Surface Tension Containment Experiment (STCE)- Increasing Science Throughput on ISS

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Abstract

The Microgravity Science Glovebox (MSG) on the International Space Station (ISS) is used for fluid transfer in many types of experiments. Reagents are handled in the MSG to prevent their accidental release into the cabin. However, the MSG is currently over-subscribed, creating a backlog of users in flight. As a recourse, current experiments are underway to assess the possibility of moving certain science operations from the MSG into the open cabin of the ISS. The experiments are designed to assess the efficacy of exploiting surface tension as a control to prevent the unwanted release of liquids. Dyed water currently serves as an ersatz for potentially more hazardous liquids. Common wet-lab operations such as de/mating wetted Luer-Lok fittings, liquid-bearing container lid removal, and pipetting between well plates are performed illustrating the facility and challenges imposed by the microgravity environment. Concerning the latter, various pipette cannula sizes are deployed at various injection, withdrawal, and translations rates to map the existence, size, velocity, and trajectory of satellite droplets expected to form when breaking contact between the water surface and the pipette tip. Though such drops frequently form in terrestrial operations, they are nearly imperceptible and inconsequential—due in part to their speed and because gravity quickly returns them to the well plate from which they came. The use of airflow to capture and collect such satellite droplets is demonstrated. The dynamic stability of the liquid-filled well plates is quantified in response to a variety of crew-imparted disturbances. From a safety perspective, the results from the STCE are of immediate practical value. If such routine low-gravity capillary fluidic operations can be established as mundane, their performance may be moved out of the MSG and into the cabin, significantly increasing the efficiency of experiments performed on ISS.