NWTF
NATIONAL WIND TUNNEL FACILITY

UNIVERSITY OF OXFORD

T6 Multi-mode Shock Tunnel

University of Oxford
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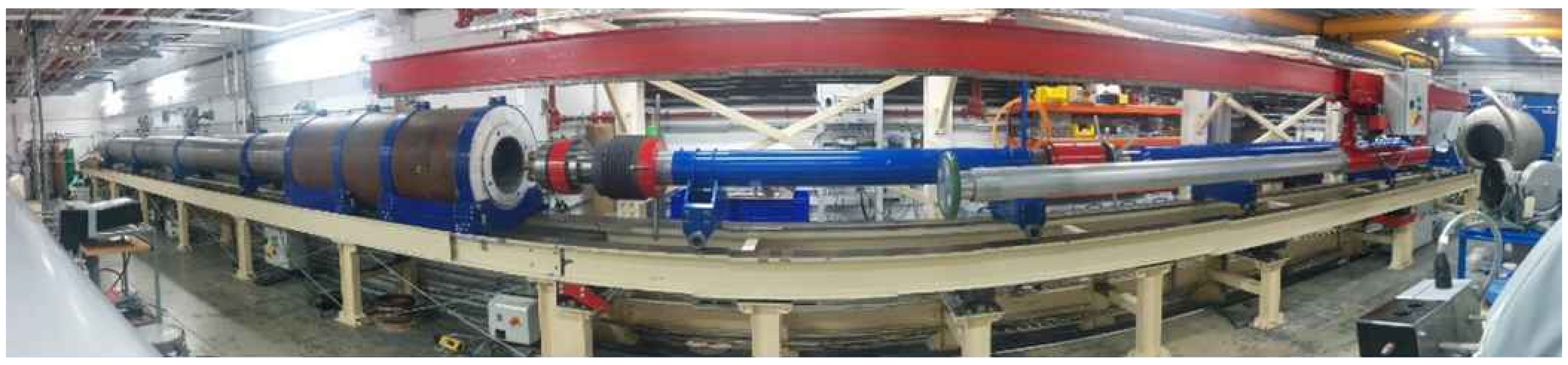
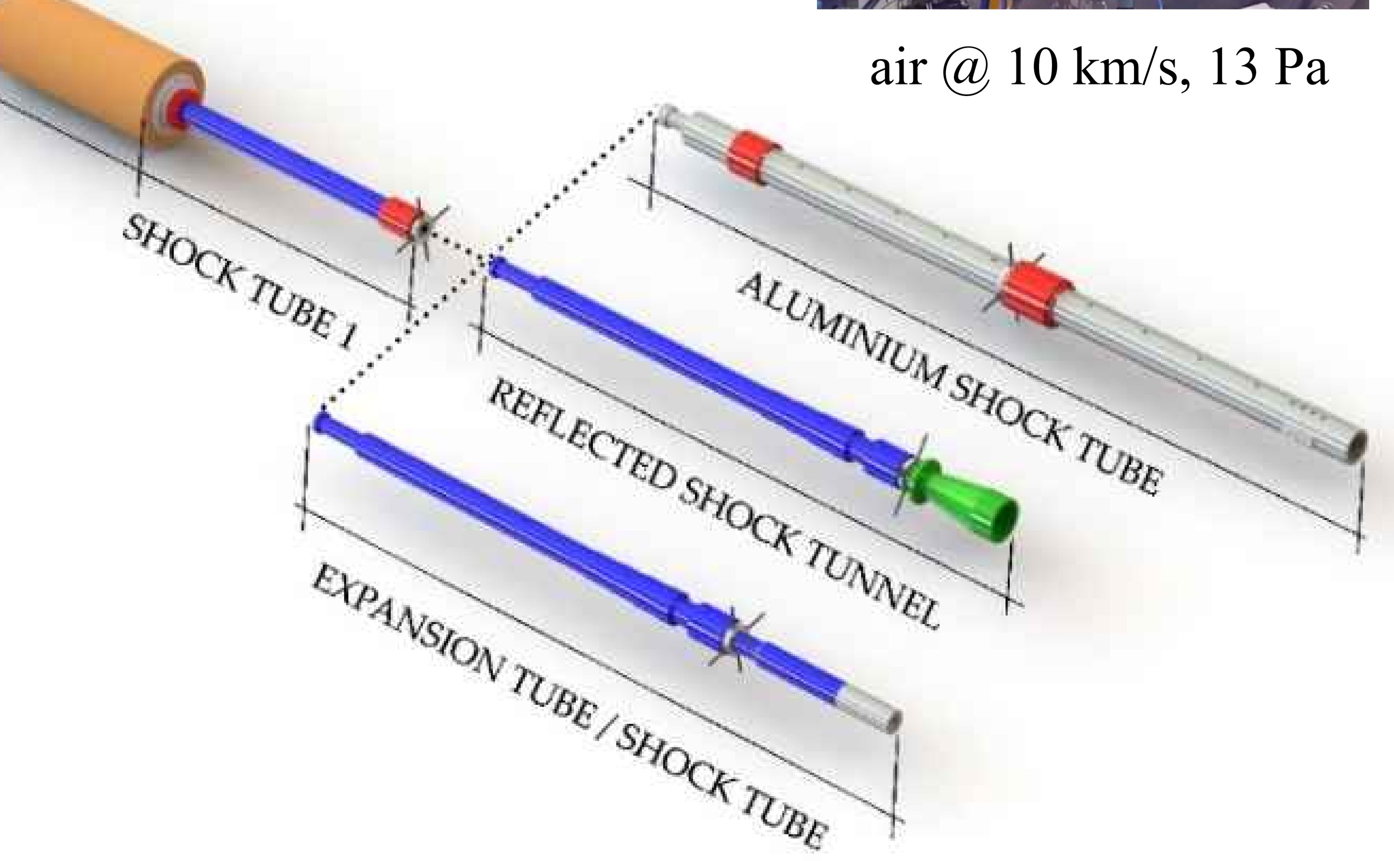
Facility



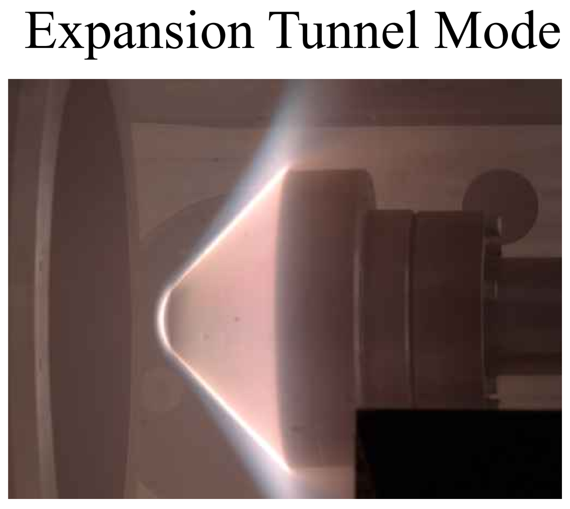
FREE PISTON DRIVER



Aluminium Shock Tube Mode

air @ 10 km/s, 13 Pa

Expansion Tunnel Mode



45° sphere cone.
85%H_2/15%He, 18 km/s

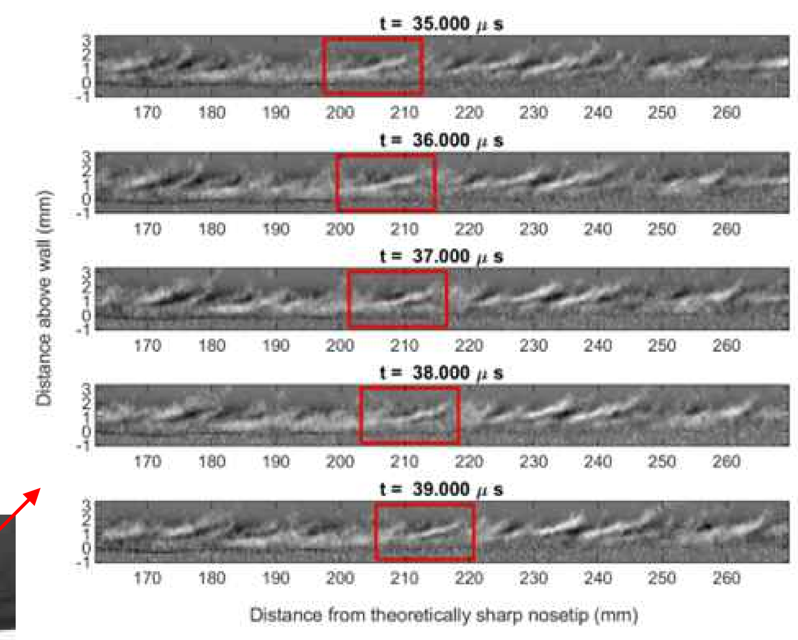
	Reflected Shock Tunnel	Expansion Tunnel	Shock Tube
Testing type	Subscale model	Subscale model	Radiation / Thermochemistry
Test duration	1-3 ms	50-500 µs	2-50 µs
Core flow diameter	150-200 mm	50-120 mm	96.3/225 mm
Max flow speed	6.5 km/s	12 km/s	18 km/s

Industrial & Academic Partners

The University of Queensland Australia
Universität Stuttgart
Boulder
NASA
esa
Engineering and Physical Sciences Research Council
Ministry of Defence
UK SPACE AGENCY
QINETIQ

Boundary Layer Transition Mechanisms

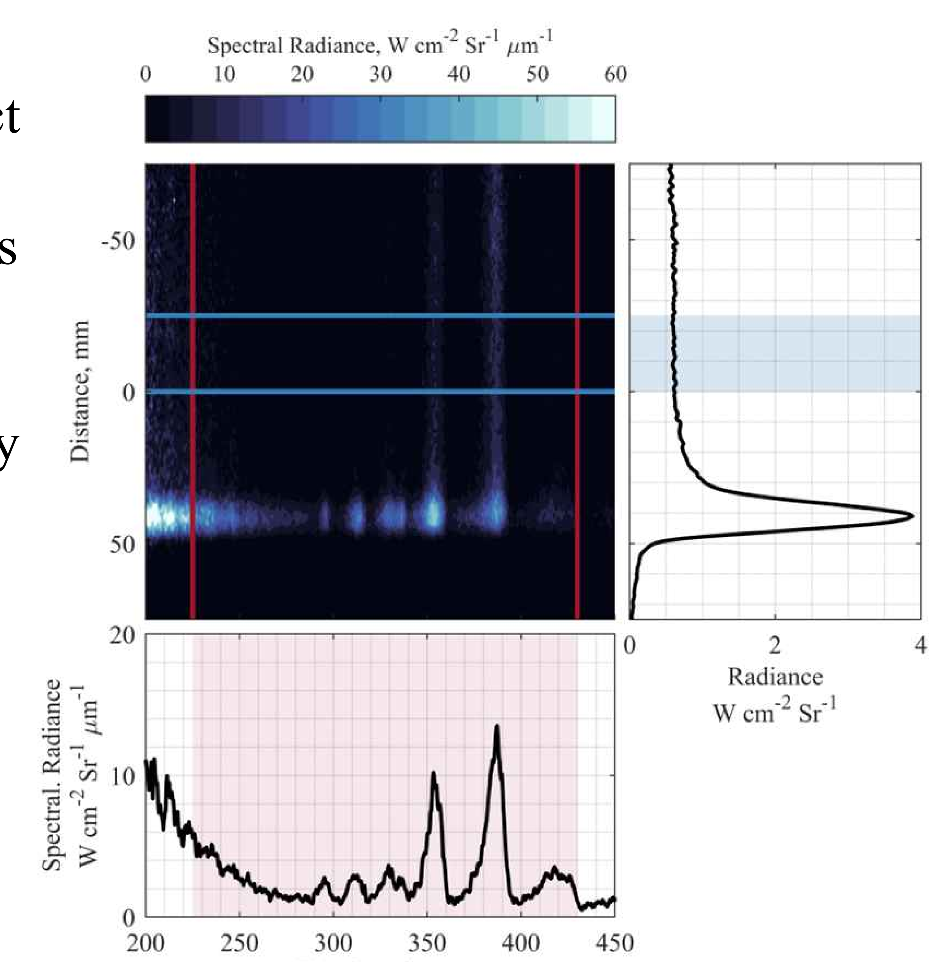
- 2nd Mack mode boundary layer instability dominates and effected by thermochemistry
- Mach 7 flight condition in RST mode:
  2.4 MJ/kg, p_0 = 35 MPa



- Schlieren applied at 2Mfps on a 7 degree cone
- 2nd Mack mode wave packets observed
- Non-modal effects measured at higher speeds

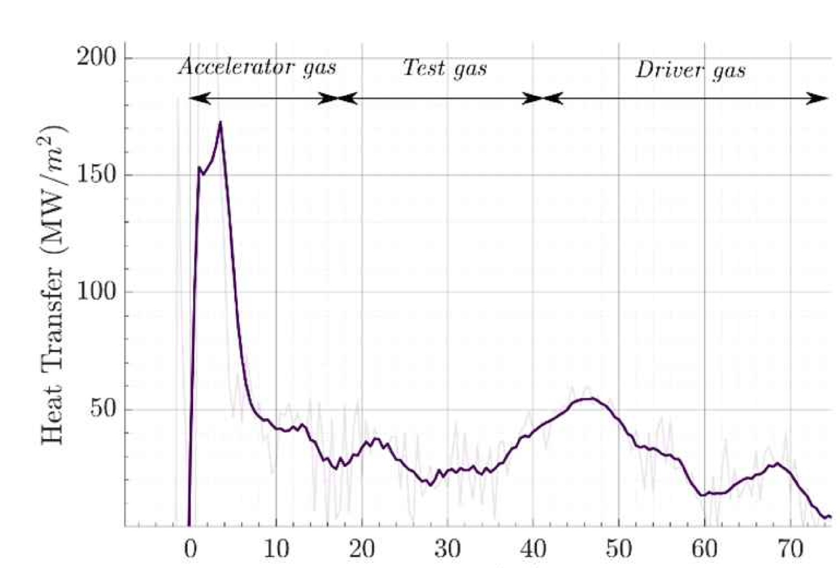
Shock Layer Radiation

- Radiation becomes dominant heating effect for Earth return at Lunar return conditions
- Effect of shock speed variation quantified to allow for higher quality analysis in future
- Testing undertaken in AST mode:
  10 km/s @ window, 13.3 Pa
- Optical Emission Spectroscopy used in visible range, 500 ns



Convective Heating

- Convective heating needs to be measured for various hypersonic vehicles,
- Testing for Ice Giant entry in ExT mode:
  85%H_2/15%He, 18 km/s



- Measurements of heat flux with surface abraded coaxial thermocouples @ 2 MS/s
- Difficulties in measuring in highly ionised flow-field → future use of Diamond based calorimeter gauges