

**Selected Applications of Laser Diagnostics
to Free-piston Shock Tunnel Flows
by the ANU/ADFA Collaboration**

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ABSTRACT

Since their invention in the 1960's, free-piston shock tunnels have proved to be very useful facilities for the ground testing of atmospheric re-entry vehicles and advanced scramjet propulsion concepts. They also produce flows that present significant challenges to laser-based measurement techniques, including very short flow duration, chemical and vibrational nonequilibrium and highly luminous flow. The research groups at the University of New South Wales, Australian Defence Force Academy and the Australian National University have developed a suite of laser-based diagnostic techniques that can overcome these obstacles and allow measurement of flow properties of fundamental importance such as temperature, velocity and species mole fraction.

The presentation will highlight selected case studies of flows investigated over the last decade including nozzles, bluff bodies, hypersonic boundary layers, hypersonic separated flow and supersonic combustion to illustrate a range of issues in the application of different techniques to these facilities. Planar laser-induced fluorescence, coherent anti-Stokes Raman spectroscopy and tuneable diode-laser absorption spectroscopy will be discussed in terms of their application to these problems.

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