Photonics and Ultrafast Laser Science

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Frontiers of ultrafast optics driven with hollow-fibre light sources

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ABSTRACT

Nonlinear optics is required to develop new light sources that go beyond the range of wavelengths and pulse durations naturally achieved with laser systems. Despite being more than six decades old, the field of nonlinear optics is still a rich source of research and surprises. Over the last two decades, the use of gas-filled hollow fibres as a platform for pushing the boundaries of nonlinear frequency conversion and pulse compression has become established. In my research group we are pushing this platform to its extremes.

In this seminar I will present the extreme soliton (XSOL) beamline, the most ambitious systems under development in my labs, which we hope will unlock access to high brightness table-top attosecond X-ray and electron pulses for the first time. This system is capable of delivering terawatt-scale, sub-femtosecond optical attosecond pulses alongside sub-2 fs deep-and vacuum-ultraviolet radiation with peak powers exceeding 60 GW. Apart from experimental complications, modelling and characterising the pulses propagating through this system has proved both challenging and enlightening. I will present our latest techniques and results. THz spectroscopy and as a first demonstration, we successfully reproduced the magnon dynamics in YFeO3 using on-chip 2D-THz spectroscopy. This work advances waveguide-based THz spectroscopy into the nonlinear regime, which offers exciting possibilities for measuring microscopic samples and in space-constrained experimental geometries. THz field enhancement structures deposited on the waveguides may enhance the field sufficiently to even enable far-from-equilibrium excursions.

ABOUT THE SPEAKER

John C. Travers is a Professor of Physics at Heriot-Watt University in Edinburgh, Director of the Laboratory of Ultrafast Physics and Optics, and Royal Academy of Engineering Chair in Emerging Technologies.
John has made multiple significant contributions to ultrafast nonlinear optics and is recognised as a pioneer in using gas-filled hollow waveguides for ultrafast frequency conversion, pulse compression and supercontinuum generation. John earned his M.Sci from Durham University (2003) and Ph.D from Imperial College London (2008), winning the European Physical Society's Quantum Electronics Thesis Prize. After positions at Imperial College London and the Max Planck Institute for the Science of Light, he joined Heriot-Watt in 2016. His awards include ERC Starting (2015) and Consolidator (2020) Grants, IET A F Harvey Engineering Research Prize (2022), and a Royal Academy of Engineering Chair in Emerging Technologies (2024). He is a Fellow of Optica and the Royal Society of Edinburgh.