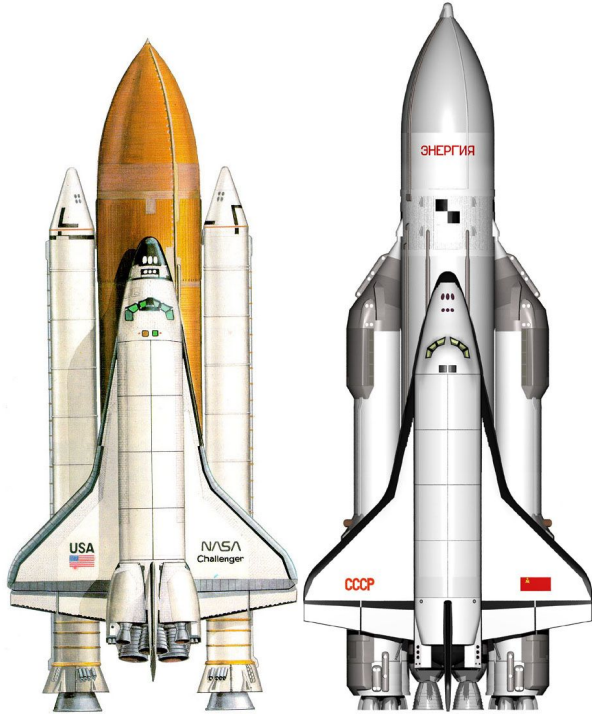


RD-170 Rocket Engine

Dash Slamowitz, Lukas Wolf, Brandon Beckle



Energia/Buran



A space shuttle to
match...
...needed a powerful
engine

Development

1976-1987

NPO Energomash led by Valentin Glushko

The first firing occurred in August of 1980.

Failures and issues in tests continued until 1983, and calls to return to the single chamber NK engine.

Eventual successful development and integration onto the energia boosters





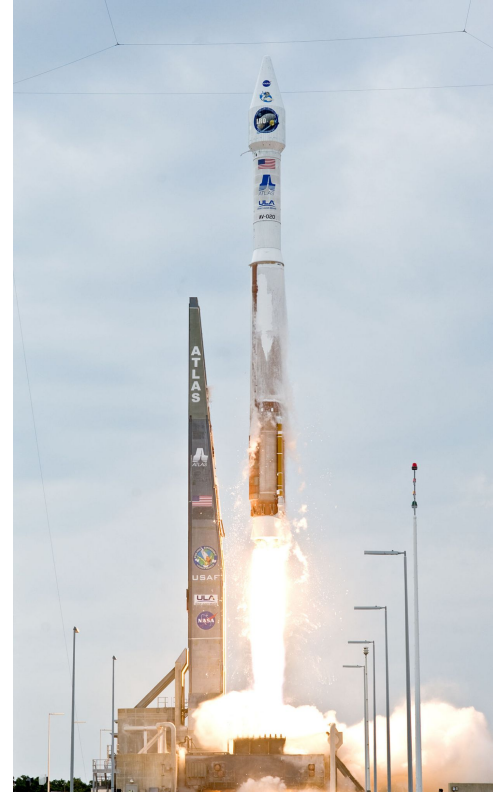


Death of the Buran

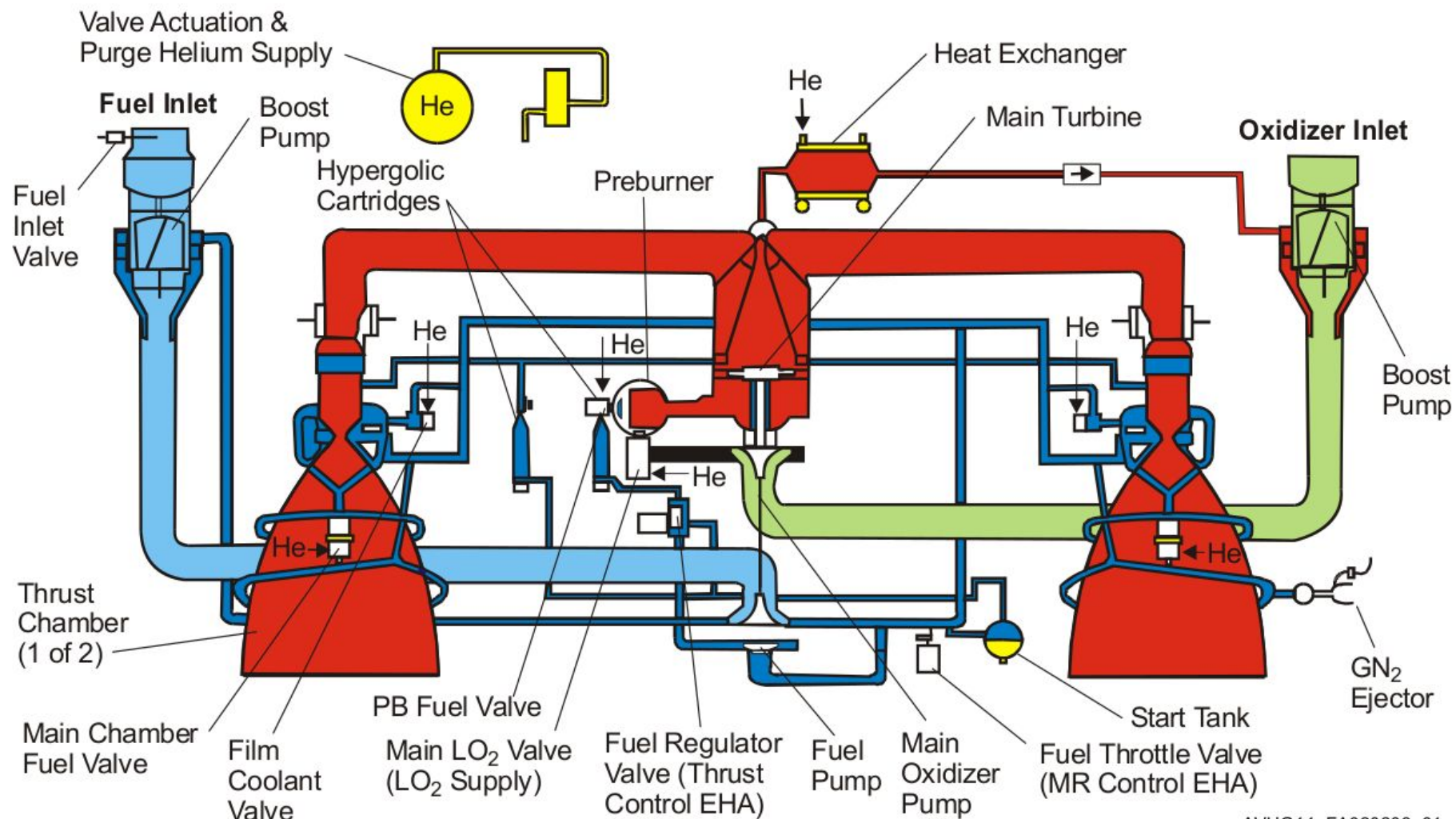
Continued Legacy



RD-180



ULA Atlas V



RD-170 Specifications

Combustion Chambers: 4

Fuel: Kerolox

Mixture Ratio: 2.63

Nozzle Ratio: 36.87

Mass: 9,750 kg

Cycle: Oxidizer rich staged combustion

Thrust: 7,257 kN (sl), 7,904 kN (vac)

Specific Impulse: 309 s (sl), 337 s (vac)

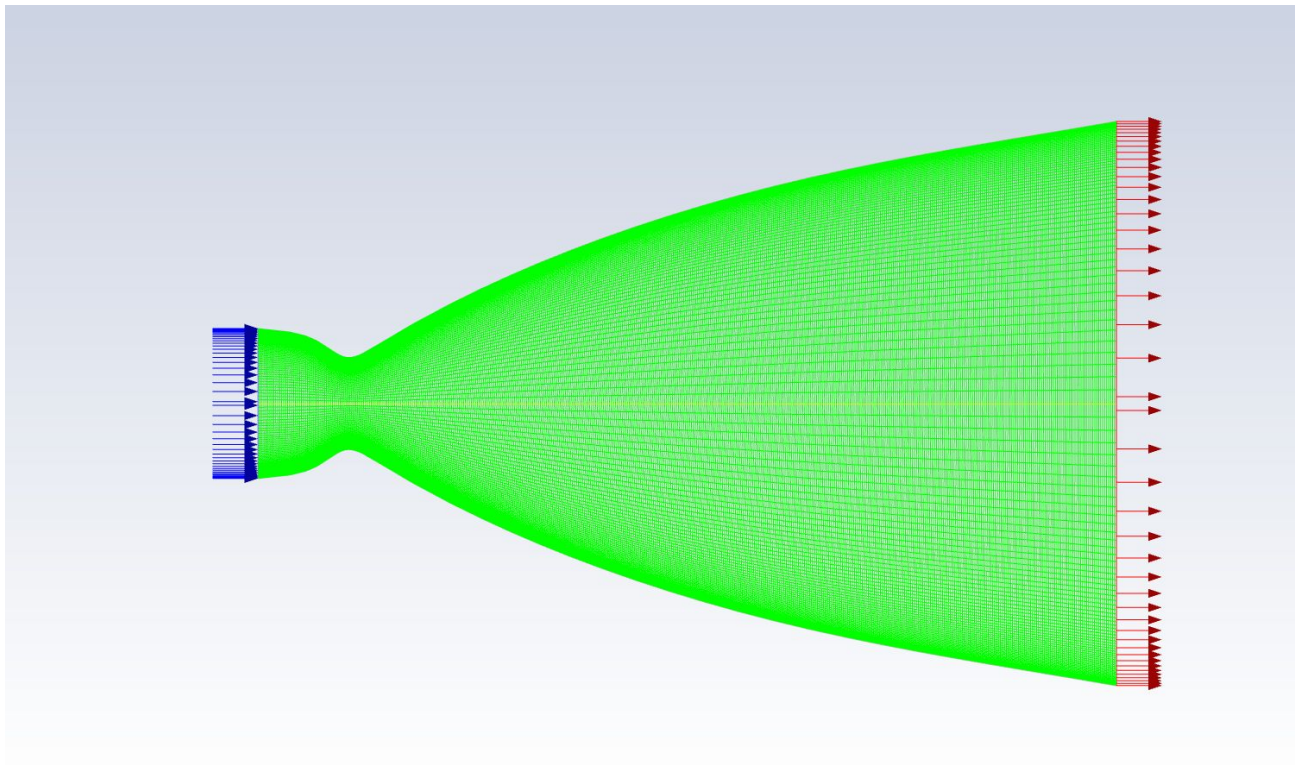
TWR: 36.87

Chamber Pressure: 24.52 MPa

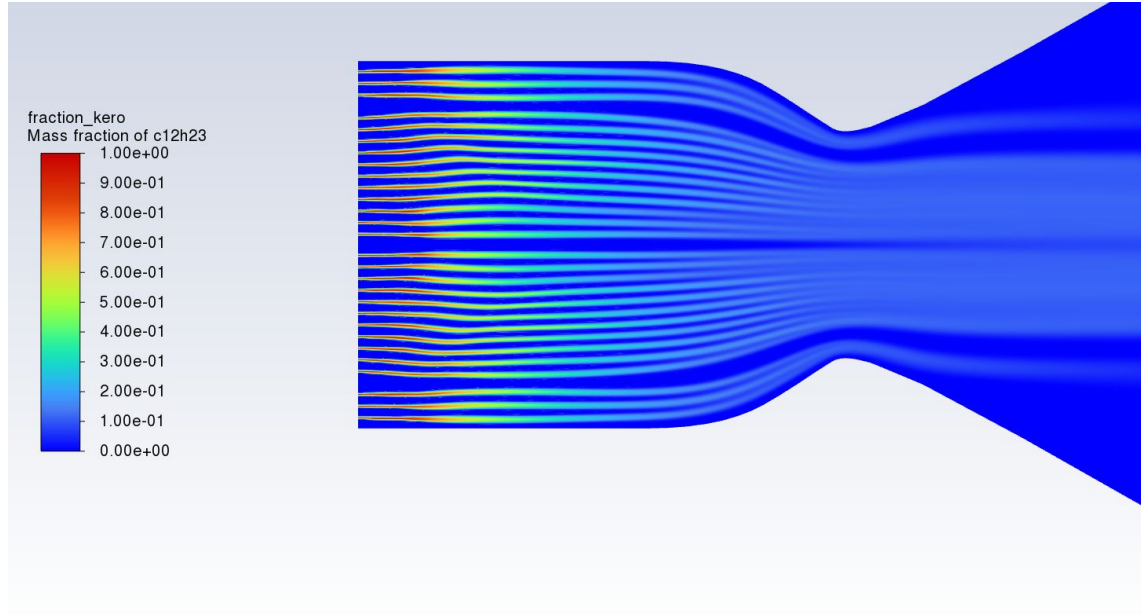
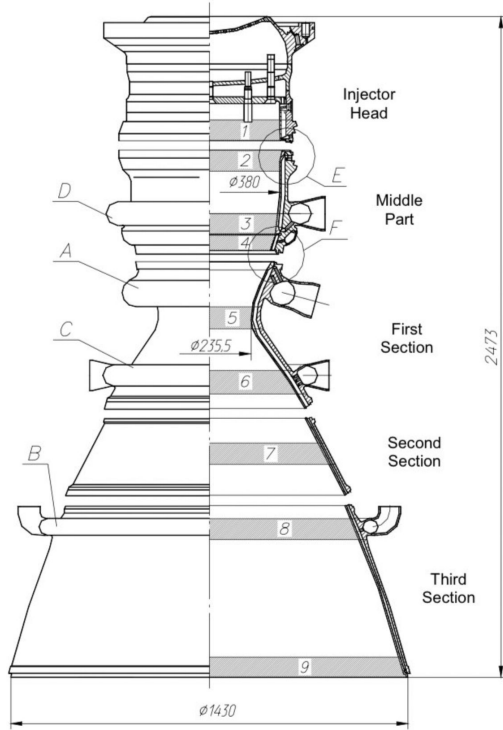
Oxidizer Flow Rate: 432 kg/s

Kerosene Flow Rate: 166.2 kg/s

RD-170/180 Mesh v1



Combustion Simulation



Nozzle Flow Simulation

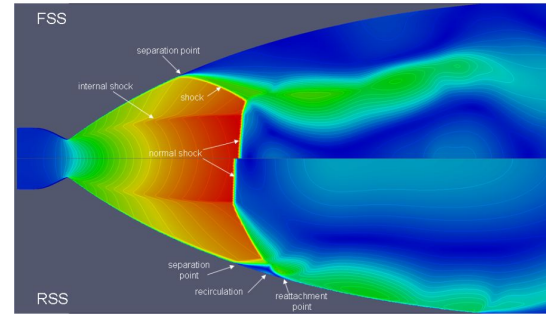
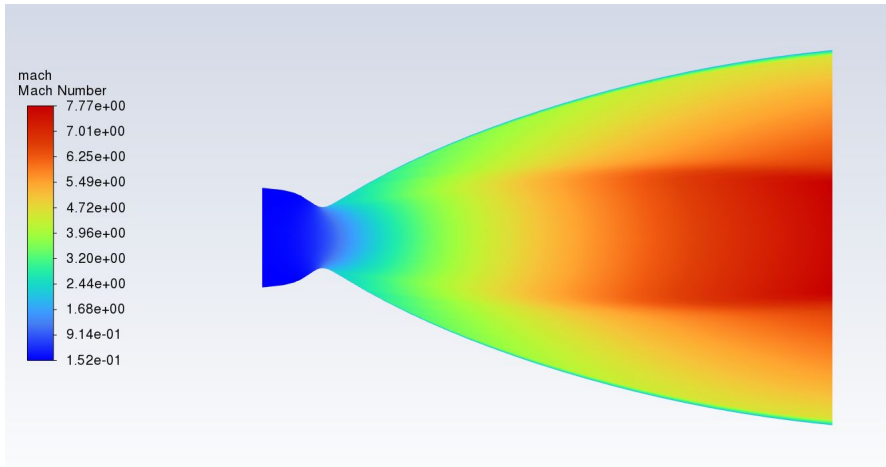


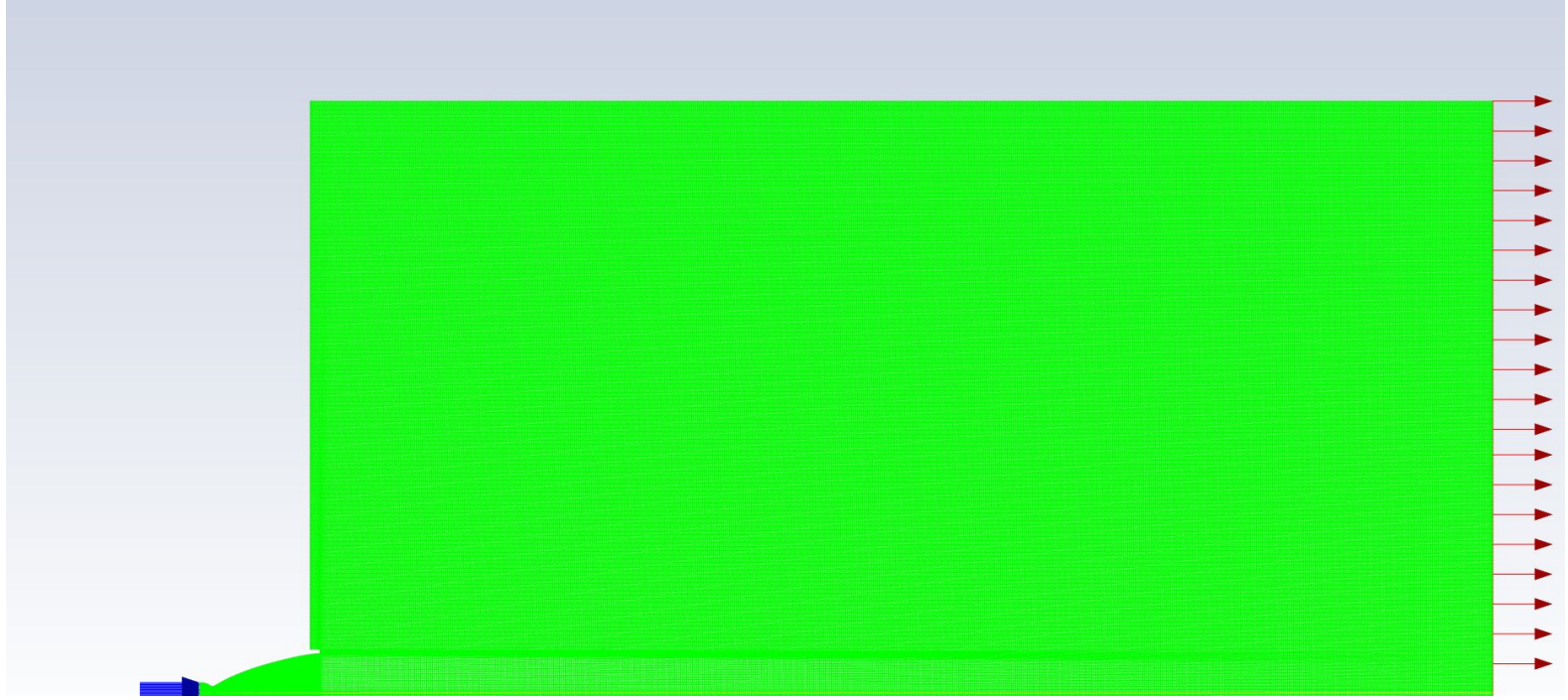
Figure 1. Mach number contours from SSME simulation comparing free shock separation (upper) and restricted shock separation (lower).

$$\frac{A}{A^*} = \left(\frac{\gamma + 1}{2} \right)^{-\frac{\gamma + 1}{2(\gamma - 1)}} \frac{\left(1 + \frac{\gamma - 1}{2} M^2 \right)^{\frac{\gamma + 1}{2(\gamma - 1)}}}{M}$$

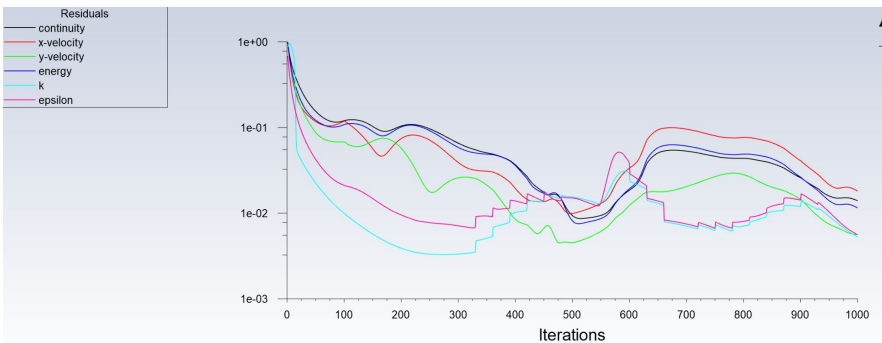
Ansys Exit Mach = 7.8

Analytical Exit Mach = 5.5

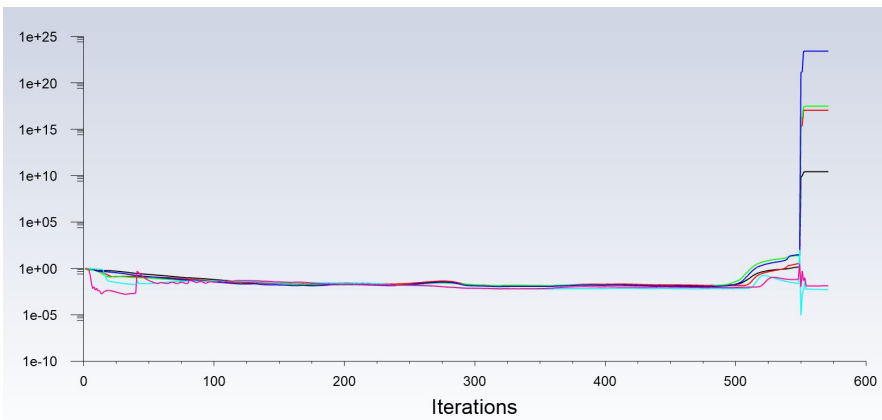
Jet Flow Simulation Setup



Jet Flow Convergence Issues

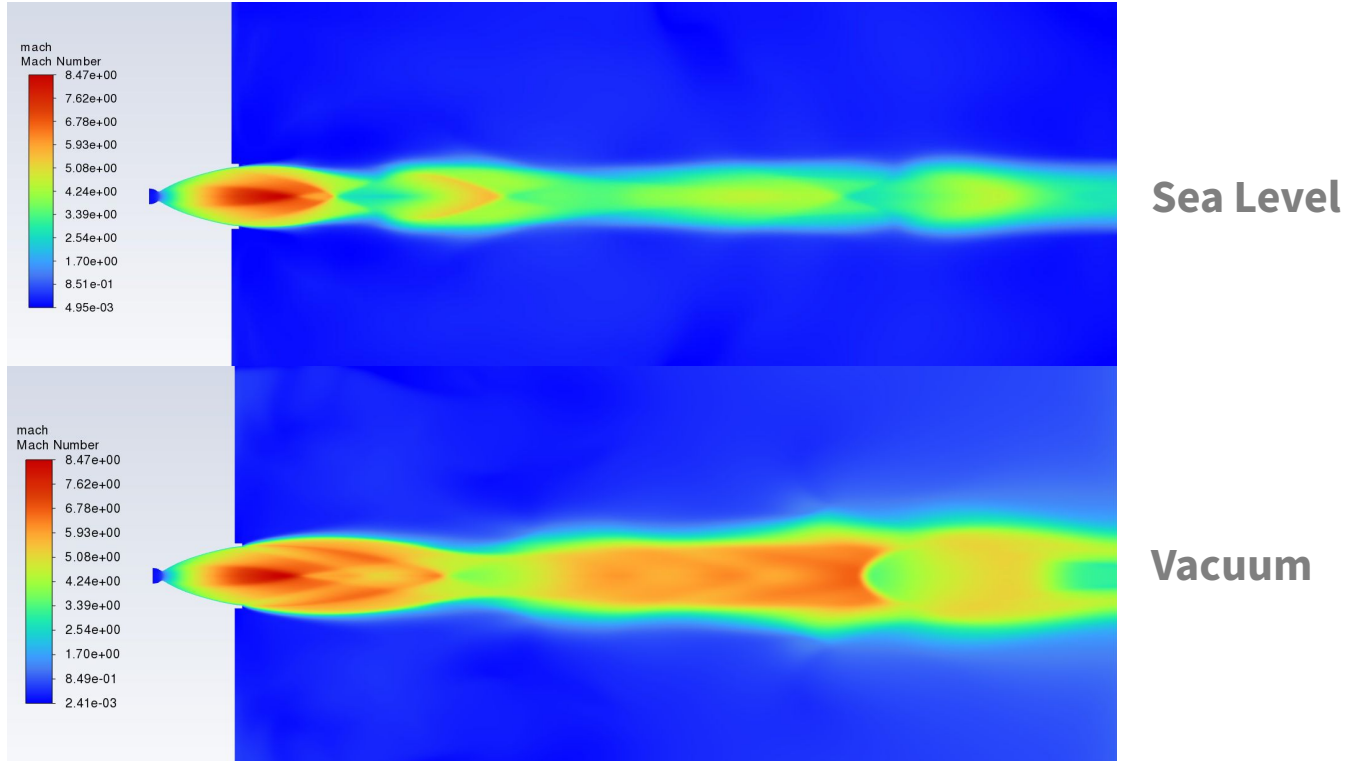


Low Convergence



Simulation Failure

Jet Flow Simulation Results



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