Fluids and Space Engineering Seminar
Date: Thursday, December 12, 2024 at 14:00
Location: ZARM, Room 1730

Spacecraft Fire Safety

An overview and latest updates of the FLARE project supported by JAXA

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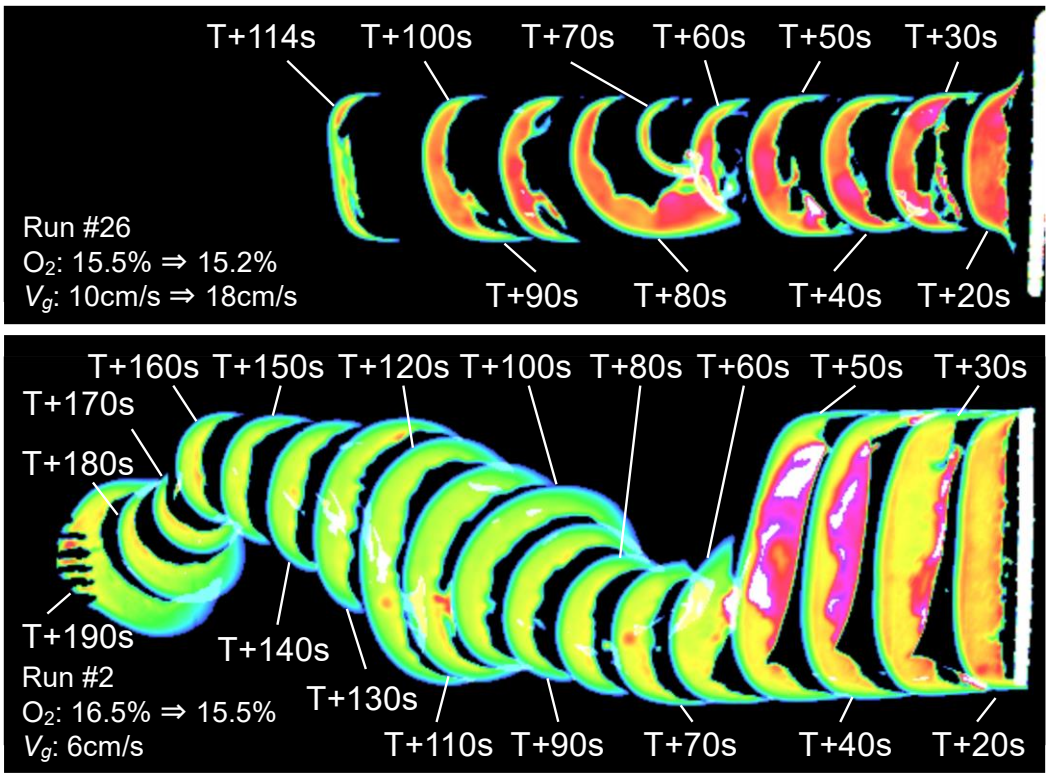

Infrared sequence of the two-dimensional stable flame spread behavior (top) and the three-dimensional unstable flame spread behavior (bottom) observed in the on-orbit flame spread experiment of filter papers.

In recent years, the rise of private companies in space development has been remarkable, exemplified by SpaceX in the United States. Numerous space startups are now establishing space-related businesses, including space travel and transportation, bringing us closer to a future where ordinary people can easily access space. However, alongside these advances in space development, the diversification and prolongation of human spaceflight have inevitably increased associated risks. Among the three major incidents in human spaceflight—hazardous substance leaks, pressure drops, and fires—fire represents the most critical threat to human life in the confined environment of space, where escape is not an option.

Currently, fire safety in spacecraft such as the International Space Station is ensured by pre-testing materials intended for spacecraft structural components and equipment according to NASA's combustion test standard, NASA-STD-6001B. Only materials that pass these combustion tests, conducted under Earth's normal gravity, are used in spacecraft. However, it remains unclear whether these tests accurately assess flammability in the actual microgravity environment of space. Many studies report that materials can exhibit higher flammability in microgravity than under Earth's gravity, suggesting that the NASA-STD-6001B standard may underestimate material flammability. Furthermore, as NASA-STD-6001B is based on the legacy standard NHB8060.1, published in 1971, certain aspects of its specifications lack scientific justification.

The FLARE (Flammability Limits At Reduced-g Experiments) project was thus launched with support from JAXA (Japan Aerospace Exploration Agency) to develop methods for quantitatively predicting and evaluating the flammability of materials in microgravity environments. The ultimate goal of this project is to standardize this method of assessing material flammability as an international safety standard for fire prevention in human spaceflight, thereby contributing to the future of space exploration from the perspective of fire safety. Additionally, the academic insights gained throughout this process hold the potential for broader applications beyond advancing combustion science, such as the development of fire-resistant materials, making FLARE a highly innovative project with wide-ranging impacts. In this seminar, I will provide an overview of the FLARE project and present the latest updates on the solid combustion experiments currently being conducted aboard the International Space Station.