The Brouard Group

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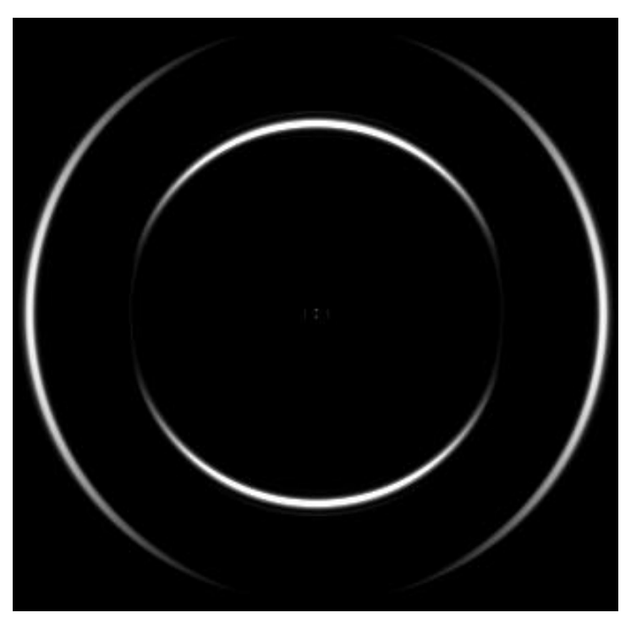
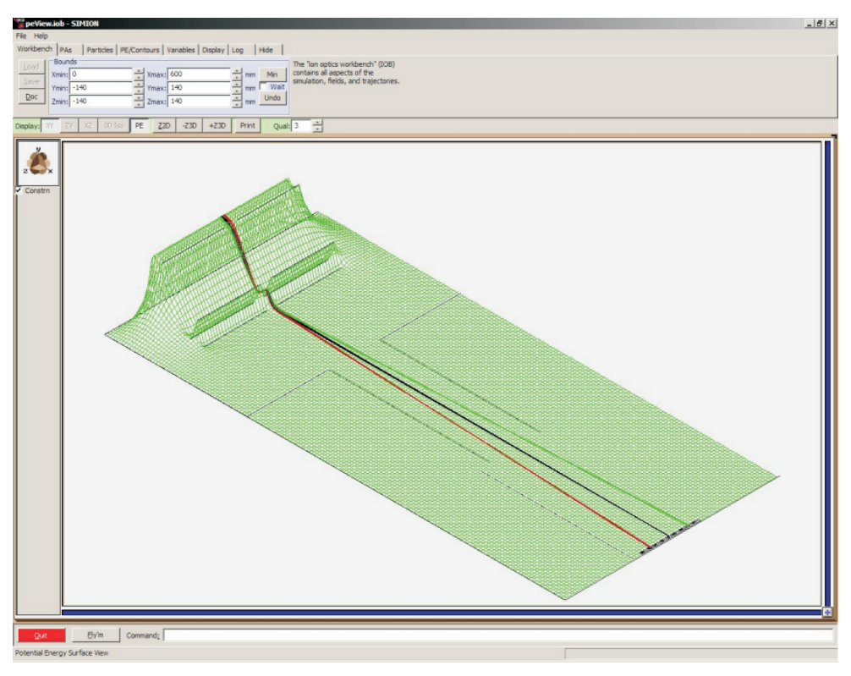
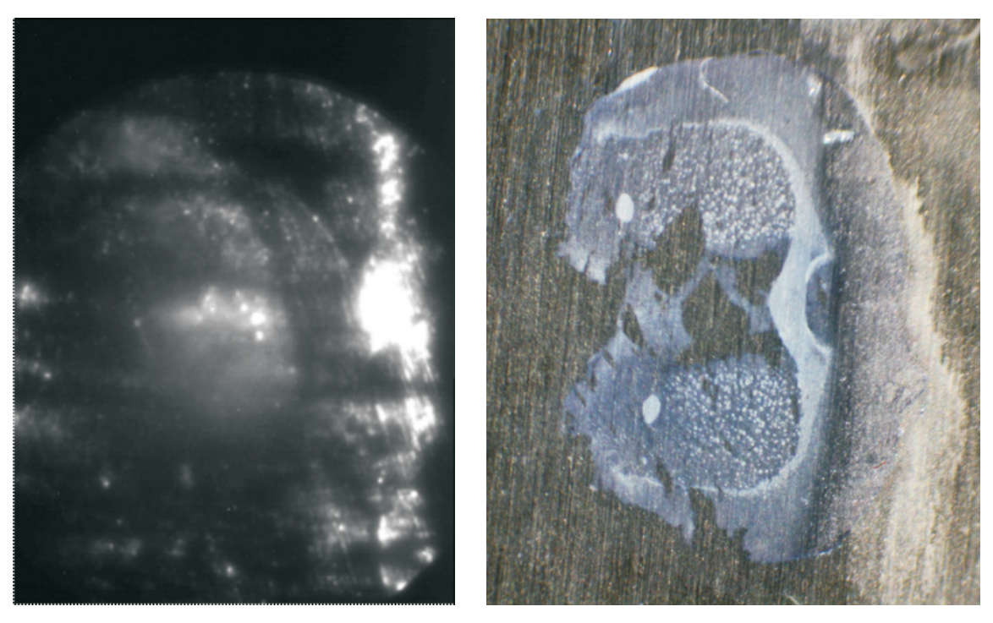
What we do:



- Investigations into the dynamics of gas phase chemical processes and collisions using techniques such as ion imaging, and laser induced fluorescence;

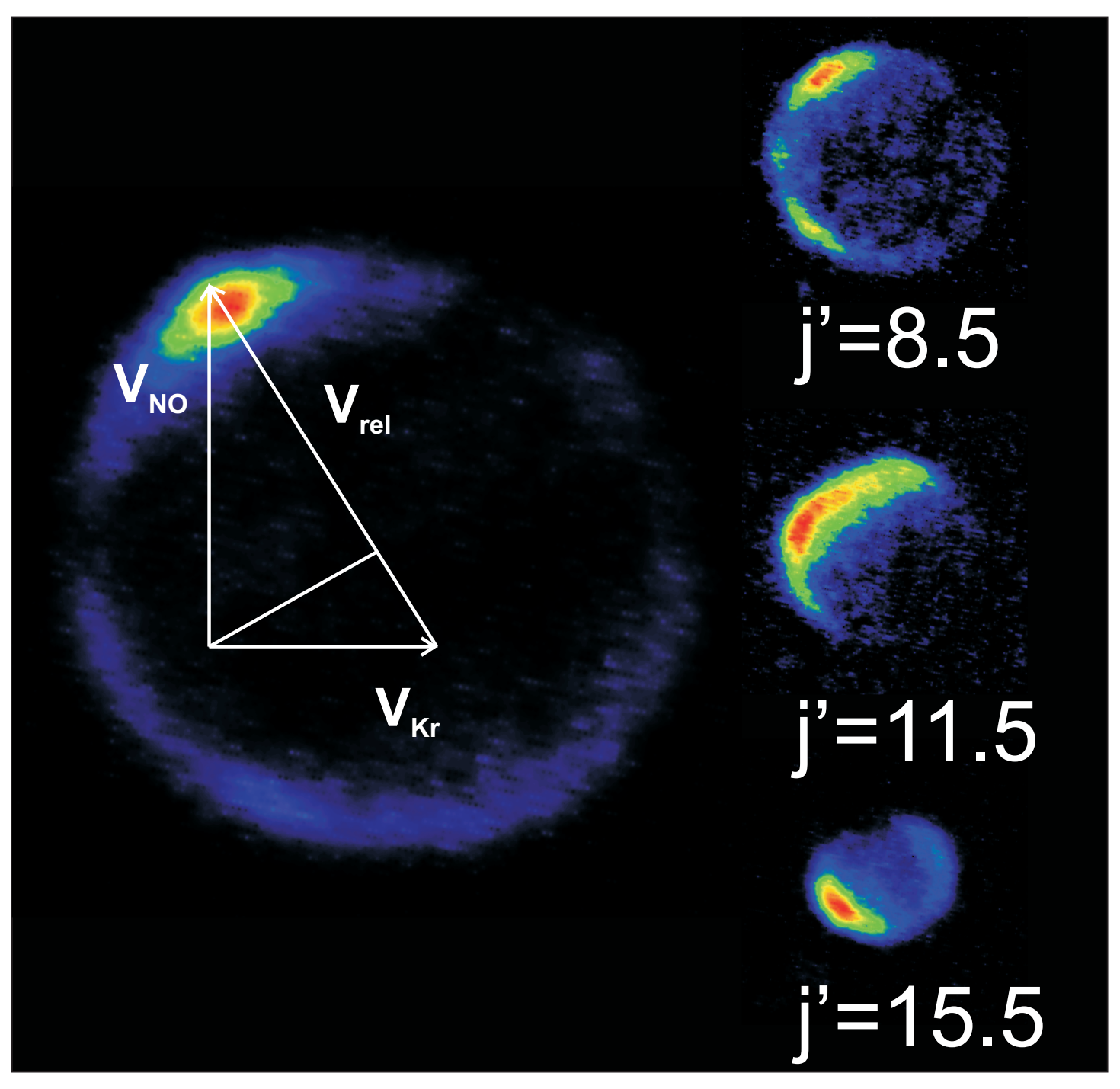


- Simulations, and the development of models used to describe these fundamental processes;
- Development and application of chemical imaging techniques used in medical sciences, and for high throughput chemical analysis.



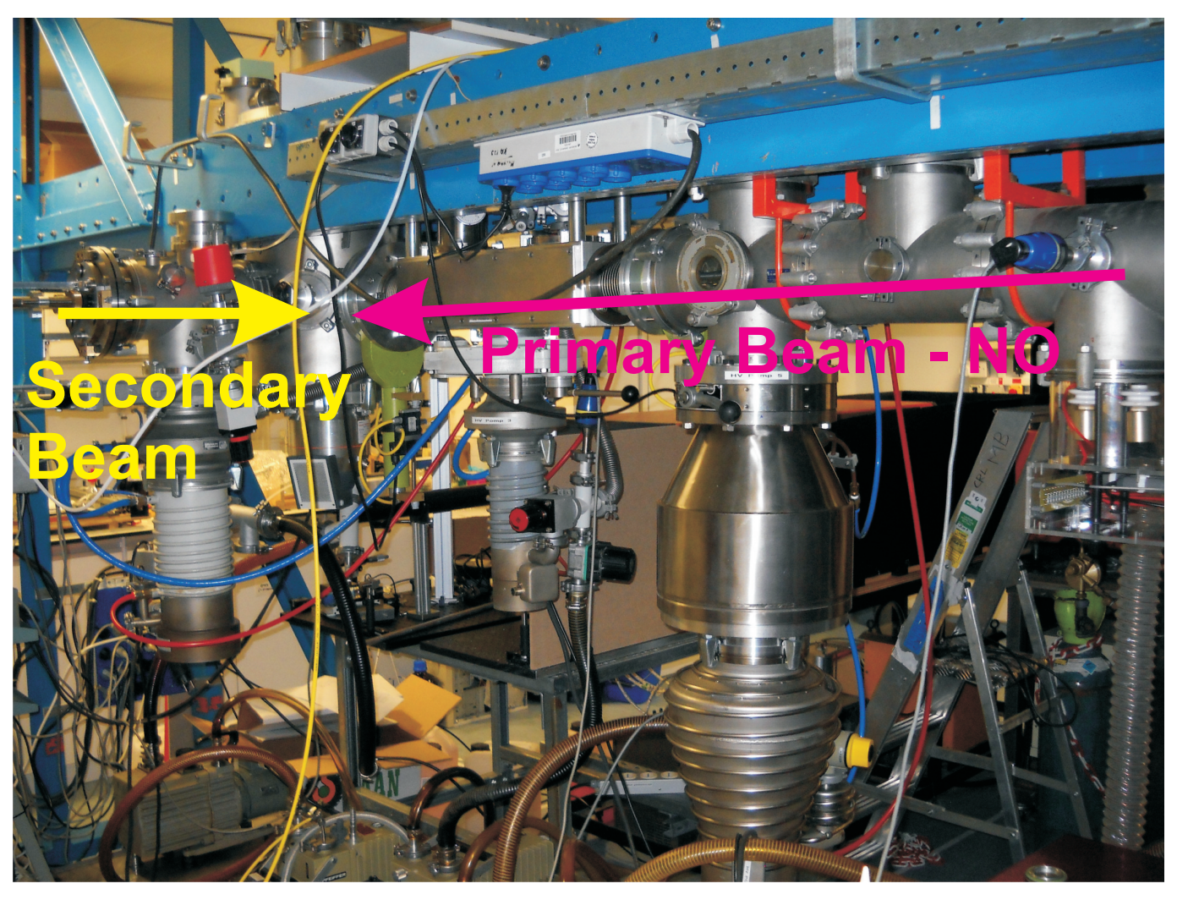
An ion (left) and optical (right) image of a biological sample

Quantum state resolved scattering



Ion images for scattering of NO with Kr. The intensity reflects the state-to-state differential cross section for the collision.

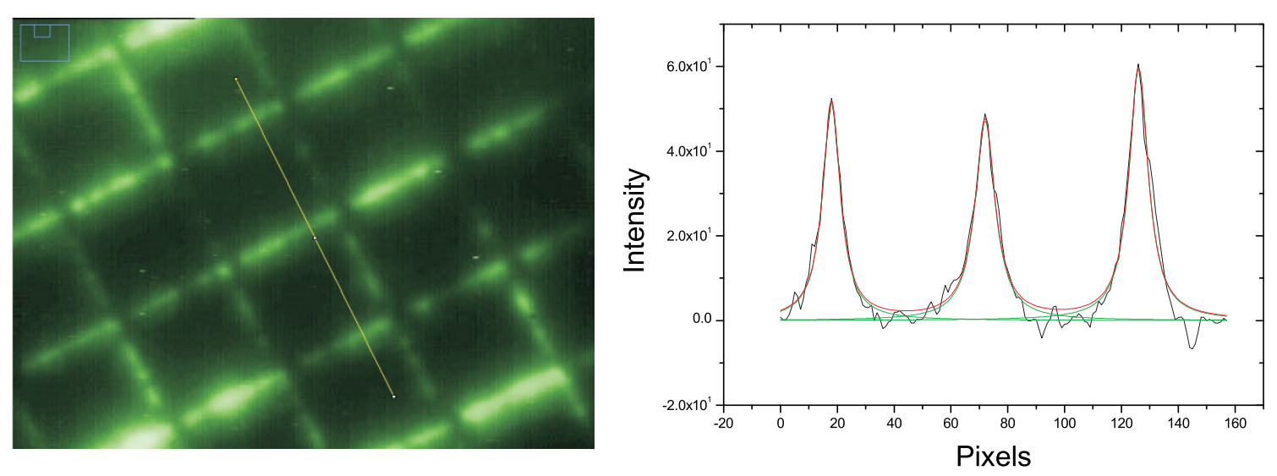
- The Blue monster allows observation of the angular distribution of fully quantum state selected scattered molecules.
- A hexapole electric field selects the initial quantum state of the NO molecules in the primary beam.
- The beam of NO molecules is then intersected by the secondary beam containing Krypton.
- The scattered NO molecules are then state-selectively excited and ionised and accelerated onto a detector to give the images shown here.



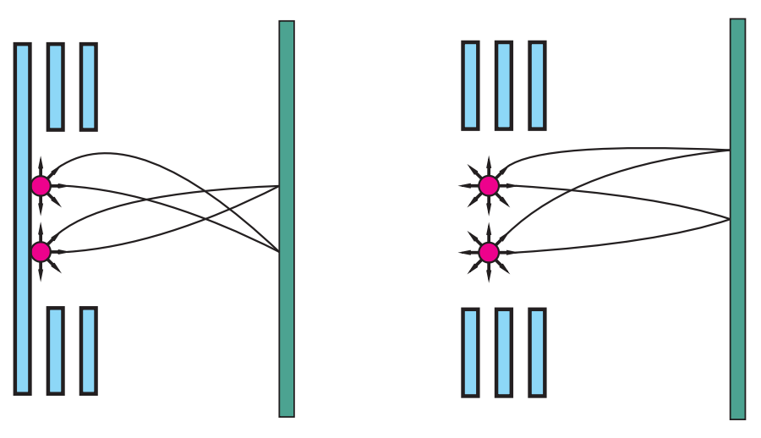
- For simple systems such as NO + rare gas, the experimental differential cross sections can be compared with theoretical quantum mechanical scattering calculations.
- We plan to study more complex systems such as NO + diatomics by changing the gas in the secondary beam.

Imaging Mass Spectrometry

A chemical microscope:

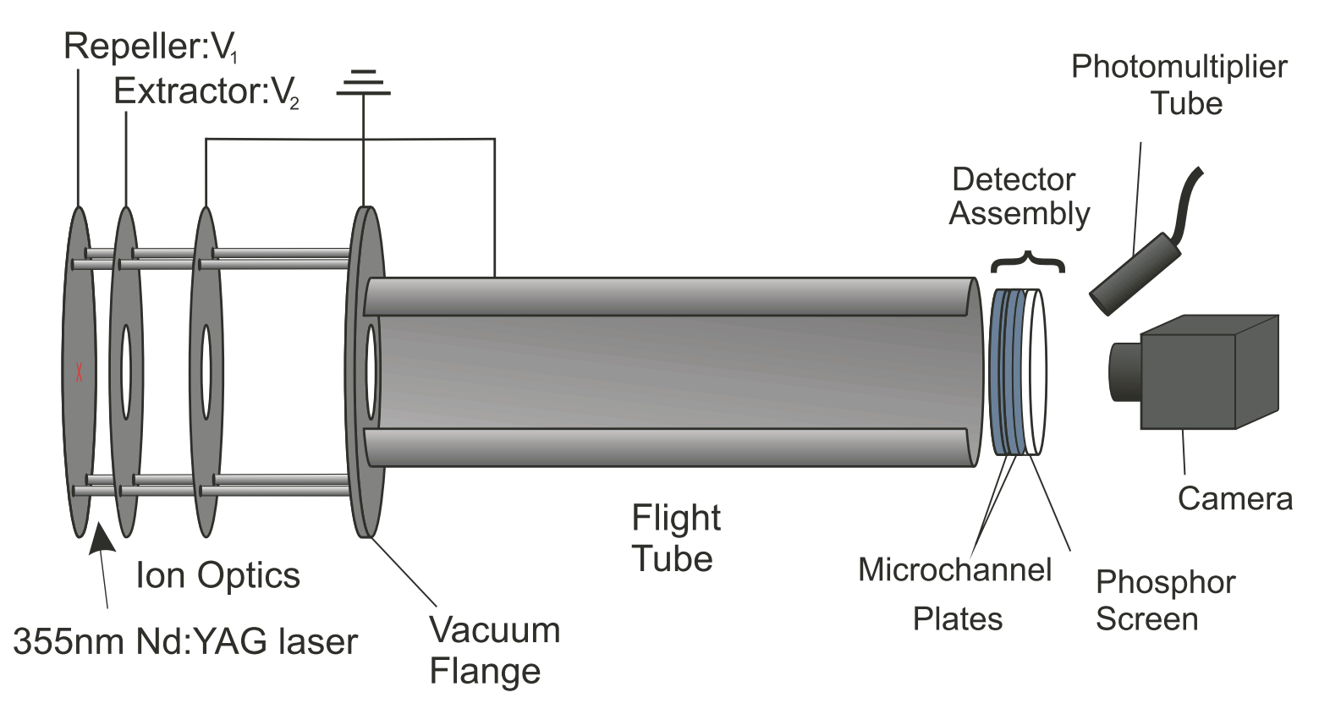


An ion image of a MALDI matrix sprayed into a grid pattern



- Changing the voltages applied to our ion optics allows us to determine whether particles will be imaged conserving their spatial or velocity information.

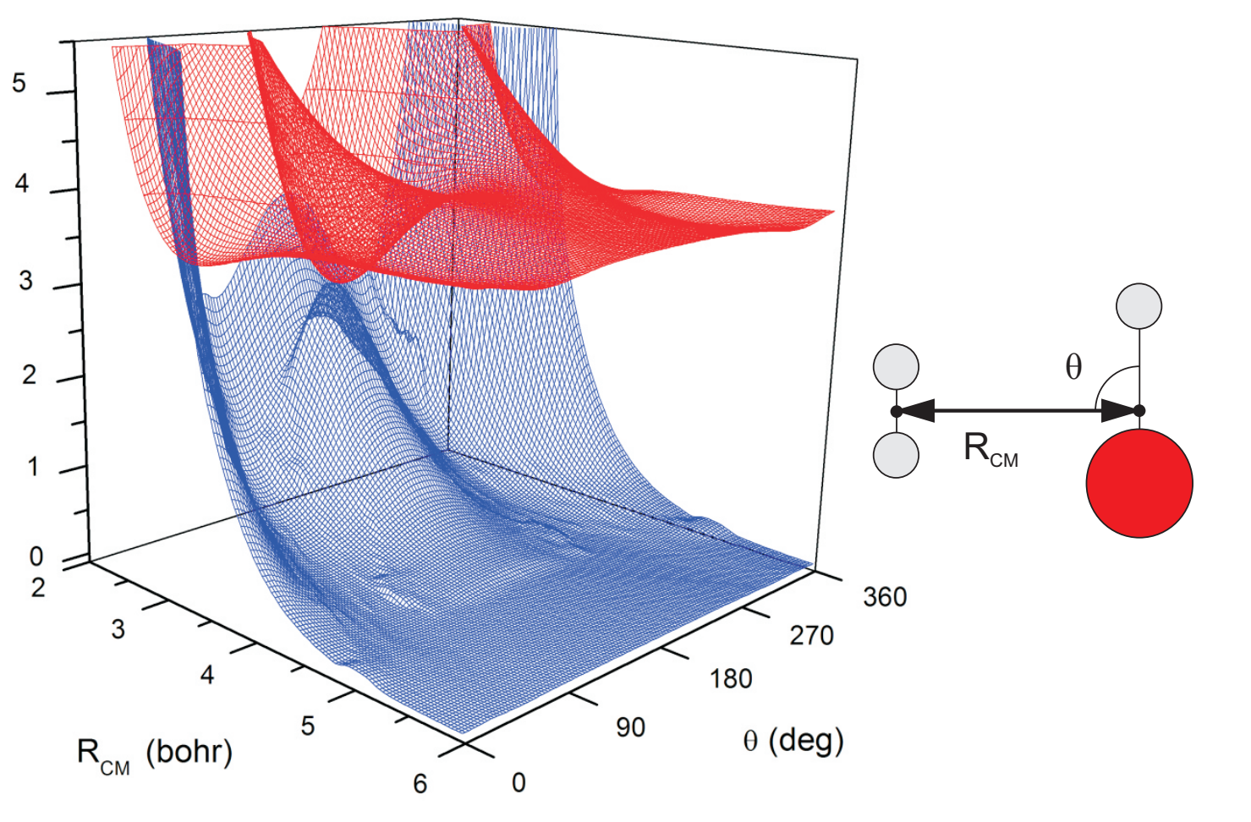
- By desorbing and accelerating a sample we can conserve spatial information as well as time-of-flight (mass) information and create a chemical map of a surface.
- The spatial information can be used either to determine the position of proteins on a tissue sample, or to distinguish between multiple mass spectrometry experiments run in parallel.



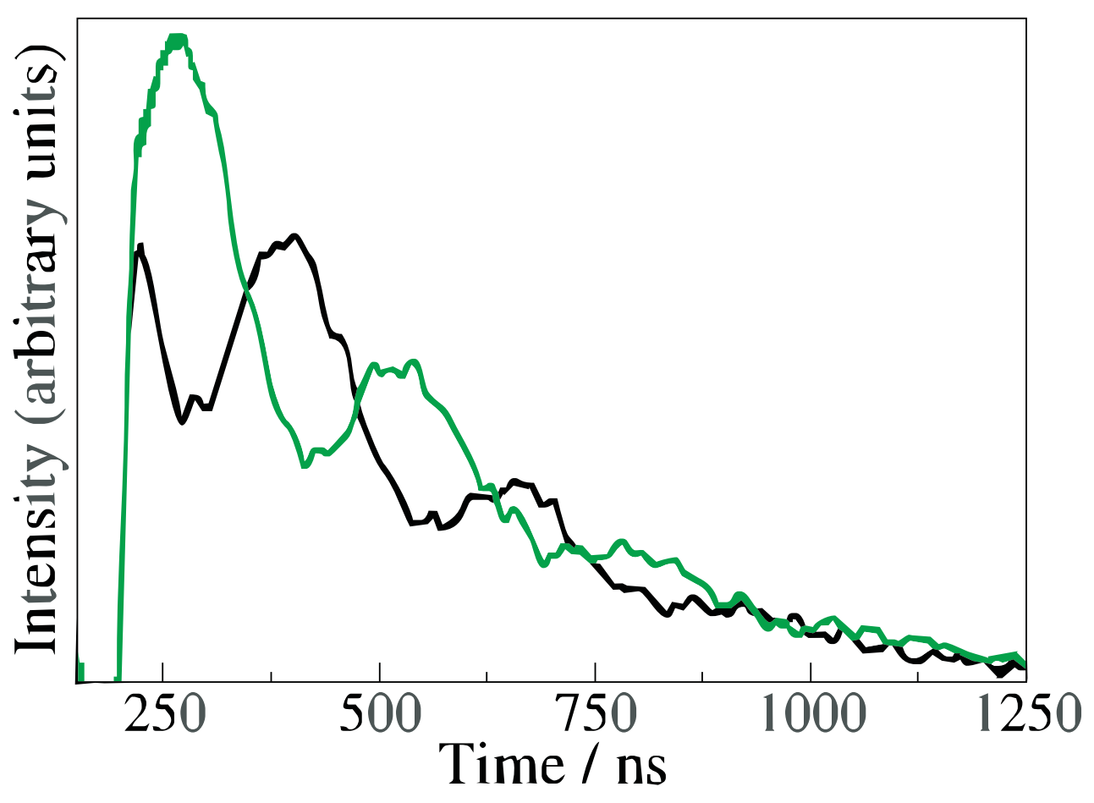
For further information contact mark.brouard@chem.ox.ac.uk; or just speak to one of the group members here, we will be happy to show you around our lab!

Angular Momentum Polarisation

- Studying the effect of collisions on the angular momentum of molecules gives a sensitive insight into the dynamics of the process.
- By taking an initially polarised sample of OH(A) and colliding it with H_2 the decrease in the degree of polarisation can be measured.



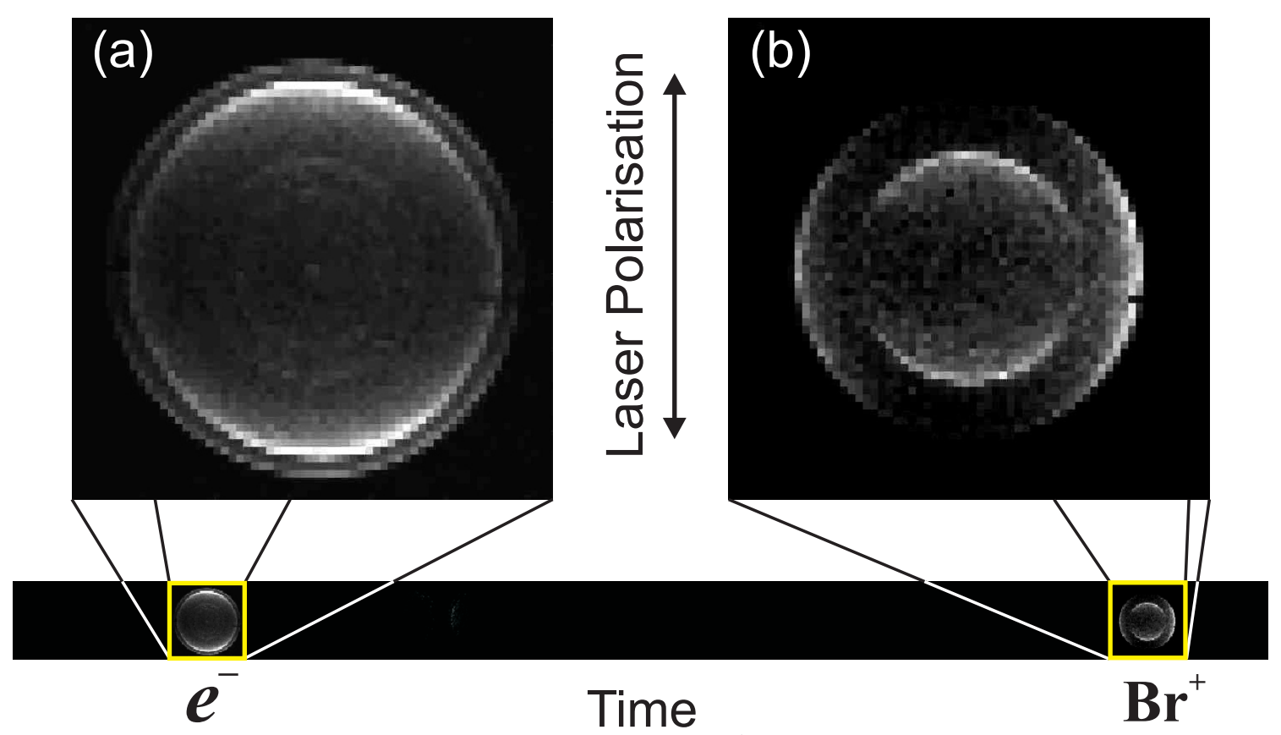
- A weak magnetic field is applied which causes the angular momentum distribution to precess about the field axis resulting in modulations in the fluorescence intensity.



- The potential energy surface (PES) for this process (above) can be used to simulate the collisions.
- Trajectory simulations have been performed using newly developed 4-atom code.

Coincidence Imaging

- Imaging multiple fragments from a single chemical event in coincidence can reveal detailed information pertaining to the underlying dynamics.
- We have developed a novel method of imaging both electrons and ions simultaneously in each experimental cycle using fast switching extraction potentials.



Simultaneously imaged electrons (a) and ions (b) captured using a Dalsa fast framing device.

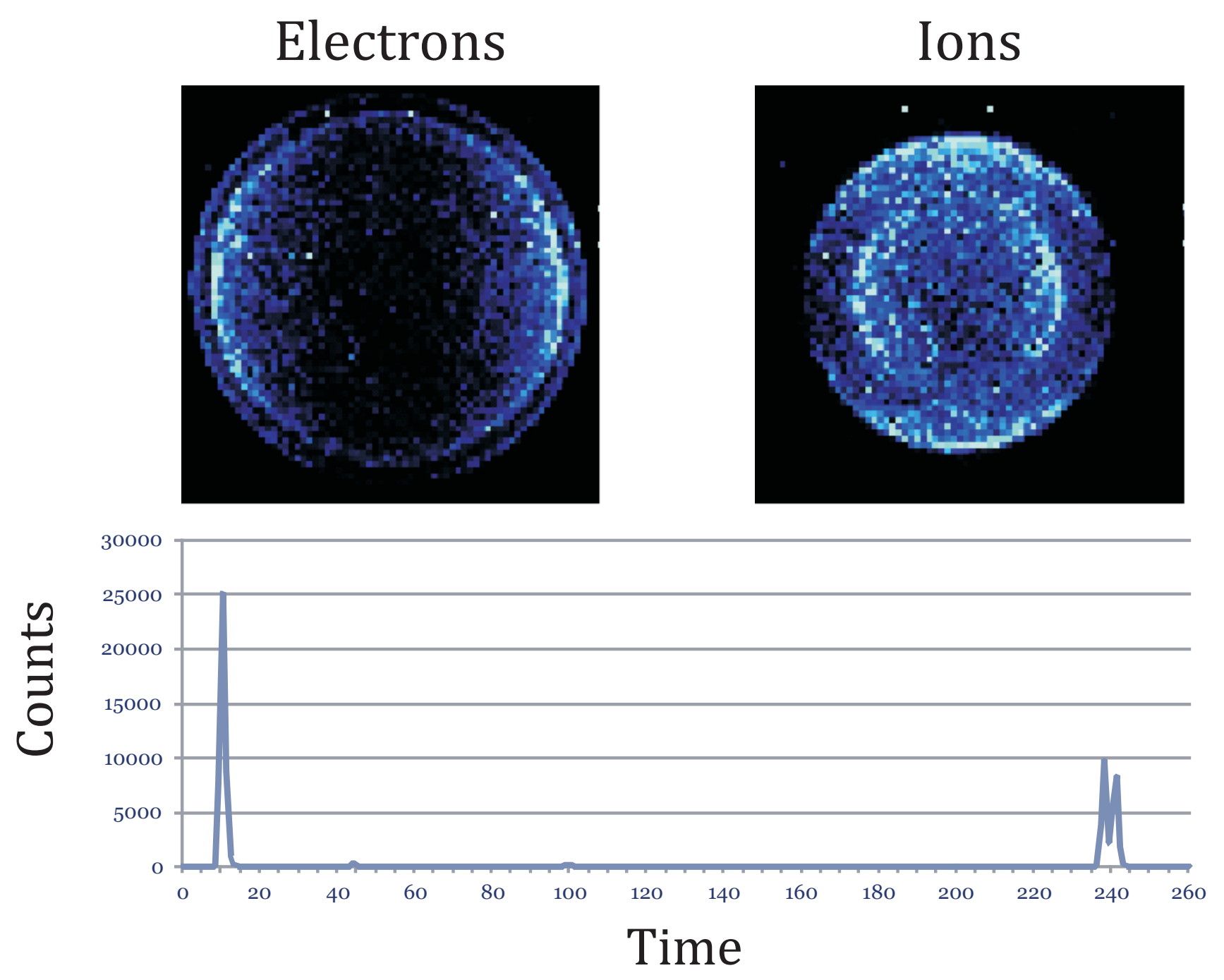
PImMS

(**P**ixel **Im**aging **M**ass **S**pectrometry)

- The PImMS camera utilises novel CMOS (complementary metal oxide semi-conductor) technology to capture multiple images in a single experimental cycle.

The PImMS camera

- This allows for species of different masses to be imaged simultaneously in an ion imaging experiment.



Angular Momentum - It makes the world go round!