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Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

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CAPILLARY CHANNEL FLOW - THE CCF EXPERIMENT ON THE INTERNATIONAL SPACE STATION

Abstract

The CCF experiment performed first operations between January and March 2011 onboard the International Space Station (ISS). The purpose of the Capillary Channel Flow experiment (CCF) is to investigate the behavior of capillary flows through open capillary channels in an environment of compensated gravity. The international science team controlled the experiment from a ground station located at ZARM in Bremen, Germany. One of the most pressing challenges is to determine the maximum forced flow rates that are possible before the free surface of the liquid becomes unstable and collapses - a phenomenon that in fluid mechanics is referred to as 'choking'. The CCF experiment is a joint German (DLR – ZARM) and American (NASA – PSU) endeavor. It is supervised and supported by NASA's Glenn Research Center. The experimental unit was constructed in Germany by Astrium Friedrichshafen and in April of 2010 was transported to the ISS onboard flight STS-131 of the space shuttle Discovery. NASA astronauts installed the unit into the Microgravity Science Glovebox onboard the ISS. Having passed initial tests, CCF operations have commenced successfully. Onboard the ISS, the team is able to utilize the compensated gravity environment to perform a great deal more and longer experiments. They are able to vary parameters such as channel length, flow rates, and even accelerations and oscillations of flow. The experiment is equipped with numerous sensors and a high-speed camera which produces an abundance of data that was down-linked to the ground station at ZARM. The newly acquired data will be used to validate current mathematical models of capillary flows helping optimize the development of liquid management systems in space. The talk aims at a general introduction to the subject of a flow channel in space. The fundamental equations and boundary conditions, and the tools to solve them, will be explained. The scientific hardware and its functionality, the scientific and technical stimuli as well as the measurements techniques will be introduced. A description of the operational scenario will be concluded with first results of steady, unsteady and oscillatory flows.

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