**Exploring Atmospheric Photochemistry using Ultrafast Laser Spectroscopy**

**About the project or challenge area:** Photochemical reactions are of vital importance in the natural world, and are exploited in many areas of science, technology, and medicine. For example, they initiate the mechanisms of animal vision, drive photosynthesis, affect air quality in our cities, and are central to advances in cell imaging using fluorescence microscopy. Photochemical reactions begin with absorption of light by molecular chromophores, leading to electronic and structural changes in the absorbing molecules. In natural and artificial systems, these chromophores are often surrounded by a complex environment such as an aqueous solution or a protein, with the surroundings playing a crucial role in controlling the photochemical outcomes. This research project will contribute to a major new EPSRC-funded programme of research *Ultrafast Photochemical Dynamics in Complex Environments* (EP/V026690/1, led by the University of Bristol) to explore how molecular-level interactions with the surrounding environment affect the photochemical pathways of molecules of environmental, biological, and technological importance. The project will apply transient absorption spectroscopy using the ultrafast laser system at the University of Bristol to study the photochemical changes that occur in aqueous solution for selected compounds of atmospheric importance. The three target molecules are glyoxylic acid, pyruvic acid, and 2,4-dinitrophenol. The outcomes will contribute to our understanding of how organic compounds in aqueous droplets oligomerize photochemically to produce secondary organic aerosol particles in ambient air.

**Why choose this opportunity?** A molecular-level understanding of photochemical processes is essential to address current challenges facing society, such as mitigating pollutants in air, developing new tools for disease diagnosis, sustainably improving crop yields, and efficiently harnessing solar energy. The focus of your project will be on atmospheric photochemistry, which will provide an excellent platform to learn about the environmental impacts of anthropogenic emissions. Your work in this area can make a real impact on global challenges, such as improving air quality in our cities, with benefits to the health of the population. You will develop and increase your expertise in spectroscopic and photochemical techniques, while becoming familiar with the fundamentals of molecular photochemistry and atmospheric chemistry. Furthermore, this project will require your collaboration with other research groups in Bristol and the partner Universities in the EPSRC-funded programme, thus improving your teamwork and networking skills, and giving you an opportunity to learn about how photochemistry is important in other scientific and technological areas. You will develop a range of additional transferable skills, including presentation, scientific writing, and project and time management. Finally, you will be interacting with students from all over the world, learning from their culture and skills, adding to your professional and personal development.

Full training will be provided for all aspects of this project. You will be embedded in the Supervisor's research group, who will provide support. In addition, you will be assigned a mentor for the duration of your project, who will provide extra support and help you to identify any additional training needs or opportunities.

**About you:** You will have skills and knowledge in physical chemistry, reaction kinetics, analytical methods, teamwork and time management. These skills are desirable but not essential.

**Bench fees:** A bench fee of £3000 is required.

**How to apply:** Applications are accepted throughout the year, and you should complete the online application form for Chemistry (MSc by Research).

**Supervisor:** Your supervisor for this project will be Andrew Orr-Ewing, Professor of Physical Chemistry in the School of Chemistry. You can contact him at +44 (0) 117 928 7672 or email a.orr-ewing@bristol.ac.uk

**Find out more about your prospective research programme:** For further background to the research field, see this article on the environmental photochemistry of $\alpha$-keto acids such as pyruvic acid: Rapf *et al*., ACS Central Science 2018, **4**, 624. For information about the University of Bristol's laser spectroscopy and dynamics group, see www.bristoldynamics.com. Descriptions about the use of ultrafast laser spectroscopy to study photochemical dynamics can be found in recent publications from the Bristol group listed here: https://research-information.bris.ac.uk/en/persons/andrew-j-orr-ewing/publications/**.**