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COLD-WELDING IN SPACE: ASTROBEAT'S NOVEL APPROACH TO SPACECRAFT HULL
REPAIR

Abstract

This paper provides an overview of ASTROBEAT, a project investigating cold-welding as a novel method for repairing spacecraft hull damage caused by hypervelocity impacts with space debris. The project aims to develop and test an experimental rig to study cold-welding under microgravity conditions onboard the International Space Station (ISS). The launch is targeted towards the end of 2024, hosted upon a SpaceX CRS mission. Cold-welding, the fusion of similar metals at ambient temperatures under high contact pressures, offers potential advantages over traditional repair methods. In space, the lack of reoxidation facilitates atomic diffusion, allowing cold-welding at lower forces. While previously viewed as a detrimental structural phenomenon, ASTROBEAT explores its potential for repair. Prior to carrying out the experiment aboard the ISS, the investigation will be conducted in ground laboratories. The project will assess the contact forces required for patch application and evaluate the structural properties of the repaired systems. The experimental setup consists of material test beds, a hull perforation repair device, and electronic, communication and data acquisition subsystems. This payload will be integrated into a 1U cube, Nanolab, installed on a rack on the ISS and will not interfere with the living environment of astronauts. The recovered payload will enable further metallurgical analysis of the cold-welded joints. The project leverages expertise from the Malta College of Arts, Science Technology – MCAST (Malta), South East Technological University - SETU (Dublin), the University of Padova (Italy) and Skyup Academy (Italy). By investigating cold-welding for spacecraft repair, ASTROBEAT holds promise for safer and more efficient in-situ operations, contributing to the long-term sustainability of space exploration.