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ENHANCING CRITICAL RLV-TECHNOLOGIES: TESTING REUSABLE CRYO-TANK INSULATIONS

Abstract

Implementing reusable systems in cost-effective European space transportation requires not only hypersonic flight testing. The development of all critical technologies and their demonstration in ground testing is a sine-qua-non for the successful realization of an RLV.

In 2017, a multidisciplinary research project called **AKIRA** (**A**usgewählte **K**ritische Technologien und **I**ntegrierte Systemuntersuchungen für **R**LV **A**nwendungen or in English specific critical technologies and integrated system investigations for RLV applications) was launched in DLR. In AKIRA technologies critical for the success of reusable space transportation system development are theoretically and experimentally investigated following launcher system requirements.

The AKIRA project covers a range of RLV relevant topics. Due to limited resources, not every important aspect can be addressed in detail. However, the main benefit of the project is the bundling and tight integration of the various activities, and the orientation of the technology work on RLV reference configurations and reference missions. AKIRA is planned for a duration of 3 years and total funding amounts to around 6.2 million.

Reusable cryo-tank insulation is one of the key-challenges because today's thermal insulations on ELV cryo-tanks are not designed for multiple flights. A suitable combination with the external TPS protecting the vehicle from reentry loads is another aspect only relevant for RLV. The formation of ice, due to climatic conditions at the launch site, on either the external surfaces or within internal layers of the insulation is to be avoided. In AKIRA several insulation concepts have been traded and investigated by numerical and experimental methods.

A preferred reusable insulation concept is defined which subsequently is assembled as an Integrated Test Object (ITO) to be tested in DLR's facilities under relevant conditions. This ITO, to be built at various sizes, is combining a cryogenic fluid compartment, reusable insulation, external thermal insulation as well as sensors for data acquisition and health monitoring.

The paper provides an overview of the ongoing activities in enhancing RLV tank insulation and summarizes major research results available by summer 2019. The ITO concept is described and the impact of this design on a full scale reusable launcher stage is assessed.