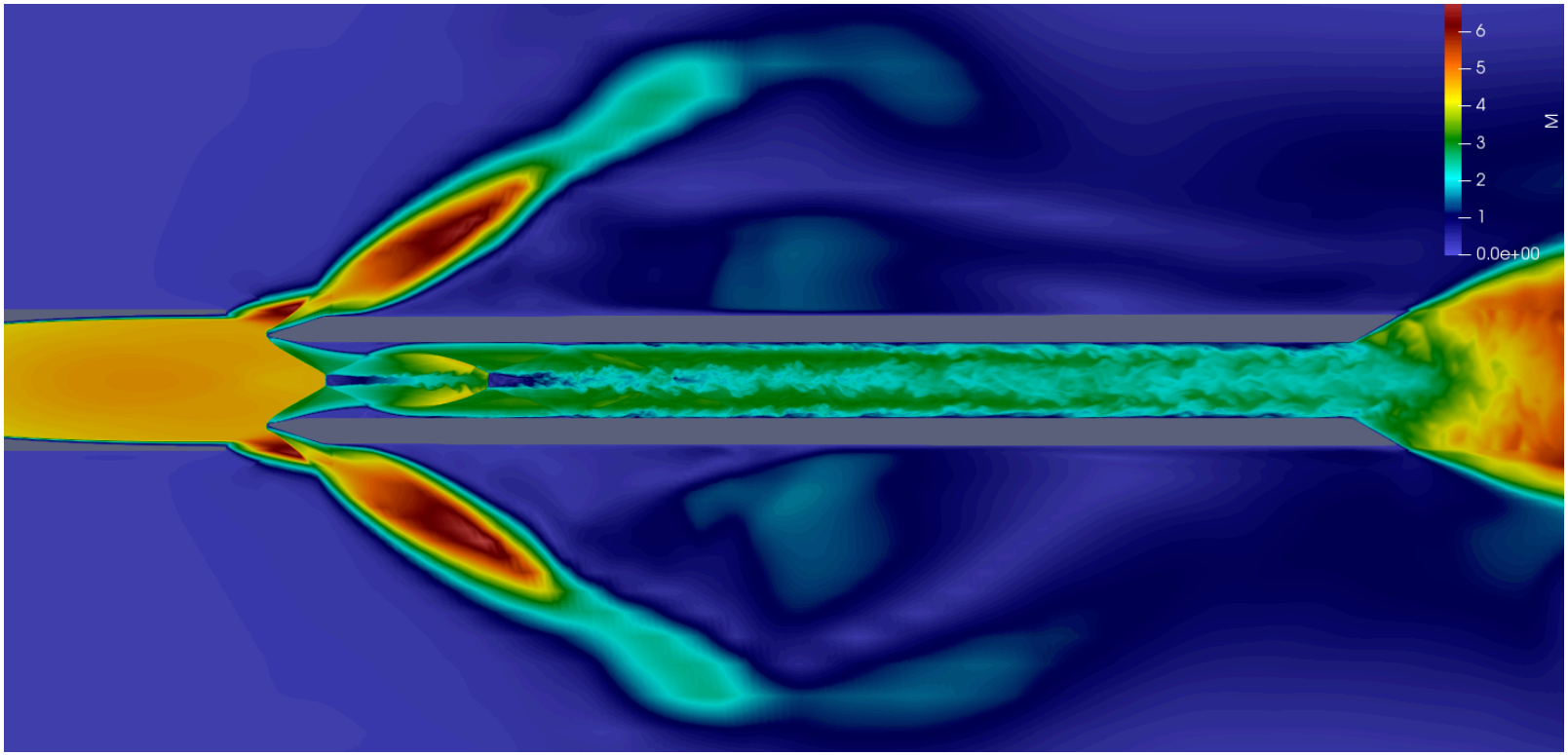
Model Document

Experimental Driver: y0_euler.py



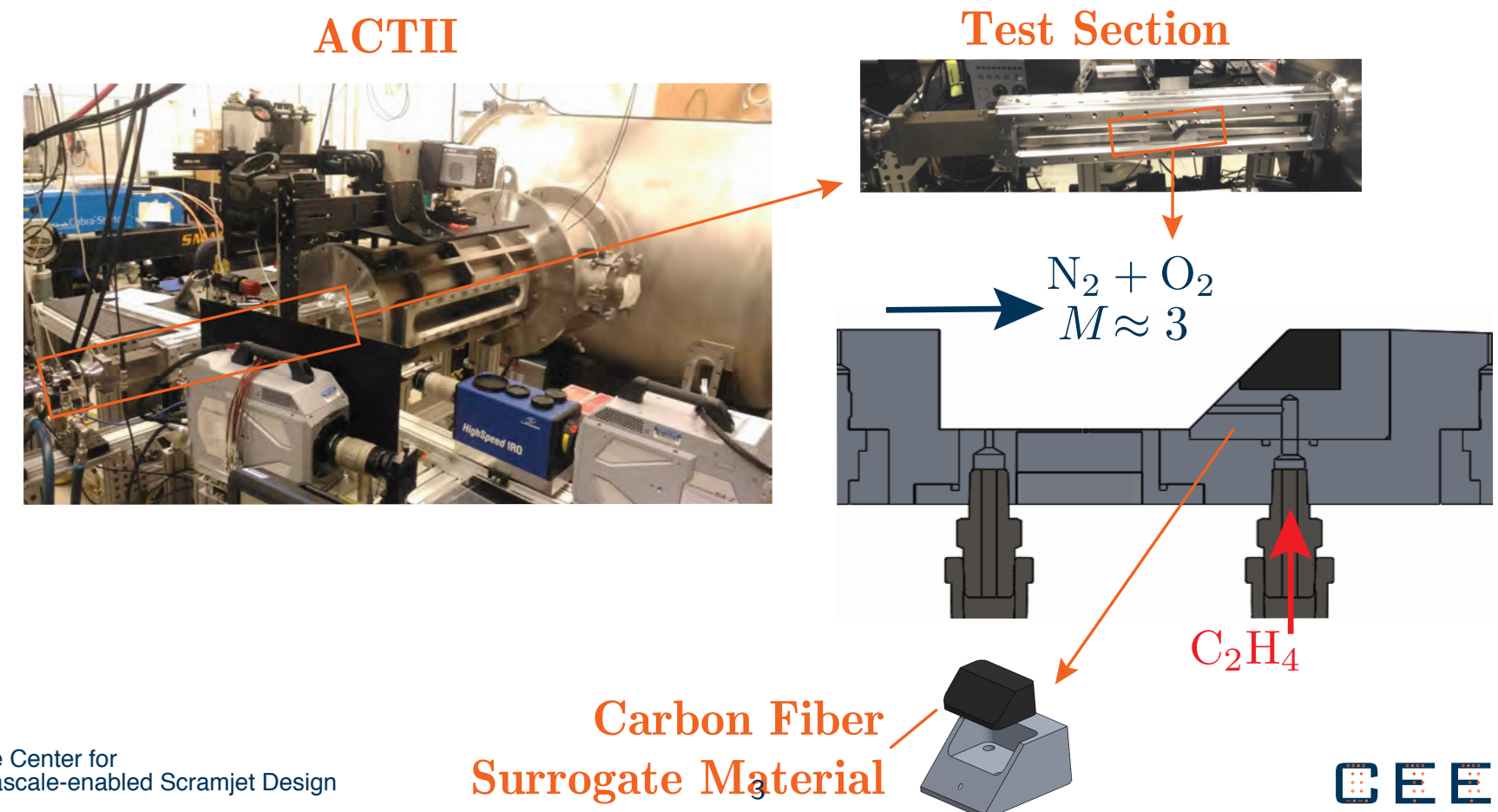
Mike Anderson

Overview

- ACT-II facility, experimental basis
- Numerical Model
- Simulation Initialization
- Sample results

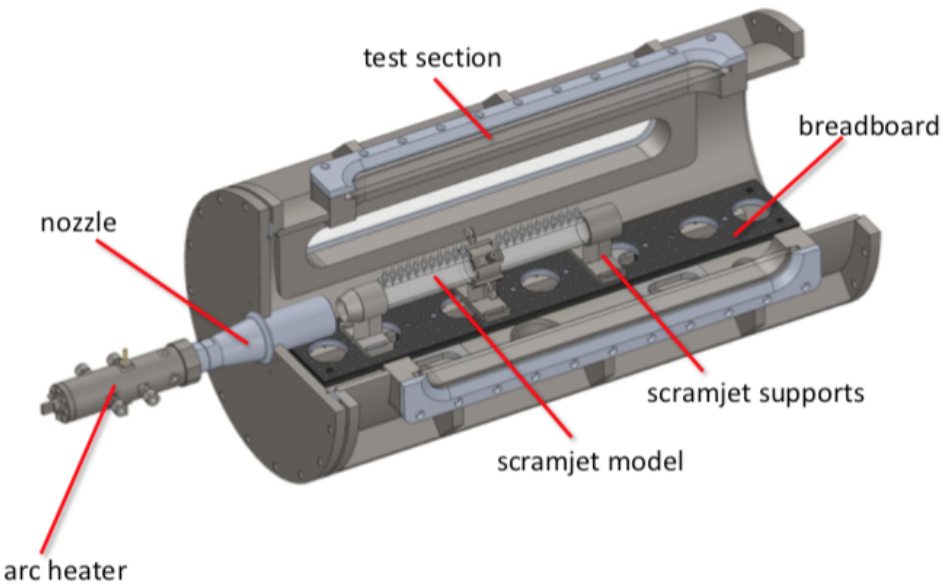
ACT-II Experimental Facility

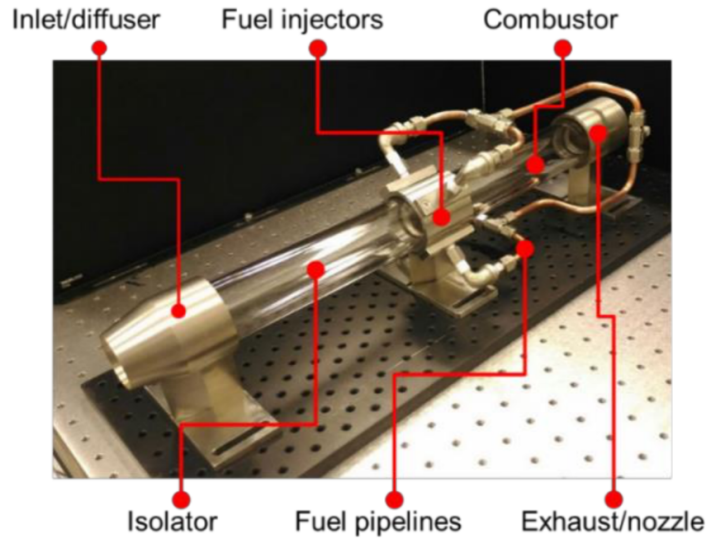
- **ACT-II**: on-campus AFOSR-funded supersonic combustion facility
- Arcjet driven: low cost ($\lesssim$ \$10), low turnaround time ($\lesssim$ 10 min)
- direct-connect or free-jet configurations



Experimental Setup - Unstart in a Free-Jet Scramjet

- ACTII Experimental facility
- Mach 4.5 nozzle
- Varying inlet contraction ratio
- Low (CO_2) and high ($O_2/N_2/C_2H_4$) enthalpy runs
- Mass injection or combustion induced unstart





Baccarella, Experimental Study of Flow Choking and Inlet Unstart in an Axisymmetric Model Scramjet. 2018. University of Illinois.

Modeling Timeline Y0/Y1

Goal: *PlasCom2* simulations provide Y1 prediction and development milestones for *MIRGE-Com*

Y0 Target: October 2020

- Low enthalpy, unstart by mass injection
  - CO_2 flow, N_2 injection
  - 4 port, supersonic injection

Y1 Target: Winter 2020/Spring 2021

- High enthalpy, unstart by mass injection
  - 16 port injector, air injection
- High enthalpy, unstart by combustion
  - 16 port injector, C_2H_4 injection, auto-ignition

Y1 Prediction Targets

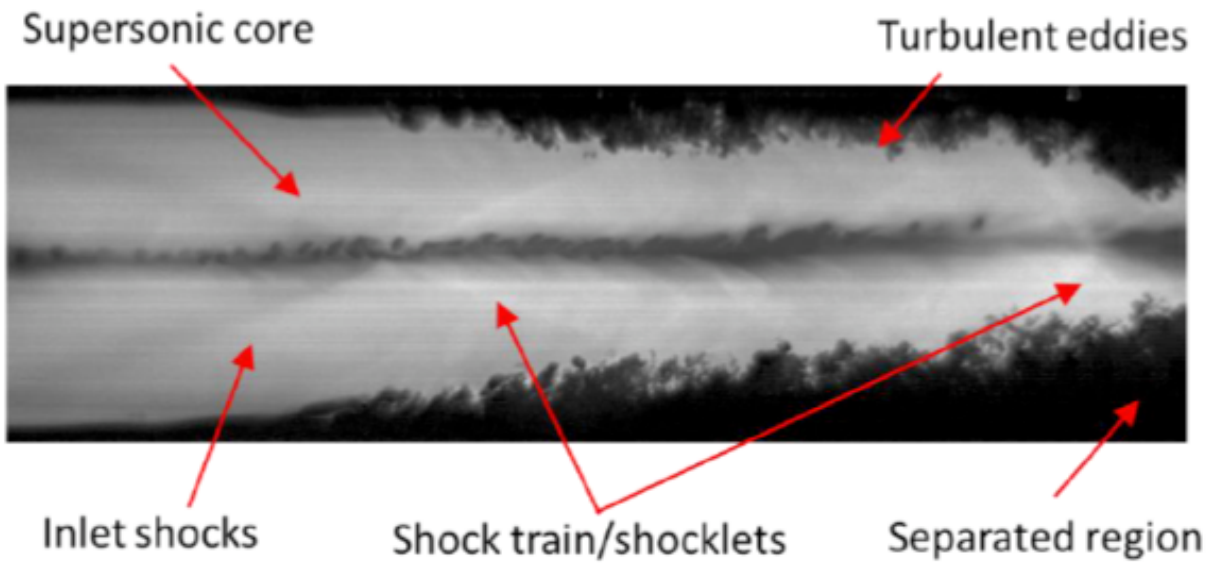
Qualitative

- Unstart Go/No-Go
- PLRS comparison

Quantitative

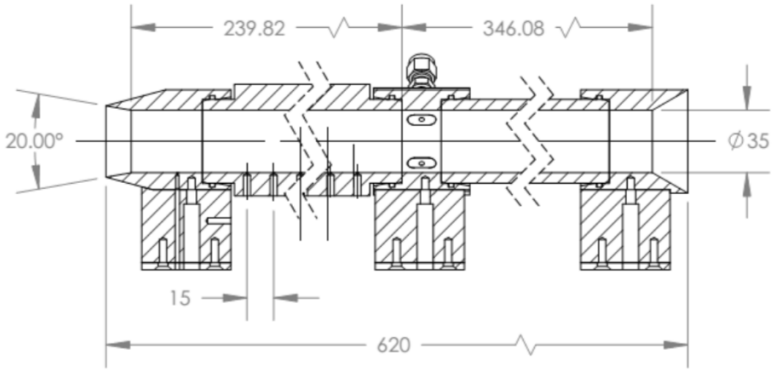
- Scramjet model pressure
- Shock/pressure oscillation frequency

Isolator length	Inlet contraction ratio	Injected mass ratio	Condition Designation	Unstart
Isolator 200 mm	CR=1.3	16.7%	A1	No
		17.8%	A2	No
		19.1%	A3	No
		20.1%	A4	No
		21.2%	A5	Yes
		21.8%	A6	Yes
	CR=1.6	13.2%	B1	No
		14.5%	B2	No
		16.3%	B3	No
		17.2%	B4	No
		17.9%	B5	No
		18.1%	B6	Yes
	CR=1.9	11.8%	C1	No
		12.2%	C2	No
		13.1%	C3	No
		13.9%	C4	No
		14.6%	C5	No
		15.5%	C6	Yes
Isolator 300 mm	CR=1.3	20.2%	D1	No
		21.7%	D2	No
		22.7%	D3	No
		23.8%	D4	No
		25.0%	D5	Yes
	CR=1.6	16.4%	E1	No
		17.1%	E3	No
		18.1%	E3	No
		18.8%	E4	No
		20.0%	E5	Yes
	CR=1.9	14.4%	F1	No
		15.2%	F2	No
		16.0%	F3	No
		16.6%	F4	No
		17.5%	F5	No
		17.6%	F6	Yes



Numerical Setup - PlasCom2

- Mesh generation tool based on CAD
- Nine overset meshes
- Variable resolution in nozzle, scramjet model
  - HalfX - $9.8M$
  - OneX - $69M$
  - OneX+ - $170M$
  - OneX++ - $973M$
- OneX resolution sufficient to resolve inlet shocks and nozzle boundary layer
- Increase scramjet interior resolution to capture turbulence leading to unstart

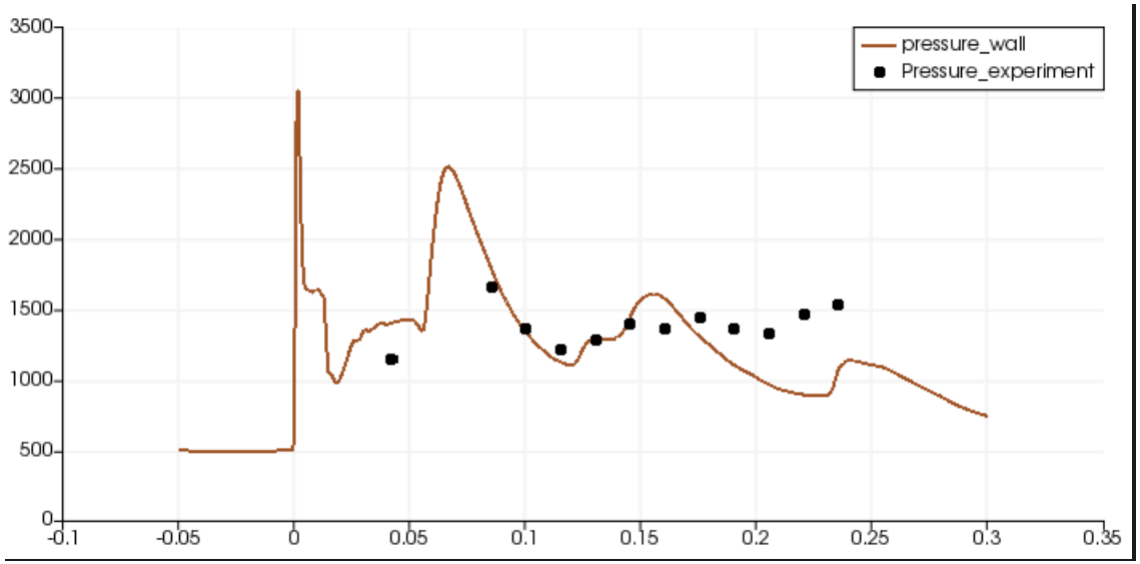


Figures/inletMesh.pdf

Figures/meshPieces.pdf

physics (eqns) eos (model closure) boundary conditions (numerical closure) initialization sample results

Sample Scramjet Interior Pressure?



- Favorable comparison for initial shock structures
- Under-resolved BL structures?

CEESD

Questions?

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