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MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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DESIGN AND DROP TOWER TESTING OF A LIQUIDS EXPERIMENT INVESTIGATING THE CHAOTIC DRIPPING REGIME IN LOW GRAVITY CONDITIONS

Abstract

Small Microgravity Liquid Experiment (SMiLE) is an experiment developed for use on board the International Space Station (ISS), currently scheduled to launch in December 2015. The purpose of SMiLE is to statistically categorize the development of droplet formation when liquid is ejected at a constant velocity from a small circular nozzle in a very low gravity environment. Specifically, SMiLE aims to investigate the existence of a chaotic dripping regime within such environments, which has been documented at low Reynolds numbers ($240 < Re < 470$ for pure water). In this regime, drops do not have a constant time of formation. SMiLE consists of a liquid injection assembly and a viewing chamber, including two cameras to provide high quality stereoscopic recording of the droplet formation. Precise control of the flow velocity is provided through a syringe pump driven by a stepper motor. The temperature of the fluid is constantly monitored immediately prior to the nozzle. SMiLE has been designed to conform to a 1.5U payload slot (150x100x100mm), weigh less than 1.5kg and consume less than a 2W peak externally supplied power. In order to ensure that the experiment requires no external intervention when on board the ISS, a novel centrifuge system has been included such that the liquid is recycled for each new test, precluding the necessity for large test and waste reservoirs. This paper will initially present the overall design of the experiment. The drop tower characteristics are provided, as well as the experimental methods utilized for the drop tower testing. Finally, preliminary results gathered from the drop tower are provided and discussed. The results of the drop tower testing allowed the transition flow rates between periodic (constant time of formation) dripping, chaotic dripping, and jetting to be experimentally defined. The results provide a platform to discuss the viability of SMiLE in its current state.