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Scientific development of the Italian Radio Telescopes for solar observations and study for possible solar and radio-science SDSA configurations

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The Radio Sun is an interesting celestial object to study for the richness of physical phenomena that involve not only the astrophysical area of interest, but also plasma, nuclear and fundamental physics. The joint collaboration ASI/INAF is focused on the investigation of the Sun environment and its emission mechanism. Through the tracking of interplanetary Spacecraft and the Single-Dish direct observation from the ground with the Sardinia Radio Telescope (SRT 64-m), it is possible to obtain complementary information useful to better understand some of the complex solar phenomena, like the emission from the Corona.

The configuration of the ground antenna devoted to space activity, Sardinia Deep Space Antenna (SDSA), is in the implementation phase. In this context, the possible scientific requirements to perform interplanetary spacecraft tracking for radioscience observations are being investigated. This configuration needs a highly stable radio link, like the one required by BepiColombo mission, at X-band (8-9 GHz) and Ka-band (31-33 GHz). Moreover, at these frequency bands the Solar spectrum shows some peculiar features: an entangled emission of free-free and gyro resonance from thermal electrons, which can eventually be connected with geoeffective Space Weather phenomena.

The radioastronomy configuration is developed in the context of the SunDish project, which aims to map and monitor the Sun at high radio frequencies with the SRT and the Medicina Radio telescope (32-m). At the moment, we are observing in the K-band range (18-26 GHz), since in the framework of solar observations there is a lack of precise calibrated measurements at these frequencies, and in prospective we are going to extend our range up to 100 GHz. Since the two instruments were not originally designed to observe the Sun, a new solar radio imaging system was implemented. To date we acquired more than 200 solar maps with resolutions in the 0.7-2 arcmin range and a brightness temperature sensitivity $<$10 K. Thanks to spectral characterization studies, we are exploring possible connections between spectral variation in the Active Regions spectrum and explosive events like flares and Coronal Mass Ejections.