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2022 YEAR IN REVIEW

The Pillars of Creation from the Webb telescope

NASA'S DART MOVES AN ASTEROID

NASA'S SLS ROCKET NAILS ITS DEBUT

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SHAPING THE FUTURE OF AEROSPACE

◀ NASA researchers tested a method for measuring propellant distribution during a parabolic flight conducted in May.
NASA Launch Services Program

Multiple microgravity laboratories help advance fluid dynamics and combustion research

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The **Microgravity and Space Processes Technical Committee** encourages the advancement and public awareness of low-gravity studies in physics, materials, biological sciences and related fields.

In February, **Cornell University** researchers published their findings on how water droplets disperse in microgravity. On Earth, a droplet of water on a solid surface spreads out slowly until it approaches a stable shape, but without the effects of gravity, a water droplet on a vibrating solid surface has an alternating outer edge, also referred to as the contact line. In the Cornell study, funded by the **National Science Foundation**, astronauts on the **International Space Station** deposited 10-milliliter water droplets via syringe on nine different hydrophobic surfaces with varying degrees of roughness to measure the moving contact line. Researchers determined the **droplet mobility parameter**, a crucial input in an analytical model that predicts droplet behavior more accurately than existing models. Outcomes from this investigation could help refine our understanding of droplet-spreading behaviors and help mitigate the extent of surface defects in fabrication processes, including additive manufacturing.

In May, the **Launch Services Program at NASA's Kennedy Space Center** in Florida flew an **electrical capacitance tomography, or ECT, experiment** on a parabolic flight aircraft. In an accelerated environment, liquid propellant in a tank tends to settle at one end of the tank, but this is not necessarily the case in microgravity, rendering many of the current methods for gauging mass inadequate. ECT measures the capacitance between multiple pairs of thin conducting plates to determine liquid distribution inside the tank, which can then be integrated to obtain mass. The May flight raised the technology readiness level of this technique to 6, meaning a prototype was demonstrated in a relevant environment. The results show that even in the current prototype generation, ECT sensors could be useful for liquid mass gauging in both accelerated and microgravity environments.

In August, researchers from the **University of Colorado, Freie Universität Berlin and University of Bremen** in Germany, and the **University of Warwick** in the United Kingdom published findings on another separation method: using magnets to move gas bubbles. In an experiment that concluded in December 2021, they dropped a capsule containing three liquid-filled syringes and magnets from the **ZARM drop tower**, which provides 4.74 seconds of microgravity experiment time. They concluded that a neodymium magnet could attract and repel water bubbles in different carrier liquids, including water and olive oil. The results from this investigation could help development of microgravity magnetic phase separators to remove bubbles from propellant management devices and wastewater recycling systems on spacecraft.

It was also a productive year for microgravity combustion experiments. Astronauts on **ISS** ignited hundreds of flames in the combustion chamber of the **Advanced Combustion in Microgravity Experiment**, or ACME, insert on the **Combustion Integrated Rack**. Six research teams investigated various aspects of flames in microgravity related to fire safety, flame extinction, electric field effects on flames, soot formation and cool flames. In March, ACME was replaced in the rack with the **Solid Fuel Ignition and Extinction Experiment**, or SoFIE. In the coming months, astronauts will observe how solid-fuel fires burn over long durations in microgravity.

The **U.S. Congress** in July approved the **Creating Helpful Incentives to Produce Semiconductors Act**, which **President Joe Biden** signed into law in August. The NASA authorization bill in the CHIPS Act extended NASA's participation in ISS to 2030, allowing microgravity research actives to continue while development of future privately owned space stations continues. ★