Physical Science for Exploration at NASA GRC: Fire Safety, Cryogenics, Fluids and Thermal Management, and Granular Material Dynamics. Emily Johnson[1], Paul Ferkul [1,2], Ian Madden [1,2], Henry Nahra [1], Mohammad Kassemi[3], Claire FortenBerry [1], Tyler Hatch [1], Suman Sinha Ray [1,2], Kelly Bailey[1], John McQuillen[1] , David Urban[1], 1 NASA Glenn Research Center, 21000 Brookpark Rd, Cleveland, OH 44135, 2 Universities Space Research Association, 425 3rd St SW #950, Washington, DC 20024, 3 Case Western Reserve University, Nord Hall, 2095 Martin Luther King Jr Dr Rm 500, Cleveland, OH 44106

As stated in the 2024 Civil Space Shortfall Rankings provided by NASA's Space Technology Mission Directorate (STMD), there are roughly 187 technology shortfalls that need to be further investigated to support NASA's future missions and enable a sustained human presence on the Lunar surface or Mars (https://www.nasa.gov/spacetechpriorities/).

The physical science research teams at NASA Glenn Research Center (GRC) study the fundamentals of fire science, fluid physics, and soft matter/granular physics that directly contribute to NASA's planetary and exploration goals. In this presentation, we will discuss projects within the physical science portfolio at NASA GRC that have direct applications or impact to the planetary and exploration communities. Topics covered will include granular (regolith) flow and clogging dynamics, material flammability and fire safety, cryogenic propellent storage, cryogenic fluid transfer, fluids based thermal management systems, plant water management, water reclamation for life support, and air quality/particulate monitoring.

We will also highlight upcoming workshops, our drop tower facility, and other opportunities for the planetary and exploration communities to learn more about the work in the full Biological and Physical Science (BPS) portfolio and engage with the larger physical science community. The physical science team at NASA GRC is funded by BPS, STMD and the NASA Mars Campaign Office (MCO).