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 + Al₂O₃ particles)
• Two Gaseous Species (thermally perfect, equivalent air and plume, frozen chemistry)

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**SFD-1 SPIN MOTOR PLUME IMPINGEMENT**

Pre-flight Heating Contours  Post-flight Charring

**SFD-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-2 Powered Phase, 0 ≤ M ≤ 4.1

SFDT-2 Powered Phase, 0 ≤ M ≤ 6.0