Making (per)waves: Space study could improve future fuels

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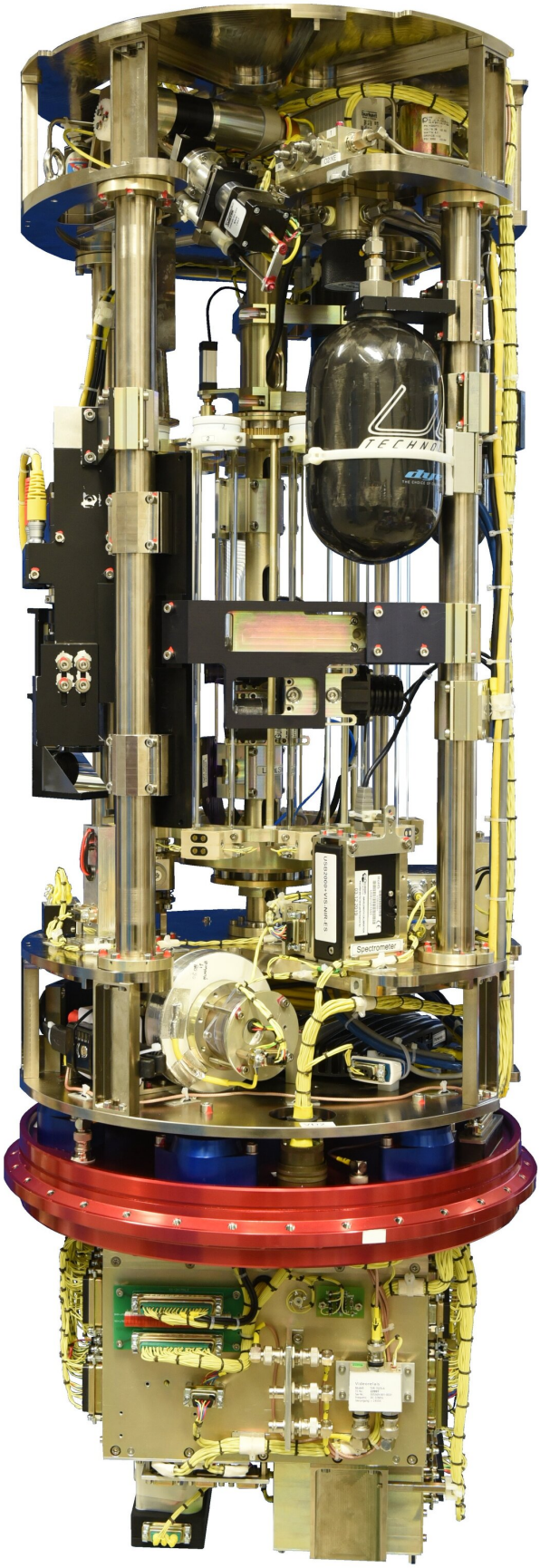
Spectrometer

Credit: Airbus sounding rocket team, Bremen

What looks like an engine made its way to space and back last November. While the hardware of the Perwaves experiment will not end up in your car, results from this research could lead to more efficient and carbon-free fuel in the future.

Perwaves, or percolating reaction-diffusion waves, set metal powder on fire to study how it burns in a chamber. This is done in weightless conditions because the powder clumps under gravity. In weightlessness, the metal powder can be evenly spaced and suspended, making it easier to study.

Why metals? Because of their high energy density, metals can compete with gasoline and oil for fuel efficiency. The only waste product is rust, which can easily be recycled back into metal powder, making metals a fully carbon-free source of energy. However, metals do not ignite easily unless in powder form, when they burn in a process known as "discrete burning."

Like a sparkler lit on New Year's Eve, the metal powder ignites and burns completely due to the heat created by other fuel elements around it. Unlike traditional fires that burn through their fuel continuously, discrete fires spread by jumping from one fuel source to another.

The Perwaves experiment is looking for the ideal blend of oxygen and metal powder as well the ideal size of the metal dust to create the best conditions for combustion. The results from the burning will be analyzed to create discrete burning models to extrapolate the ideal conditions and

to optimize industrial burner designs.

Perwaves launched on the Texus-56 sounding rocket from Esrange, Sweden last November. The rocket flew to 260 km before falling back to Earth, offering researchers six minutes of zero gravity. During this time, researchers confirmed that the hardware works and that iron-fuelled combustion is sustainable.

The team details their work in an article published in *Acta Astronautica* but the next step is to fly the experiment in the world's weightless laboratory, the International Space Station, to continue collecting scientific data over longer periods of time.

Perwaves was conceived by McGill University in Montreal, Canada and designed by the sounding rocket team at Airbus in Bremen, Germany.

More information: Jan Palečka et al. Percolating Reaction–Diffusion Waves (PERWAVES)—Sounding rocket combustion experiments, *Acta Astronautica* (2020). DOI: 10.1016/j.actaastro.2020.07.033

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