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Author: Mr. Remi Canton
Centre National d'Etudes Spatiales (CNES), France, remi.canton@cnes.fr

Mr. Philippe Bioulez
Centre National d'Etudes Spatiales (CNES), France, philippe.bioulez@cnes.fr
Mr. Christophe Delaroche
Centre National d'Etudes Spatiales (CNES), France, christophe.delaroch@cnes.fr

DECLIC EVO: REPAIR, UPGRADE, AND NEW SCIENCE OBJECTIVES

Abstract

DECLIC is a multi-user facility to characterize critical fluids behavior and directional solidification growth structures of transparent alloys. As part of a joint NASA/CNES microgravity/material science research program, DECLIC has been operated onboard the ISS since October 2009. Housed inside a NASA science rack, DECLIC operates three experiment inserts alternatively for periods of 3 to 6 months: HTI (High Temperature Insert, studying critical water), ALI (Alice Like Insert, studying critical sulfur hexafluoride) and DSI (Directional Solidification Insert). Experiments are monitored and controlled from CADMOS control center at CNES in Toulouse, France. The initial scientific program has been completed, and the R (for refurbished inserts) program is almost complete. Unfortunately, a laser failure in November 2017 degrading a key interferometric diagnostic significantly impacted the scientific schedule: as a consequence, it has been decided to return DECLIC facility to the ground on SpaceX-16 on Dec.13th 2018 (after completion of additional DSI-R and ALI-R sequences that did not require interferometric measurements) to have it repaired and upgraded into DECLIC-EVO. That upgraded facility -which should re-fly early 2021- is paving the way to new perspectives and horizons. It would allow the completion of the full DECLIC scientific program (R and R2 series), as well as new identified scientific objectives hosted in two newly developed inserts (see below), to cover at least until 2024. On the engineering side, the challenge of refurbishing a 10-year old payload is to find solutions with respect to obsolete components, without affecting the overall system architecture (physical, electrical, thermal, optical, software...). For instance, the laser that failed is not manufactured anymore, and it has been a challenge to find another laser with the exact same optical properties that physically fits exactly in lieu of the previous one and matching its optical path. On the scientific side, NASA/CNES agreed on two new inserts:

-AEROSOL insert, that will help understanding the phenomena taking place within clouds (thermal and matter transfers), which is essential for a better climate understanding.

-SCOW (Super Critical Water Oxidation) insert, whose objective is to pursue studies led on supercritical water with HTI inserts, targeting the development of oxidation processes in supercritical water. The applications would be, for instance, the treatment of organic waste, which is in phase with NASA's Exploration vision.

This paper aims at presenting the current status on DECLIC repair/upgrade, on the 10-year-long science and operations, and an overview of the new scientific inserts.