Paper ID: 69473
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IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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OBJECTIVES AND ACHIEVEMENTS OF THE HYPERSONIC FLIGHT EXPERIMENT STORT

Abstract

Since numerical simulation of hypersonic flight environment has still significant shortcomings and ground test facilities cannot duplicate the flight exactly, complementary flight experiments are essential. Hypersonic flight experiments by means of multi stage sounding rocket configurations are the most cost-efficient options to gather valuable flight data. The past DLR's hypersonic flight experiments reached high Mach numbers up to 10. However, the test phase with high aerothermal loads of these experiments was less than 30 seconds. To close this gap and achieve higher Mach numbers the flight experiment STORT (Key Technologies for High Speed Return Flights of Launcher Stages) uses a three-stage sounding rocket configuration.

The long duration hypersonic flight experiment STORT on top of a three-stages sounding rocket configuration is going to be launched in June 2022. In order to achieve high integral heat loads, the third stage will fly a suppressed trajectory at approximately 45 km altitude and a Mach number of 8 with a duration of 110 seconds. The nose section and forebody of the scientific payload are equipped with CMC materials as thermal protection. Three canards equipped with active and passive thermal management systems should provide valuable flight data on the thermal efficiency of these methods. Several engineering science experiments like aerothermal heating of the CMC forebody, material response at temperature above 2200 K, active and passive thermal management, measurement of shock wave boundary layer interaction (SWBLI), CFRP module with cork coating for high temperature application, fin and tailcan instrumentation, miniaturized infrared camera and radiometer sensors passed the critical design review successfully. Hardware components are almost completely manufactured. A reduced in-flight 3 DoF trajectory simulation is implemented on the flight computer to ensure that the experiment conditions in terms of Mach number and apogee altitude can be reached even in the presence of dispersion, which is minimized by means of an on-board determined optimum third stage ignition time point.

Most of the aerothermal characterization and qualification tests have been carried out. A final experimental study concerning the forebody heat flux distribution and shock wave boundary layer interaction induced heat augmentation around the canard in different flow regimes is under preparation. Bench tests and environmental tests are planned in May 2022. This work will present an overview about the development and first results in case of a successful flight.