Molecular Universe Early Stage Researcher Position
Team 5

- **Location of Appointment :** Durham
- **Team Leader (contact person):** D. R. Flower
- **Address :** Physics Department, Durham University, Durham DH1 3LE, UK
- **e-mail :** david.flower@durham.ac.uk
- **Telephone :** +44 (0)191 334 3625
- **Fax :** +44 (0)191 334 5823
- **Various URL :** http://www.dur.ac.uk/physics/research/atomic/media.php and http://www.ias.u-psud.fr
- **Duration of Appointment (in months) :** 36
- **Starting Date :** 01-10-2005
- **Requirements with respect to candidate :** Masters degree in physics or astronomy
- **Title of Research project :** Simulations of the spectra of shocks in regions of star formation
- **Abstract of Research Project**

An opportunity exists to study for a Ph.D. degree at the University of Durham (under the direction of Prof. David Flower), with secondment at the Institut d'Astrophysique Spatiale, Orsay, France (under the direction of Prof. Guillaume des Forêts). The thesis will be concerned with the simulation of the spectra of jets in regions of star formation. The mechanisms of excitation of the lines by shock waves will be studied, and line intensities and profiles will be calculated. Species such as H_2, SiO, CO, H_2O, SO and SO_2 will be considered, with a view to interpreting currently available observations and to making predictions for the Herschel and ALMA observing facilities.
The research programme will require the use of a sophisticated model of shock propagation, coupled with a treatment of radiative line transfer by means of the Large Velocity Gradient (LVG) approximation. The intention is to simulate the 'bow' shock structures which are frequently observed along jets. Molecular data relating to the collisional excitation of the emitting levels, which will become available during the lifetime of the 'Molecular Universe' RTN, will be incorporated in the model.
The graduate student will study in the Physics Department of the University of Durham. Students are expected to attend lectures and to contribute to the programme of research seminars, with a seminar every week in physics and one on more general physics topics (many more seminars are available in the Departments of Physics and Chemistry). Furthermore, the University of Durham provides a structured modular training programme to support the personal and career development of graduate students.
The position is available immediately, but a start date up to 1 October 2005 can be envisaged. Applications should be made to Prof. David Flower, Physics Department, South Road, Durham DH1 3LE, UK (david.flower@dur.ac.uk), preferably by e-mail and attaching a full CV, before **31 March 2005**. Further information can be obtained directly from david.flower@dur.ac.uk
Significant References

- The influence of grains on the propagation and structure of C-type shock waves in interstellar molecular clouds D. R. Flower and G. Pineau des Forts, MNRAS, 343, 390-400 (2003)
- The contribution of J-type shocks to the H2 emission from molecular outflow sources D. R. Flower, J. Le Bourlot, G. Pineau des Forts and S. Cabrit, MNRAS, 341, 70-80 (2003)
- New determinations of the critical velocities of C-type shock waves in dense molecular clouds J. Le Bourlot, G. Pineau des Forts, D. R. Flower and S. Cabrit, MNRAS, 332, 985-993 (2002)