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Science Results from Ground Based Research (4)

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GROUND-BASED EXPERIMENTAL FACILITY FOR ORBITAL AERODYNAMICS RESEARCH:
DESIGN, CONSTRUCTION AND CHARACTERISATION.

Abstract

In very low Earth orbits (VLEO), below 450 km altitude, the aerodynamic properties of satellites are primarily determined by the flow regime, free molecular flow, and the interaction of atomic oxygen with the surfaces of the spacecraft.

The Rarefied Orbital Aerodynamics Research (ROAR) facility is a novel experimental facility designed to simulate these conditions in a controlled environment to characterise the aerodynamic properties of materials. It is built as part of DISCOVERER, a Horizon 2020 project developing the different technologies required to enable the sustainable operation of satellites in VLEO. Because ROAR isn't intended to perform erosion studies, it differs quite significantly from other atomic oxygen exposure experiments and its characteristics are discussed in this work.

ROAR consists of an ultrahigh vacuum system, responsible for generating the free molecular flow conditions, a source of hyperthermal oxygen atoms at orbital velocities, and mass spectrometers; the latter used to characterise the gas-surface interactions, and therefore the material's aerodynamic performance. This work will include a description of ROAR's main components, together with the experimental methodology for materials testing and early results. Among the main parameters to be considered are atomic oxygen flux, beam shape and energy spread, mass resolution, and signal-to-noise ratio.