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 anthropocentric emitters and to study their correlations with the occurrence of seismic events. More in general, the 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 (Bologna, LNF, Napoli, Roma Tor Vergata, TIFPA Trento), together with several Chinese and Italian Universities and research Institutes (INAF-IAPS, INGV, IFAC-CNR). All the information related to the first mission CSES-01, launched in February 2018 and currently in operation, has been provided in the previous LNF Reports (2018 - 2020). The LNF group participates in the data analysis of this first mission and in the organisation and coordination of the publications and of the conference events through the LIMADOU Speaker and Publication Office.

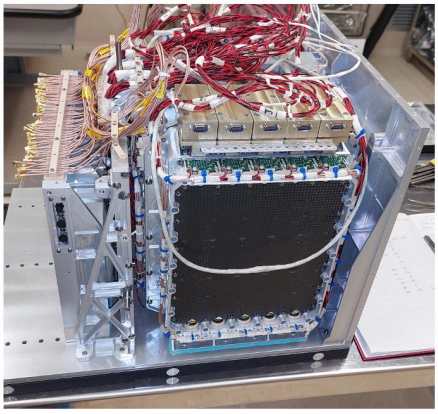

Figure 1: *The Flight Model of HEPD-02 during assembly and tests.*

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 late 2023. Italy has the responsibility of two detectors HEPD-02 (High Energy Particle Detector) and EFD-02 (Electric Field Detector). The HEPD-02 detector is conceived to detect individual incident particles. In particular, for each particle

it identifies the type (proton, electron, nucleus), measures the energy and determines the angle between the flight line and the Earths magnetic field line to the Equator (pitch angle). HEPD-02 can detect particle flows coming from the Van Allen belts and determine with great accuracy the magnetospheric region of their origin, with the aim of obtaining the energy spectrum and the composition of the particles of the stability bands that suddenly fall into the atmosphere, in case of external disturbances (Particle burst). It consists, essentially, of a calorimeter (12 plastic scintillator planes and 2 crystal (LYSO - Lutetium Yttrium Orthosilicate scintillator planes), a tracker made of 5 standalone tracking modules and a couple of trigger planes segmented on plastic scintillating bars. Fig.1 shows the Flight Model (FM) of HEPD-02 during its assembly and test phase.

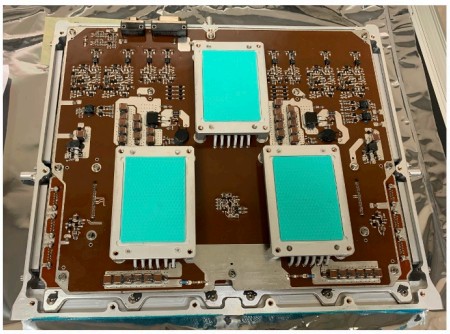

Figure 2: *The three LVPS boards mounted on the Flight Model of HEPD-02 in the assembly phase.*

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, production and integration of the final flight system. During 2022, this task has been completed with the realisation of the Flight Model of the LVPS boards (Fig.2), that have been tested and integrated in the FM of the HEPD-02. Beam tests (electrons, protons and nuclei in the MeV range) have also been carried out at BTF LNF and CNAO Pavia (Centro Nazionale Adroterapia Oncologica) to verify the performance of some subsystems of the HEPD-02 and of the FM of the HEPD-02 itself. Further tests, including vibration, thermo-vacuum and e.m. compatibility are scheduled in the first months of 2023 before the start of the final integration in the CSES-02 satellite in China.

References

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