

19th IAA SYMPOSIUM ON SPACE DEBRIS (A6)  
Space Debris Detection, Tracking and Characterization - SST (1)

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UNISAT-7 AND CASTELGAUSS: JOINT OPERATIONS FOR ENHANCED COOPERATIVE OBJECT  
DETECTION

**Abstract**

CastelGAUSS Space Debris Observatory is an astronomical observatory managed by GAUSS Srl, in cooperation with Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences and the Municipality of Castelgrande. It is located in Castelgrande (PZ), Southern Italy, at 1250m a.s.l., sharing the same mountain area with the Italian astronomical observatory run by Istituto Nazionale di Astrofisica (INAF) and its own MPC site code is L28. CastelGAUSS Observatory is part of KIAM International Scientific Optical Network (ISON). It has been actively operating since October 2017 for the optical observation and detection of objects in GEO/HEO/MEO/LEO not yet present in international debris databases, and positional measurements of GEO satellites for orbit determination and conjunction analysis. Currently observed objects are active satellites, space debris and NEOs. It features two automated observatory domes. The first houses a 22-cm aperture ORI-22 telescope (with 4.14.1 FOV, 510mm focal length and 3.58 arcsec/px scale) installed on a Skywatcher EQ-6 Pro mount and equipped with a 4K4K FLI CCD camera. The second dome includes a 35-cm Ritchey-Chrètien telescope with 40' FOV on a Skywatcher EQ-8 mount. CastelGAUSS has been performing photometric observations of artificial satellites, primarily of launch vehicle upper stages, for the acquisition of light curves and determination of rotation periods, size, shape, surface composition. UNISAT-7 is the latest micro-satellite developed by GAUSS: a 32kg, octagonal shaped micro-satellite, featuring a fine Attitude and Determination Control System for platform detumbling and commanded attitude stabilization, and a low-thrust propulsion system for orbital altitude changes. It is scheduled to be launched in Q1 2021 by a Soyuz-Fregat LV. UNISAT-7 includes a GAUSS-developed sat-to-ground optical link research payload named EARENDIL (Experimental Astronautical Research for Nadir Directional Light). It integrates two high-power, high luminous flux LEDs with known visible spectral signature, surrounded by reflectors for enhanced directionality, that will be activated when the spacecraft is passing over the observatory. This payload will involve joint operations with CastelGAUSS Observatory and the entire ISON Observation network, in order to detect the light curve of the satellite. Optical spectrometers will be used to measure response at selected LEDs wavelengths. Standard light curves of the spacecraft will be analyzed in conjunction with downloaded UNISAT-7 telemetry data, specifically on attitude determination info gathered by the

satellite at the moment of the recorded observation. This research will delve into potential benefits for object tracking and exploitation of sat-to-ground optical links.