2° Forum della Ricerca Sperimentale e Tecnologica

INAF Technologies for Space Weather

P. Diego on behalf of INAF Space Weather Working Group
Piero.diego@inaf.it

Abstract

Space Weather (SW) is a branch of astrophysics of great interest for human activities as it deals with the terrestrial, circumterrestrial and interplanetary environment. Thanks to the large quantity of possible measurements, the study on SW is extremely interdisciplinary. INAF has a strong and consolidated heritage in many branches of studies related to SW.

In order to promote collaborations and synergies in this topic, INAF has established a specific Working Group that coordinates the various aspects of this research.

The present contribution aims to represent the variety of INAF technologies of interest for SW topics.

Technological skills

Laboratories:

- *Instruments development and calibration stage* – Several INAF laboratories have full capability in developing prototypes to verify instrumental concepts and perform calibrations to validate their design
- *AIV&T* – INAF Technicians and Technologists have acquired specific heritage in procedures for Assembly, Integration and various kind of Test

Advanced Analyses and Simulations:

- *Instruments Projects stage* – Sensors and devices (e.g. analog and digital process units) are directly designed by the INAF Research teams
- *Payload structural/thermal analyses* – Capability in perform numerical simulations like F.E.M. and thermal analyses to validate the instrument design
- *Comparative test for in-situ data validation* – Laboratories and facilities are equipped with specific tools to simulate the space environment

Ground Based Observations:

- *Various bands Telescopes* – Project and management of Optical-Infrared and Radio Telescopes also including data analysis and dissemination
- *Geomagnetic measurements* – Atmospheric spectrometers and magnetometers for ground environment monitoring

Space Missions:

- *Instruments design and development* – Space borne instruments for e.m. (X, UV, IR) and particles (plasma, neutral atoms, SEP) flux monitoring
- *Space Standard AIV&T* – Skills and facilities for space qualification test (Thermal cycles, Thermal-vacuum, Vibrations)
- *Ground Segment* – SW development for space missions downlink and data processing

Technological involvement of INAF in SW topics

- **Experimental activities and tools development**
  - Spectroscopic references for space measurements – Opto-mechanic and cryogenic systems development for Ground and Space applications (Ref. Andrea Tozzi – OAA)
  - Dosimetric simulations for UV, SEP and GCR, environmental compatibility for space borne materials and technologies (Laboratorio di Astrofisica Sperimentale, Ref. Maria Elisabetta Palumbo – OACT)
  - Space plasma compatibility and sensors development (SpaceItUp, Plasma Chamber facility, Ref. Piero Diego – IAPS)
  - Cosmic Debris spectroscopic analysis (Ref. Gaetano Valentini – OA d'Abruzzo)
  - EUV/FUV Microchannel plate sensors development (Ref. Michela Uslenghi – IASF-Milano)
  - Trieste Solar Radio System 2.0 – Solar Radio Polarimeter for the monitoring of left and right hand circularly polarized solar emissions in the range 1-18 GHz (Ref. Giovanna Jerse – OA-Trieste)
  - Scintillation and solid state sensors for High Energy Astrophysics and low noise electronics development (Ref. Riccardo Campana – OAS)
  - Solaris Project – Experimental activities (telescopes design, sensors development and testing) for Solar imaging system at high radio frequency for continuous Solar monitoring and Space Weather applications (Ref. Fabrizio Villa – OAS).
  - AGILE mission – Development of pipeline for the solar flare monitoring and characterization (Ref. Carlotta Pittori – OAR)
  - SWORDS – Development of new technologies for the next Solar hard X-ray polarimeters: (1) photoelectric polarimeter (10-40 keV) based on GridPix ASIC (Ref. Paolo Soffitta - IAPS); (2) new SiPMs sensors for Compton scattering polarimeters (20-100 keV) (Ref. Sergio Fabiani - IAPS - for instrument design and Giuseppe Romeo - OACT- for SiPM characterization)
- **Ground Based instruments**:
  - SAMM V2, SAMMNET – Optical/IR binocular telescopes equipped with magneto-optical polarimeter. SAMM allows an extremely narrow band Na and K absorption line monitoring to identify even the smallest variations of magnetic structures in the atmospheres of the Sun (Ref. Roberto Speziali – OAR/OAC).
  - BART (3 meter dish BAsovizza Radio Telescope to be used for educational purposes) to perform calibrated high time resolution L-band radio flux density observations. On going upgrade will improve the sensitivity and the S/N ratio, considering the narrow beamwidth of the dish tracking the sun (Ref. Alessandro Marassi - OA-Trieste)
  - CALLISTO – The Trieste CALLISTO station (part of the e-CALLISTO network http://www.e-callisto.org/) established in 2012 at the Basovizza Observing Station (45°38'37'' N, 13°52'34 E'', 398m above MSL) to study solar radio bursts and the response of the Earth's ionosphere and geomagnetic field. In addition Fluxgate Magnetometers allow the Earth environment monitoring (Ref. Alessandro Marassi - OA-Trieste).
  - LOFAR – Electronics development for the array of low-frequency radio (10-240 MHz) interferometer (Ref. Federico Perini – IRA Medicina)
- **Space Missions instruments**
  - CSES – Ionospheric Electric Field components detection in the range DC-3.5 MHz, based on "dual-probe" technique (Ref. Piero Diego – IAPS)
  - BepiColombo, SWEATERS – Development of Energetic Neutral Atoms detectors with different technologies: ENA direct detection technique with MCP to measure escaping low energetic neutral atoms; Micro Megas Gas Pixel detector applied to ion and atoms for Earth Space Weather at LEO (Ref. Elisabetta DeAngelis– IAPS)
  - CUSP – Phase B space mission for X-ray polarimetry. Instrument for solar flares X-ray polarimetry based on the Compton scattering (20-100 keV) in the framework of the ALCOR programme of ASI (Ref. Sergio Fabiani - IAPS)
  - UVISS – UV telescope for the International Space Station. METIS - coronagraph of the scientific payload of Solar Orbiter (Ref. Michela Uslenghi – IASF Milano)
  - ARIEL – Opto-mechanic devices for optical/IR payload to maintain the shape and position of the surfaces of an optical system of the telescope. The cryogenic system allows instrument and telescope to work below 50 K (Ref. Andrea Tozzi – OAA).

Info di contatto

INAF Space Weather Working Group: ***Segretario/Portavoce: Alberto Pellizzoni (alberto.pellizzoni@inaf.it)***

Coordinatori Tematici: P. Romano (vice-segretario), S. Ivanovski, C. Sasso, M. Molinaro, P. Diego, I. Ermolli,