1- Agency Programs and Plans for Future Low-Cost Planetary Missions
2- Latest Science Results from Ongoing Missions
3- Missions Currently Under Development for Launch in the Near Future
4- Science Instruments Enabling the Next Generation of Low-Cost Planetary
    Exploration
5- Advanced Concepts for the Next Generation of Low-Cost Missions, Including
    CubeSats, NanoSats and others
6- Access to deep space, launch solutions, use of commercial services in support to
    planetary exploration such as transportation, navigation and communication

Innovative ground motion sensors for planets and asteroids: PIONEERS H2020-SPACE European project

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ABSTRACT

Planetary seismology is a key technique to image the internal structure of planetary objects. It targets fundamental science objectives from the formation of planetary systems to the characterization of habitable worlds. PIONEERS is a H2020 granted project starting from January 2019. It is aimed at entering a new realm of planetary exploration with an innovative ground motion instrumentation concept relying on high precision sensors based on optical interferometry, and on 6 degrees of freedom (6 DoF, with 3 translations and 3 rotations) measurements. It will provide substantially more precise science return compared to usual seismometers. Only recently emerging for terrestrial applications, 6 DoF measurements target fundamental planetary science

objectives, from the formation of planetary systems to the characterization of habitable worlds, supporting also planetary defence and asteroid resources applications.

The PIONEERS project will develop two 6 DoF instruments for measuring ground deformations of planetary objects. The first instrument is a very low noise 6-DoF engineering model dedicated to imaging the internal structure of terrestrial planets. The second one is a high TRL, reduced scale version of the same instrument dedicated to the exploration of small bodies, in order to support planetary defence and asteroid resources applications.

Instruments will be designed based on scientific requirements, and re-using planetary seismology expertise and space qualified, high performance optical technologies provided by the PIONEERS partners. The science case of 6 DoF planetary exploration will be demonstrated through simulations, application of innovative data analysis methods, and testing in Earth analogue and laboratory environments. An improvement of instrument noise of two orders of magnitude is expected for the planetary prototype by using optical sensing technologies. Cost optimization and adaptation to CubeSat standards will drive other technological developments that will open new markets for high precision scientific instrumentation. The PIONEER project initial specification and performance analysis will be presented.

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