1. Ion-Molecule and Electron Attachment Investigations
2. Towards the modelling of molecular interactions in radiation therapy dosimetry

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In this joint talk Chris Mayhew will first describe the experimental apparatus used in the Molecular Physics Group at the University of Birmingham for research programmes ranging from technological plasmas through to trace gas analysis involving ion-molecule and electron attachment studies. Richard Hutenburg will then describe his work on modelling of molecular interactions in radiation therapy dosimetry. Radiobiological indices for radiation therapy are typically determined using cell and in vitro models. However Monte Carlo methods are increasingly being utilized to predict radiation efficacy via modelling of the radiation physics through to the biology that describes to cellular and organism endpoints. Implicit in the utilisation of the dose quantity is that the physics of radiation transport occurring within the first few nanoseconds enables us to predict outcomes on the scale of years (an impressive 1 part in 10^{17} of the big picture). With conventional treatment approaches this appears to be reasonable, in part because the assumptions associated with experimental dosimetry are reasonable, for example that the dose is essentially proportional to the number of ionisations. This is also true of microdosimetry, though the use of atomic physics considerations, such as additivity laws, are not satisfactory for charged particle transport below 10 keV in sub-micron volumes. The implementation of conventional Monte Carlo radiation transport algorithms has been guided by their utilisation in conventional radiation therapy dosimetry. However emergent techniques, such as binary therapies, are likely to place more demanding constraints on the level of detail acceptable. For example binary therapies where selective incorporation of an activating compound in the cell nucleus occurs, such as with the cytotoxic drug Cisplatin (cis-diaminnedichloroplatinum II), will lead non-equilibrium conditions for charged particles at very low energies where newly understood physics such as electron attachment dissociation may also need to be considered.