Title of Project: Dynamics of trapped excitons in lanthanide material probed by laser spectroscopy.

Project Number: 278

University Project Leaders/Departments: Mike Reid; Physics and Astronomy

Brief outline of project

This Summer Project is an opportunity to join a Marsden-funded research programme "Energy levels and femtosecond dynamics of excited states of lanthanide phosphor materials". The student will carry out laser spectroscopy measurements currently being developed as part of this programme and analyse the results using modern theoretical models.

For the last 18 months our group has used the Dutch free-electron laser facility to study the excited states of rare-earth (lanthanide) materials. In our experiments a UV laser is used to excite Yb^{2+} ions in various fluoride host crystals. The excited state is then probed by the free-electron laser (FEL), which produces intense pulsed, tuneable, IR radiation.

The physics of the excited states in these materials is interesting and complex. The excited electron is delocalized, so the state may be considered to be a "bound exciton". We have used IR radiation from the FEL to induce transitions between internal states of the exciton, giving us information about the internal structure that was previously unknown. Furthermore, IR radiation can liberate electrons that have been trapped in lattice defects. Such defects are the basis of technology such as X-ray storage phosphors and persistent luminescence materials.

A number of extensions to this work are possible in our laboratories in Canterbury using combinations of UV and IR lasers. The Summer Project Student will use a variety of laser equipment to further investigate the dynamics of the excitonic states and the trap-liberation processes. By using equipment in our laboratory it will be possible to do a much more thorough investigation of variables, such as temperature and concentration, than is possible in a remote facility.

It is hoped that the student involved in this Summer Project will continue with thesis work on this novel new area using both local facilities and the Dutch FEL facility.

Specific student requirements:

Please indicate below any specific academic requirements you have for the summer scholarship student (e.g., specific level; specific courses, or equivalents, completed)

Some familiarity with optical spectroscopy measurements and some computing skills would be expected.

Special condition:

n/a