



The Italian contribution to the CSES satellite

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We present the Italian contribution to the CSES (China Seismo-Electromagnetic Satellite) mission. The CSES satellite aims at investigating electromagnetic field, plasma and particles in the near-Earth environment in order to study in particular seismic precursors, particles fluxes (from Van Allen belts, cosmic rays, solar wind, etc.), anthropogenic electromagnetic pollution and more in general the atmosphere-ionosphere-magnetosphere coupling mechanisms that can affect the climate changes. The launch of CSES – the first of a series of several satellite missions – is scheduled by the end of 2016. The CSES satellite has been financed by the CNSA (China National Space Agency) and developed by CEA (China Earthquake Administration) together with several Chinese research institutes and private companies such as the DFH (that has developed the CAST2000 satellite platform). Italy participates to the CSES satellite mission with the LIMADOU project funded by ASI (Italian Space Agency) in collaboration with the Universities of Roma Tor Vergata, Uninettuno, Trento, Bologna and Perugia, as well as the INFN (Italian National Institute of Nuclear Physics), INGV (Italian National Institute of Geophysics and Volcanology) and INAF-IAPS (Italian National Institute of Astrophysics and Planetology). Many analyses have shown that satellite observations of electromagnetic fields, plasma parameters and particle fluxes in low Earth orbit may be useful in order to study the existence of electromagnetic emissions associated with the occurrence of earthquakes of medium and high magnitude. Although the earthquakes forecasting is not possible today, it is certainly a major challenge - and perhaps even a duty - for science in the near future. The claims that the reported anomalies (of electromagnetic, plasma and particle parameters) are seismic precursors are still intensely debated and analyses for confirming claimed correlations are still lacking. In fact, ionospheric currents, plasma parameters and stability of Van Allen belt are constantly modified by natural non-seismic and man-made processes. Therefore, in order to identify seismo-associated perturbations, it is needed to reject the “normal” background effects of the e.m. emissions due to: geomagnetic storms, tropospheric phenomena, and artificial sources (such as power lines, VLF transmitters, HF stations, etc.). Currently, the only available large database is that collected by the Demeter satellite and by rare observations made by some previous space missions, non-dedicated to this purpose. The CSES satellite aims at continuing the exploration started by Demeter with advanced multi-parametric measurements. The configuration of the CSES sensors foresees measurements of energetic particle fluxes, ionospheric plasma parameters and electromagnetic fields, in a wide range of energy 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 Detectors) developed in collaboration with Italian team, HPM (High Precision Magnetometer) and SCM (Search-Coil Magnetometer). The research activity is at an advanced phase, being the various payloads already built and, right now, an intense activity is going on for calibration of the various sensors. In particular, the Italian payload HEPD is under test at the laboratories of the National Institute for Nuclear Physics (INFN) and the Chinese payloads LP, IDM, ICM, RPA and EFD are tested at the INAF-IAPS “Plasma Chamber” in Rome, which is a facility where the response of the sensors, and their compatibility with ionospheric plasma, can be verified in environmental conditions very similar to those met by the satellite in orbit.