

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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MINI-IRENE: DESIGN OF DEPLOYABLE HEAT SHIELD CAPSULE FOR A SOUNDING ROCKET
FLIGHT EXPERIMENT**Abstract**

MINI-IRENE is the the Flight Demonstrator (FD) of IRENE, a new-concept capsule with a variable geometry, originally conceived by ASI to widen the range of available platforms to retrieve payloads and/or data from low Earth orbit. The main characteristics of IRENE is the "umbrella-like" deployable front structure that reduces the capsule ballistic coefficient, leading to acceptable heat fluxes, mechanical loads, stability and final descent velocity. The feasibility study of the IRENE deployable re-entry system has been carried out in 2011. The TPS materials, selected for the nose cone and for the flexible umbrella shield, have preliminarily been tested in the SPES hypersonic wind tunnel at the University of Naples, and in the SCIROCCO Plasma Wind Tunnel at CIRA. Such successful tests and the preliminary experimental results proved the concept feasibility and the viability of commercial materials for low-cost re-entry nacelles. After the preparation phases A and B were successfully completed, the European Space Agency funded the current phase of the program. The object is to design and built a Flight Demonstrator and a Ground Demonstrator to prove, with a suborbital flight and with a Plasma Wind Tunnel (PWT) test campaign, the functionality of the deployable heat shield. The Flight Demonstrator shall be included as a secondary payload in the interstage adapter of a Mapheus launcher from ESRANGE. It shall then be ejected during

the ascent phase of the payload section, after its separation from the booster at an altitude of about 150 km, perform a 15 minutes ballistic flight, re-enter the atmosphere and hit the ground. The Ground Demonstrator, representative of the Thermal Protection System of the Flight Demonstrator, shall be instead exposed to a heat flux similar to that expected for an atmospheric re-entry from low Earth orbit inside the SCIROCCO Plasma Wind Tunnel at CIRA. The paper, after a short description of the mission profile both for orbital and suborbital flights, focuses on the design of the mechanism that will deploy the umbrella and that will cope with the re-entry environment. A section of the paper will also describe the mechanism that will keep the system stowed for the launch and that will trigger the deployment. An overview of the internal avionic and instrumentation systems is also provided, including the architectural solutions conceived, aimed to increase the possibility of a successful mission.