

LIMADOU-CSES

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CSES (China Seismo-Electromagnetic Satellite) is a scientific space mission dedicated to monitoring electromagnetic field and waves, plasma and particle perturbations of the atmosphere, ionosphere and magnetosphere induced by natural sources and anthropogenic emitters and to study their correlations with the occurrence of seismic events. More in general, CSES mission investigates the structure and the dynamics of the topside ionosphere, the coupling mechanisms with the lower and higher plasma layers and the temporal variations of the geomagnetic field, in quiet and disturbed conditions. Data collected by the mission will also allow studying solar-terrestrial interactions and phenomena of solar physics, namely Coronal Mass Ejections (CMEs), solar flares and cosmic ray solar modulation. The satellite mission is part of a collaboration program between the China National Space Administration (CNSA) and the Italian Space Agency (ASI), and developed by China Earthquake Administration (CEA) and INFN, together with several Chinese and Italian Universities and research Institutes. Italy participates to the CSES mission with the LIMADOU project funded by ASI in collaboration with the Universities of Roma Tor Vergata, Roma Uninettuno, Bologna, Napoli, Perugia and Trento (also TIFPA), as well as the INFN-LNF, INGV (Italian National Institute of Geophysics and Volcanology), INAF-IAPS (Italian National Institute of Astrophysics and Planetology) and IFAC-CNR Firenze.

The launch of CSES-01, the first of a series of several planned satellite missions, took place successfully on February 2nd, 2018 from the Jiuquan, Gansu Cosmodrome (Inner Mongolia). The CSES satellite (fig.1) based on the Chinese 3-axis stabilized CAST2000 platform, moves along a sun-synchronous orbit at 507 km of altitude and with a 97 degree inclination, with a periodic 5-day ground track. The expected lifetime of the mission is five years.

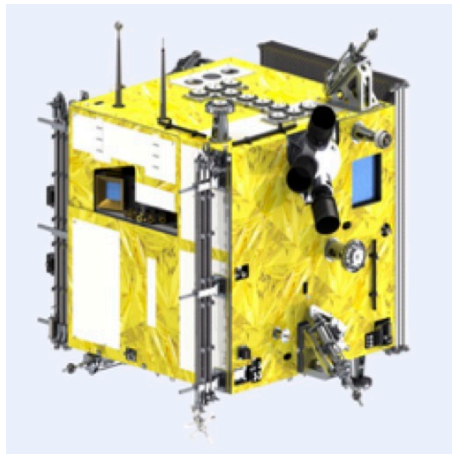


Figure 1: *Layout of the CSES satellite.*

The configuration of the CSES-01 detectors provides measurements of energetic particle fluxes, ionospheric plasma parameters and electromagnetic fields, in a wide range of energies and frequencies. The main sensors onboard the satellite are the HEPD (High Energy Particle Detector) developed by the Italian participants, and the following Chinese sensors: LEPD (Low Energy Particle Detector), LP (Langmuir Probes), IDM (Ion Drift Meter), ICM (Ion Capture Meter), RPA (Retarding Potential Analyzer), EFD (Electric Field Detector) developed in collaboration with the Italian team, HPM (High Precision Magnetometer) and SCM (Search-Coil Magnetometer). The HEPD, schematically shown in fig.2, has been designed to provide good energy resolution and high angular resolution for electrons ($3 - 100$) MeV and protons ($30 - 200$) MeV.

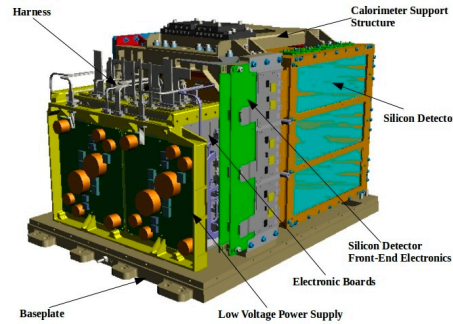


Figure 2: *Schematic view of the HEPD.*

A detailed description of the HEPD detector is given in the previous report LNF-2018 and in the referenced bibliography below. The satellite is currently in operation, nominally functioning and taking data continuously. The LNF group participates in the data analysis and in the organization and coordination of the publications and conference events through the LIMADOU Speaker and Publication Office.

In March 2019, the official agreement on the second mission, CSES-02, was signed between the Italian and Chinese Space Agencies, starting the activities for the preparation of the second satellite, whose launch is scheduled in Spring 2022. Italy has the responsibility of both the HEPD-02 and EFD-02 detectors, and the LNF group has taken the task to develop the whole Low Voltage Power System (LVPS) of the HEPD-02, namely the design, test, prototyping and realisation of the final flight system.

References

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2. P. Picozza *et al.*, "Scientific Goals and In-orbit performance of the High-Energy Particle Detector on board the CSES"; *The Astrophysical Journal Supplement Series*, **243**, 16 (2019) <https://doi.org/10.3847/1538-4365/ab276c>.
3. V. Vitale *for the CSES-Limadou Collaboration*, "Measurement of the low-energy charged particle background with the space detector HEPD"; *Rendiconti Lincei. Scienze Fisiche e Naturali*, **30**, 277 (2019) <https://link.springer.com/article/10.1007/s12210-019-00837-1>.