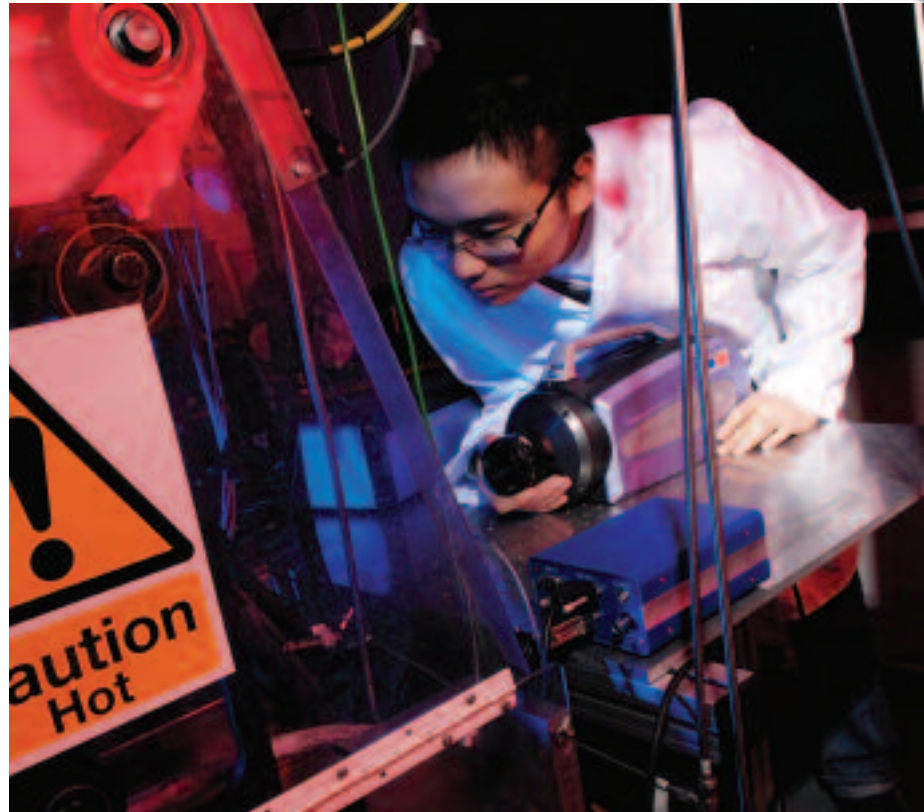
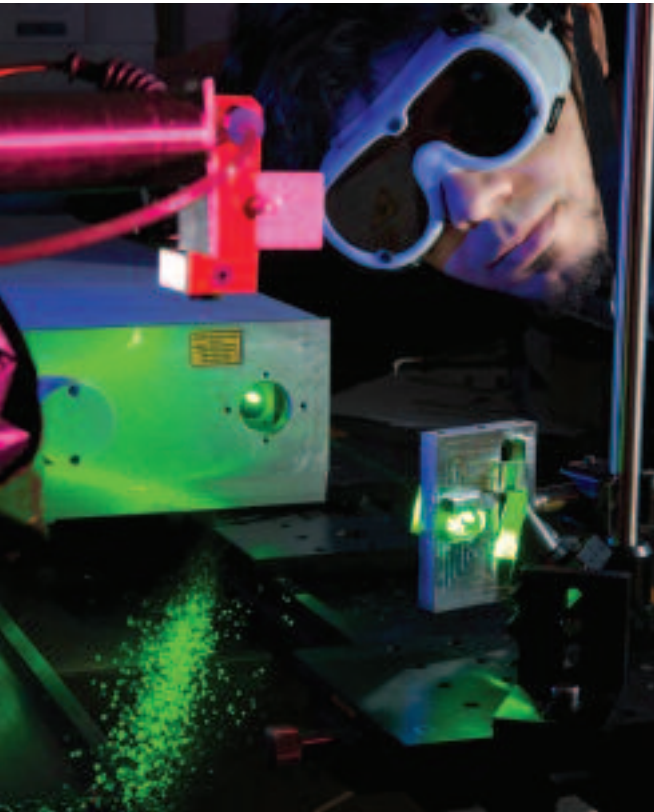


SCIENCE CITY RESEARCH ALLIANCE

UNIVERSITY OF  
BIRMINGHAM

THE UNIVERSITY OF  
WARWICK



# FUTURE ENGINES AND FUELS RESEARCH

## Optical diagnostics of flow and combustion

Optical diagnostics is an advanced tool used in the research and development of various products involving flow and combustion across domestic, industrial and transport sectors. New cutting edge diagnostics capabilities place the Science City Research Alliance at the forefront of research into the optimization of flow and combustion processes and system designs. One of the main applications is in improving the efficiency of combustion engines in order to achieve high fuel economy and low carbon emissions.

### TYPICAL APPLICATIONS INCLUDE (NOT EXCLUSIVELY):

- Household burners
- Large scale local heating
- Power stations
- Steel furnaces
- Internal combustion engines
- Gas turbine engines

### KEY FEATURES AND TECHNICAL SPECIFICATIONS:

#### Based at the University of Birmingham

- A PIV/LII/LIF system for mixture preparation and combustion diagnostics. It consists of a TDL90 dye laser, pumped by a Nd:YAG laser, covers a range from 200nm to 450nm, with max. energy 20-500 mJ/pulse). It can measure flow field velocity vectors and turbulence, soot concentrations, mixture distributions and combustion product species in the engine cylinder. The system includes:
  - 2D high speed (7.5kHz) Particle Image Velocimetry (PIV) - planar measurement of flow field, continuous velocity measurement with data acquisition;
  - 3D Laser Doppler Anemometry (LDA) point measurement of velocity and turbulence;
  - 3D Phase Doppler Anemometry (PDA) point measurement of liquid droplet velocity and size distribution;
  - 2D tuneable Planar Laser Induced Fluorescence (PLIF) - quantitative measurement of in-cylinder fuel mixture and combustion product distribution with high temporal and spatial resolution; and
  - 2D Planar Laser Induced Incandescence (PLII) - soot formation and distribution measurement.
- A Phantom speedsense V710 high speed ICCD camera with (1024x1024@3000fps, 512x512@10,000fps, top speed 1,500,000fps) colour imaging system with an intensifier can be used for the study of combustion phenomena.
- A Shimadzu Hyper Vision HPV2 (Maximum speed: 1,000,000 fps Resolution: 320\*240 fixed) ultra-high speed camera is used for recording ultra-high-speed phenomena not previously possible in a wide variety of fields that require high-speed image capture, involving fluid dynamics, fuel spray and combustion.

#### Based at the University of Warwick

- A boreoscopic engine investigation system that allows investigation of an internal combustion engine using an endoscope approach, providing an in-cylinder visualisation system which can be operated in conjunction with a number of well accepted flow measurements techniques - PIV, laser fluoresce and direct light emission being examples.

- A phase sensitive holographic camera which can create a remotely measured three dimensional temperature map in different thermal and combustion environments. There are three possible environments for the camera to operate: general air temperature diagnostic typical for a model of a heating system for a building; exhaust density and temperature structure directly behind a gas turbine combustor; and the temperature field within an internal combustion engine.
- A passive optical emission tomographic system with 30/40 solid state photomultipliers, with associated tomographic software and engine gasket. Fibre optics connected to the photomultipliers can take optical measurements of the combustion process within an internal combustion engine. The signals have a high optical noise component and high gain.

### WORLD LEADING EXPERTISE

Professor Hongming Xu, located at the University of Birmingham, and Professor Peter Bryanston-Cross, based at the University of Warwick, have an international reputation in the field of optical diagnostics of flow and combustion. Professor Bryanston-Cross is working with Rolls Royce, QinetiQ and Cubewano to develop their engine technologies. Professor Xu is currently principal investigator of two large EPSRC and TSB funded research projects in combustion research, a diesel emissions project sponsored by Jaguar Land Rover and an alternative gasoline fuel project sponsored by Shell. The Professors and their research teams can also provide industry with bespoke training courses in this research field.



For further information and enquiries, including proposals for research collaboration and consultancy:

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Birmingham Science City

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investing  
in your future  
European Regional Development Fund  
European Union



These new research facilities are part of the Science City Energy Efficiency and Demand project funded by Advantage West Midlands and the European Regional Development Fund. The project is part of a wider investment in research infrastructure of the West Midlands region, which unites the Universities of Birmingham and Warwick in the newly-formed Science City Research Alliance.