**Spectroscopy with Free Electron Lasers**

Jon-Paul Wells

Department of Physics and Astronomy, University of Canterbury, Christchurch, New Zealand.

**Abstract**

The Dutch Free Electron Laser (FELIX) provides sub-picosecond pulses, and infrared wavelengths between 5 and 250 micron. The time resolution and wide wavelength tunability allows for unique spectroscopic measurements of a variety of inorganic materials. This talk will cover experiments intended to demonstrate the versatility of the FEL in solid state spectroscopy.

1. Localized vibrational modes of light impurity ions have been a subject of study since the 1960s. Utilising direct laser excitation of the fundamental localised mode of vibration of H- in synthetic fluorite, we will demonstrate an infrared free induction decay technique. In this weakly anharmonic system, large quantum coherence effects are observable due to vibrational ladder climbing and can accounted for in terms of the resonant third order polarisation.
2. Amorphous solids are characterised by inhomogeneously broadened spectral features which, in the case of vibrational modes, can be as large as 100 cm-1 wide. Infrared transient grating and photon echo experiments have been used to study the homogeneous (or dynamic) linewidth of the Si(Ge)-H(D) stretching modes in thin film, amorphous silicon-germanium alloys. Anharmonic decay and elastic phonon scattering processes account for the majority of the relaxation processes measured. The presence of non-equilibrium phonons is inferred at cryogenic temperatures.
3. Impurity trapped excitons (ITEs) are known to play an inter-mediatory role in the optical pumping cycle of lanthanide doped phosphor materials. However it is rare that they can be studied directly. Using a two-colour (UV-IR) transient photoluminescence enhancement technique we measure the energy levels and dynamics of ITEs in CaF2 and NaMgF3 doped with divalent ytterbium. Quantitative analysis is provided in terms of a parametrised crystal-field model and rate equation modelling of the temporal dynamics.

**Wells教授简介**

University of Canterbury, Christchurch, NZ

B.Sc. (1991)

M.Sc. (Hons) in Physics (1993)

Ph.D. in condensed matter laser spectroscopy (1997)

**Employment History:**

1. Postdoctoral Research Fellow - Femtosecond Spectroscopy of Laser Gain Media, University of Strathclyde, Glasgow, Scotland (1997-1999)
2. Senior UK Facility Scientist, FELIX free electron laser facility, FOM – Institute for Plasmaphysics, ‘Rijnhuizen’, Nieuwegein, The Netherlands (March 1999-May 2002).
3. Lecturer in Ultrafast Condensed Matter Physics, Department of Physics and Astronomy, University of Sheffield, Sheffield, England (June 2002-June 2006).
4. Senior Lecturer in Laser Physics and Interferometry, Department of Physics and Astronomy, University of Canterbury, Christchurch, New Zealand (2006-2011); Associate Professor (2012-present)
5. Deputy Head of Department Physics and Astronomy (2014- )

His research interests include ring lasers, interferometry and applications, optoelectronic materials, and free electron laser spectroscopy. He has published more than 130 papers in high-impact journals such as PRL/PRB/OL/APL. He serves as Referee for the National Science Foundation (US/Italy/France).