

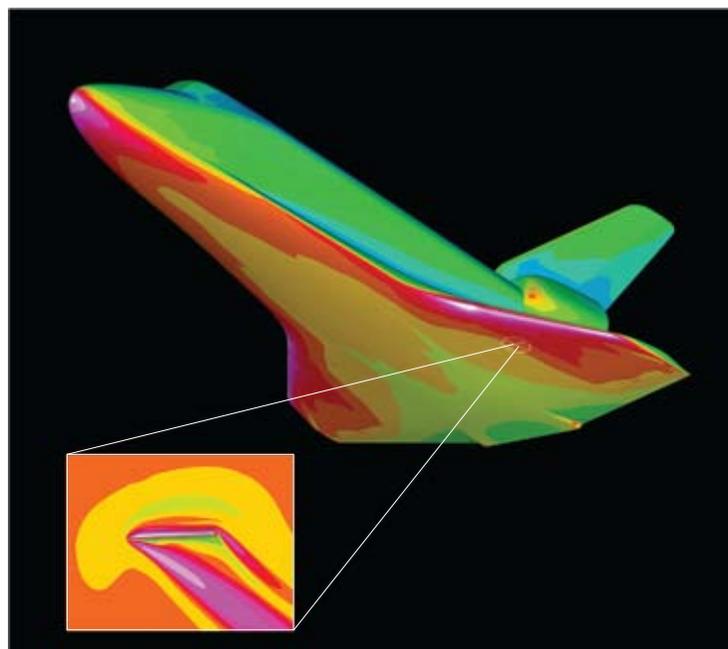
## Space Travel

# Numerical Analysis of Boundary Layer Transition Flight Experiments on the Space Shuttle

The Boundary Layer Transition (BLT) flight experiment was designed to induce the flow to transition from a laminar to a turbulent state. A better understanding of flow transitioning from laminar to turbulent will help NASA engineers design better thermal protection systems for planetary entry vehicles. The first experiment conducted, which consisted of a 4-inch long by 0.25-inch tall protuberance installed on the Space Shuttle, was flown on STS-119 in March 2009. A second flight experiment with a 0.35-inch tall protuberance was recently flown on STS-128 (August, September 2009).

- Numerous computational fluid dynamics (CFD) simulations were used to optimize the height and shape of the BLT protuberance
- Pre-test CFD solutions were computed to estimate the maximum heating rates on the protrusion and areas downstream of the protuberance—these results were then used to determine that the BLT experiments did not pose any safety issues for the Space Shuttle
- Post-test CFD analyses are being computed and compared with flight data—these comparisons will increase our knowledge of flow transition and how turbulence affects surface catalyticity

NASA's supercomputers provided the necessary resources to quickly compute BLT protuberance simulations. The rapid turnaround time allowed us to run numerous simulations to optimize the protuberance shape for minimum surface heating.



*Temperature contours on the Space Shuttle and a close-up of the Boundary Layer Transition protuberance.*