LOW DENSITY SUPERSONIC DECELERATOR (LDSD)
SUPersonic Flight Dynamics Test (SFDT)
PLume Induced Environment Modelling

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Objectives:
• Provide plume induced heating (radiation & convection) predictions in support of the LDSD thermal design (pre-flight SFDT-1)
• Predict plume induced aerodynamics in support of flight dynamics, to achieve targeted freestream conditions to test supersonic deceleration technologies (post-flight SFDT-1, pre-flight SFDT-2)

Approach:
• Star48 and Small Solid Nozzle Flow Fields – RAMP engineering code
• Star48 and Small Solid Plume Flow Fields – Loci/CHEM 3.3 CFD code
• Plume Radiation – Reverse Monte Carlo (RMC) radiation code
• Reynolds Averaged Navier-Stokes (RANS) Simulations (varying fidelity, grids)
• Two-phase Flow (Gas + $\text{Al}_2\text{O}_3$ particles)
• Two Gaseous Species (thermally perfect, equivalent air and plume, frozen chemistry)

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SFDT-1 SPIN MOTOR PLUME IMPINGEMENT
Pre-flight Heating Contours

SFDT-2 STAR48 PLUME INDUCED AERODYNAMICS
CFD, Mach = 0.7, Angle-of-Attack = 17.1°

Loci-CHEM CFD AERODYNAMIC PREDICTIONS VERSUS POST-FLIGHT, BEST EQUIVALENT TRAJECTORY (BET)

SFDT-1 Trajectory, Altitude (km)
SFDT-2 Trajectory, Altitude (km)

SFDT-1 Trajectory, Mach Number
SFDT-2 Trajectory, Mach Number

SFDT-1 SPIN-UP MOTORS (2 PAIRS)
SFDT-2 SPIN-DOWN MOTORS (2 PAIRS)

ORBITAL-ATX STAR48 (20% OFFLOADED TO REDUCE BURN TIME)