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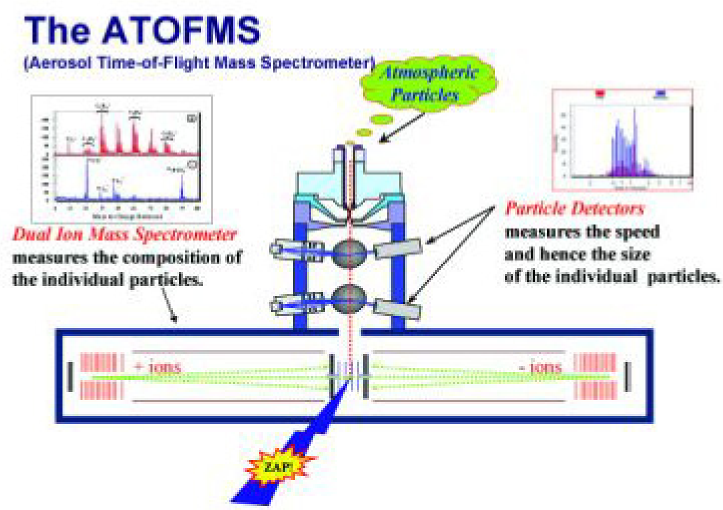
Research Interests: photochemistry, excited states, spectroscopy, ionic states, laser analysis, atmospheric chemistry and free-electron lasers

Our research is aimed at studying both the chemistry and structure of excited and ionic states of molecules, using laser and synchrotron radiation. We are also using lasers and other advanced light sources to develop new analytical techniques.



Laser Spectroscopy and Photochemistry

We use a variety of single and multiphoton laser techniques to explore the excited states of molecules such as ozone and molecular oxygen. We also use double resonance methods, together with jet cooling, to simplify complex spectra. We have shown that it is possible to obtain the spectra of molecules as they are in the process of dissociating (i.e. on the femto-second timescale). This opens up large new areas of spectroscopy and allows us to avoid the normal Franck-Condon restrictions.

High Resolution Laser Photoelectron Spectroscopy

The development of zero kinetic energy (ZEKE) photoelectron spectroscopy has revolutionised the field of ionic state spectroscopy in that it offers a level of resolution up to three orders of magnitude better than conventional photoelectron spectroscopy. This level of resolution allows us to determine both the detailed structure of ions and ionisation energies, to very high precision. In addition, species such as van der Waals complexes and free-radicals, which can be produced in our free jet expansion, are being studied. More information on ZEKE and related techniques can be found at the Home Page of the Edinburgh ZEKE Group (http://homepages.ed.ac.uk/zeke/).

Laser Analysis

The focused output from a laser can be used to evaporate the surface of materials and form a mild plasma. Ions are produced and a mass spectrum of the material can be obtained. Various methods of sample preparation are used to enhance the ionisation process.

Aerosol Research

We are studying atmospheric aerosols using a new technique known as single particle mass spectrometry (see the figure above). This technique allows us to directly determine the size and chemical composition of individual particles in the atmosphere, in real time.

SELECTED RECENT PUBLICATIONS

1. H.H. Telle, A. G. Urena, and R.J. Donovan, "Laser Chemistry: Spectroscopy, Dynamics & Applications", John Wiley, 2007
2. V.A. Alekseev, T. Ridley, K. P. Lawley and R. J. Donovan, "Evidence for amplified spontaneous emission from the and Î³1$_u$($^3P_2$) ion-pair states of I_2 excited by optical optical double resonance", *Chem. Phys. Letters,* 2007, **443**, 34-39
3. D.C.S. Beddows, R.J. Donovan, R.M. Harrison, M.R. Heal, R. Kinnersley, M.D. King, M-J. Schofield and K.C. Thompson, "Variations in the chemical composition of the rural background atmospheric aerosol determined in real time using time-of-flight mass spectrometry", *J. Env. Monitoring*, 2004, in press.
4. P. O'Keefe, T. Ridley, K.P. Lawley, R.J. Donovan, H.H. Telle, D.C.S. Beddows, and A.G. Urena, "An optical-optical double resonance study of the perturbed O_2 d3sσ $_g$($^1\Pi_g$) Rydberg state excited via single rotational levels of the b($^1\Sigma_g^+$) valence state", *J. Chem. Phys.*, 2000, **113**, 2182-2187.
5. P. O'Keeffe, T. Ridley, K.P. Lawley, R.R.J. Maier and R.J. Donovan, "Kinetic energy analysis of O($^3P_0$) and O_2(b$^1\Sigma^+_g$) fragments produced by photolysis of ozone in the Huggins bands", *J. Chem. Phys.*, 1999, **110**, 10803-10809.