Two experiments to help humans "go farther / stay longer" in space

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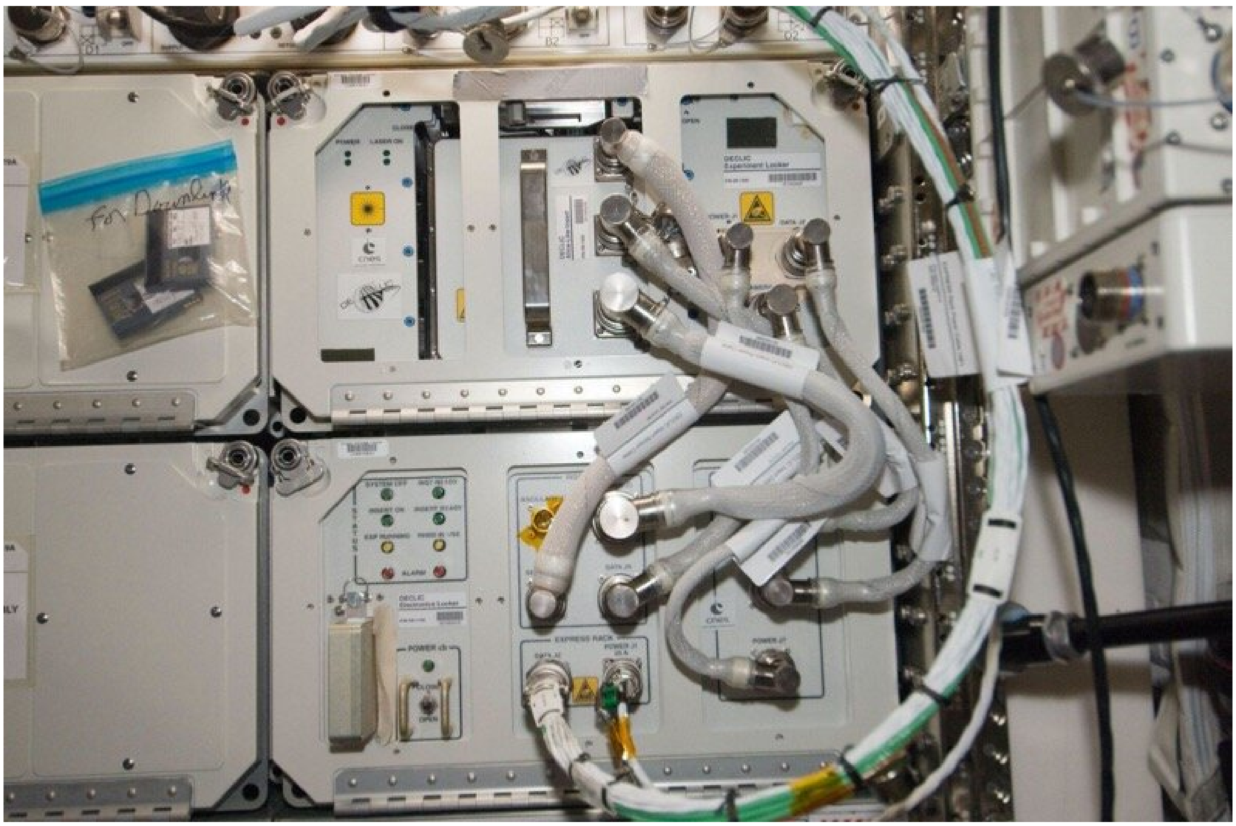

DEvice for the study of Critical Liquids and Crystallization experiment locker. Credit: NASA

When the Space X23 rocket launches on August 28th to resupply the International Space Station, it will carry two experiments designed to sustain humans as they go farther and stay longer in deep space: A physical science investigation known as DEvice for the study of Critical Liquids and Crystallization—Directional Solidification Insert-Reflight (DSI-R), and a space biology experiment known as the Advanced Plant EXperiment-08 (APEX-08).

While DSI-R's full title may be long, its purpose is succinct: How can material scientists make metal alloys stronger, and last longer under various gravity conditions? The answer may lie in a series of computational models that researchers hope to refine as a result of this experiment. Dr. Rohit Trivedi, a senior scientist at Ames Laboratory and a professor of materials science and engineering at Iowa State University in Ames Iowa is the principal investigator: Dr. Alain Karma, a professor of physics at Boston's Northeastern University is the Co Investigator. They explain what they hope to observe and learn.

Dr.: Trivedi says, "We will be using the Device for the Study of Critical Liquids and Crystallization (DECLIC) which allows you to actually see what happens when a liquid alloy begins to harden to become a solid. As it does so, it forms branched microscopic crystals known as dendrites. In a perfect world, all the dendrites would be uniform in size and grow in the same direction towards the hot liquid in the mold. But we know that doesn't happen. Groups of dendrites grow in different directions leaving behind crystal defects in the solidified material that impact its mechanical properties. The question is then why do these casting defects occur and how do we prevent them? The DECLIC is a wonderful scientific instrument that was built by France's CNES. It's basically a rack mounted mini lab that allows us to conduct experiments from the ground where we can use the Directional Solidification Insert DSI to control key variables such as alloy composition, which was increased for the reflight experiments (DSI-R), the temperature gradient and solidification rate and visualize in situ how crystals form and grow without fluid flow induced by gravity."

Dr. Karma says, "Once we make these observations and get this new data, we can test and refine our computational models to help predict how to make metallic alloys stronger, lighter and long lasting. This is important both for long term space flights and here on Earth. For materials processing in space or the lunar surface and long term space flight, we'll most likely be using 3D printers to manufacture replacement parts for our spacecraft. In simple terms we can take metal powders and apply a laser to them to make the part we need. But multiple variables in the manufacturing process means trial and error is not optimal. Instead, these new computational models will help us narrow down the choices. We'll also use those models to tell us how to manufacture these parts under various gravity conditions from the Moon to Mars to deep space itself. Back on Earth, these same computational models will help us produce superior structural metallic alloys to use in our infrastructure projects. And remember, there are new materials yet to be discovered—for example alloys with the capacity to operate at higher temperatures under extreme environments. It's very exciting to participate in the research that will lead to the discovery of these new materials."

The APEX-08 is another example of the "make it, don't take it" approach to future space travel. Like humans, plants grown in space for consumption can experience stress when exposed to microgravity conditions. Since compounds known as polyamines contribute to the plant stress, APEX-08 will examine the role these compounds play, specifically in the plant: Arabidopsis thaliana, aka thale cress. The experiment's results may provide insights into the mechanisms plants use to modulate the stress of microgravity.

Provided by NASA

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