25th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

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HERMES: CUBESATS CONSTELLATION ENABLING MULTI-MESSENGER ASTROPHYSICS

Abstract

The first Gravitational Wave (GW170817) direct detection in 2017 marked the beginning of the multi-messenger astrophysics, in which new observations of Gravitational Waves (GW) added up to traditional electromagnetic observations from the very same astrophysical source. The nearly simultaneous detection of a GW signal from merging Neutron Stars (NS) detected by the Advanced LIGO/Virgo and of a short Gamma-Ray Burst (GRB) detected by the Fermi and INTEGRAL satellites, proved that short GRBs are due to merging NSs, hypothesized since about thirty years. Further, emission in the IR, UV and X bands were also captured. The X/Gamma transients are indeed possible GW events valuable markers: in fact, while optical and near infrared transients may be very large in number, X-ray transients are limited. X-ray transients monitoring, therefore, is the keystone capability to support the 2020 interferometers new generation which will search for events in a sky volume 100 times larger than in the GW170817 case. HERMES (High Energy Rapid Modular Ensemble of Satellites) is a mission concept, to detect and characterize X-ray transients with global sky coverage, high-duty cycle, accurate event localization capabilities and timely communication of the event to users. These requirements led to design a space segment composed by tens of identical satellites: multiple space segments ensure the requested continuous sky monitoring and the precise event localization through triangulation; timely on ground event data transmission is ensured by a distributed ground segment as well. To further ensure the sky monitoring service to be operational in a short time, the time gap between the first and the last unit in orbit insertion must be limited, constraining the launch number to units per launch ratio to be low: therefore, HERMES

mission is addressed through nano-platforms to get the operational feasibility. HERMES mission concept is forerun by its precursor mission, HERMES Pathfinder, funded by Italian Ministry of Research and University (MIUR). This paper presents the ongoing work to get the HERMES Pathfinder ready to launch early 2020: the Italian Space Agency leads the consortium composed by the National Institute of Astrophysics, to develop the payload, Università di Cagliari to lead the scientific investigation and Politecnico di Milano to provide the cubesats service modules. The new miniaturized detector design, the overall mission and platform design and MAIT activities are reported. Solutions adopted at both HW and SW level to ensure the required detection and localisation performance are also highlighted.