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STORT FLIGHT EXPERIMENT FOR HIGH SPEED TECHNOLOGY DEMONSTRATION

Abstract

Simulation Based Certification of flight hardware is one of the long term goals of the DLR's research programs. In case of reusable space transportation systems this task is very challenging. Recent studies show that reusability becomes feasible, if the separation of the first stage takes place at Mach numbers between 8 and 12. Using available two stage sounding rocket configurations the achievable Mach number for a payload mass of approx. 300 kg is limited to around 6. To achieve higher Mach numbers the flight experiment STORT (Key Technologies for High Speed Return Flights of Launcher Stages) will use a three stage sounding rocket configuration. In addition the third stage will fly a suppressed trajectory to increase integral heat load on the structures. In order to increase integral thermal loads on high temperature structures, during STORT flight experiment an additional maneuver will keep the third stage at high speed within a suppressed trajectory. The nose part of the STORT payload section is made of CMC material structure. The massive nose and remaining segments will be instrumented with pressure sensors, heat flux gauges and thermocouples. Recent successful results of the ATEK flight experiments encourage us to implement also FOS sensors in the rear part of the CMC section. Three fins of the payload will be used for three different experiments. An active cooling system with monitoring instrumentation will be implemented into the first fin. A passive thermal management system in the second fin should also keep the leading-edge temperature below a certain level. The third fin won't have any thermal management, but will be heavily instrumented to study the Shock-Wave-Boundary-Layer-Interaction around the fin. The objective in STORT is a further mass reduction of the CFRP module, which was successfully qualified during ATEK flight, and demonstration of its performance at higher surface temperatures. The payload is equipped with thermocouples and fiber Bragg grating (FBG) and strain gauges. In the frame of STORT a CMC nozzle will be flight qualified after passing two static firing tests. The modular data acquisition system for Health Monitoring of ATEK has been extended for additional sensors of the STORT. The flight experiment is planned around the end of 2021.