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STORT FLIGHT EXPERIMENT FOR HIGH SPEED TECHNOLOGY DEMONSTRATION

Abstract

Recent studies show that reusability becomes feasible, if the separation of the first stage takes place at Mach numbers between 9 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. Therefore the DLR's flight experiment REFEX with the main focus in guidance and navigation during return flight will fly at Mach numbers from 5 down to subsonic speeds [1]. Aerothermal loads on hot structures are out of the REFEX goals. To close this gap and 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. The past DLR's hypersonic flight experiments reached high numbers up to 10 [2]. But the test phase with high aerothermal loads was less than 30 seconds. Therefore an additional maneuver will keep the third stage within a suppressed trajectory with high integral thermal loads. 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 [3]. 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. In the frame of the ATEK project a new hybrid payload structure using 'Automated Fiber Placement' (AFP) technique consisting of carbon fiber-reinforced thermoplastic (CF-PEEK) has been developed and flight qualified. The objective here is a further mass reduction and demonstration of its performance at higher surface temperatures. The payload has been equipped with thermocouples and fiber Bragg grating (FBG) and strain gauges. Within the ATEK project a CMC/CFK nozzle has been developed and passed all ground tests. In the frame of STORT the modified nozzle will be qualified with two static firing tests and fly on the third stage. The modular data acquisition system for Health Monitoring will be extended for additional sensors. Again part of the acquired data will be transmitted to the ground station via telemetry. The main portion of the data will be stored in the impact-resistant storage units.