

Overview of Kibo experiment candidates for around 2012

1. Experiment Title

Detailed validation of the new atomization concept derived from drop tower experiments

~Aimed at developing a turbulent atomization simulator~

2. Principal Investigator

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3. Outline of Experiment

Since the state of spray combustion is governed by the atomization of liquid fuel, the understanding of turbulent atomization mechanism has become an important issue to develop the control method of spray combustion in environmentally accommodated aerospace engines. However, the existing knowledge on liquid atomization mechanism is very limited because the breakup process of liquid ligaments involved in turbulent atomization is a very rapid and fine phenomenon and it is not easy to observe the process in detail. This difficulty was resolved in our drop tower experiments which enabled an equivalent phenomenon to realize slowly for a scaled-up liquid ligament. The most important finding from the microgravity experiments is that the capillary wave which is created by the contraction of the liquid ligament tip plays an essentially important role for the breakup of the liquid ligament.

In the present study, the new atomization concept (self-destabilizing mechanism due to the presence of liquid column tip) which is derived from the drop tower experiments is completely validated by examining the detailed behaviors of capillary waves excited on a liquid jet slowly issuing from a large radius nozzle into the quiescent air in the space experiment. The validated atomization concept will be developed into a universal theory, which reveals the origin of unstable waves responsible for liquid breakup in various situations and make the breakup phenomenon quantitatively predictable, which can never be achieved by far.

The similar dispersive property of capillary wave is also expected to function in the formation of liquid ligaments from a high speed liquid jet in association with aerodynamic actions. Therefore, we are conducting a joint numerical research with JAXA to make a practically useful fruit from this study. Therefore, the final purpose of this study is to develop such subgrid atomization models that describe the turbulent atomization process. It is expected that a successful construction of a new spray combustion simulator in our country will appeal the scientific significance of the space utilization program.