PhD project in ASTROPHYSICS
(one page)

Title of the Project:
"Solar Physics and Space Weather with the Medicina 32-m Radio Telescope: Development, Test and Scientific Exploitation of a Spectro-Polarimetric Imaging System for Solar Radio Astronomy"

Supervisor: Simona Righini (INAF-IRA), Alberto Paolo Pellizzoni (INAF-OAC)

Scientific Case:
In the framework of the SunDish Project, a national program devoted to single-dish solar imaging with INAF Radio Telescopes, we propose a challenging Ph.D. program involving technological developments and science exploitation within an innovative and multi-disciplinary approach to Solar Physics applications. The SunDish project is devoted to radio imaging and monitoring of the solar atmosphere at high radio frequencies (at present 18-26 GHz, up to 100 GHz in perspective) through single-dish observations with the Italian radio telescopes.

Mapping the brightness temperature of the solar atmosphere in the radio band allows to reveal plasma processes, mostly originating from free-free emission in the local thermodynamic equilibrium, providing a probe of physical conditions in a wide range of atmospheric layers.

In particular, long-term diachronic radio observations of the solar disk represent an effective tool to characterise the vertical structure and physical conditions of the solar chromosphere, both for quiet and active regions, during their evolution at different phases of the solar cycle. Within this context, the Medicina 32-m and SRT 64-m radio telescopes are increasingly assessing their role in the international solar science panorama.

After a first test campaign aimed at defining and optimising solar imaging requirements for the radio telescopes, the system is ready for systematic monitoring of the Sun to provide:

1. accurate measurement of the brightness temperature of the radio-quiet Sun component, which so far has been poorly explored in the 20-26 GHz range, representing a significant constraint for atmospheric models;
2. characterization of the flux density, spectral properties and long-term evolution of dynamical features (active regions, coronal holes, loop systems, streamers and the coronal plateau);
3. prediction of powerful flares through the detection of peculiar spectral variations in the active regions, as a promising forecasting probe for the Space Weather hazard network.

A fundamental step forward in the project development will be the implementation of spectro-polarimetric capabilities at the Medicina 32-m dish (with the installation of a back-end similar to the one already in use at the SRT), placing our radio telescopes among major international facilities devoted to high-frequency radio monitoring of the Sun.

Outline of the Project:
The Ph.D. candidate will be part, through her/his involvement, in the following activities:

- test and validation of the spectro-polarimeter to be soon installed at the 32-m Medicina dish;
- execution of observations with the Medicina dish;
- development, test and optimisation of data analysis procedures;
- science exploitation of the acquired data (both using data from Medicina and SRT) in the framework of national and international collaborations/networks including both young enthusiastic researchers and affirmed experts in this field.

Contacts: simona.righini@inaf.it, alberto.pellizzoni@inaf.it