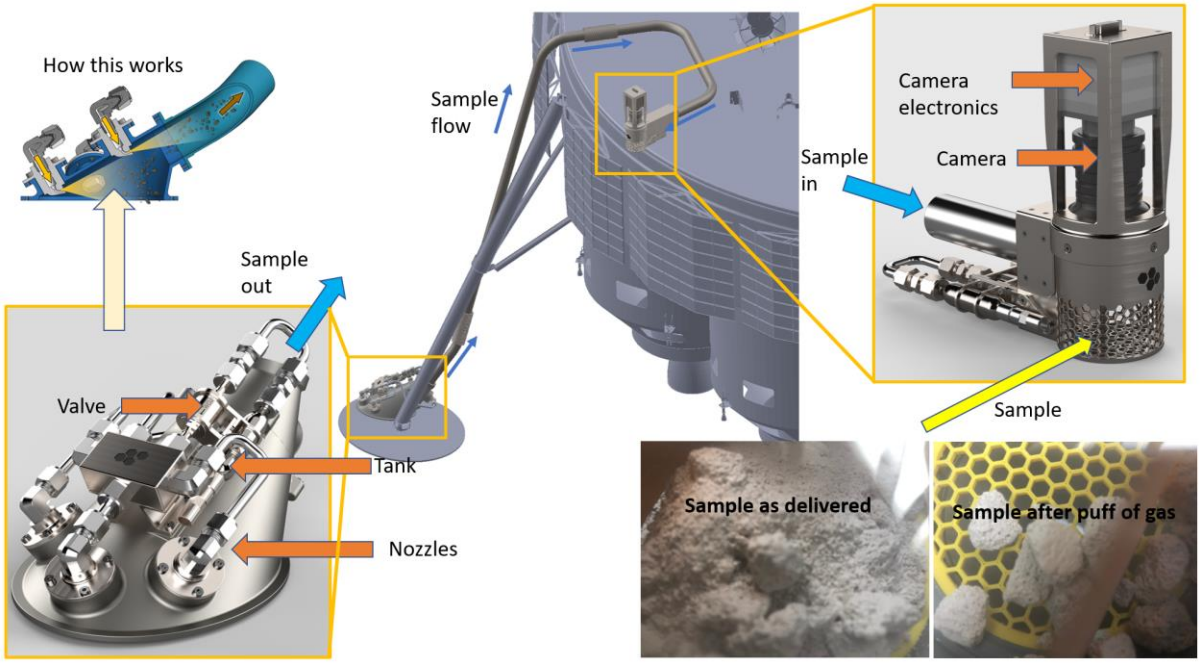

Figure 1. PlanetVac pneumatic sample delivery.

LISTP: For LSITP, PlanetVac will deliver lunar regolith and demonstrate sieving of the lunar regolith in the sample return container (Figure 1). The regolith will be split into fines and rocklets. Sample delivery verification will be done with a camera.

Acknowledgments. The funding for this work has been provided by the NASA SBIR, SpaceTech REDDI and The Planetary Society.

References. [1] Zacny et al., (2014), PlanetVac: Pneumatic Regolith Sampling System, IEEE Aerospace Conference, 3-7 March 2014, Big Sky MT, [2] Spring et al., (2019), PlanetVac Xodiac: Lander Foot Pad Integrated Planetary Sampling System, IEEE Aerospace Conf., [3] Zacny et al., (2019), Application of Pneumatics in Delivering Samples to Instruments on Planetary Missions, IEEE Aerospace Conf., 2-9 March 2019, Big Sky, MT.