

# Institutskolloquium

Am Mittwoch, den **15. Juni 2011, 16:00 Uhr** spricht

**Dr. Jom Luiten**

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über

## **‘Coherent electron beams for ultrafast structural dynamics’**

Abstract:

In 2009 the first hard X-ray Free Electron Laser has become operational – LCLS at Stanford University – which enables recording the full diffraction pattern of a tiny protein crystal in a single, few-femtosecond shot. Why bother about electrons anymore? Electrons and X-rays both enable the study of structural dynamics at atomic length scales, yet the information that can be extracted by probing with either electrons or X-rays is quite different and, in fact, complementary. A pulsed electron source with the X-ray Free Electron Laser capability of performing single-shot, femtosecond diffraction would therefore be highly desirable.

The primary obstacle facing the realization of such an electron source is the space charge problem: packing the number of electrons required for recording a full diffraction pattern in a single sub-picosecond pulse will inevitably lead to a rapid Coulomb expansion of the pulse and therefore loss of temporal resolution. We have developed a method, based on resonant radio-frequency techniques, to invert the Coulomb expansion and thus compress 0.2 pC, 100 keV electron bunches down to sub-100 fs bunch lengths. We have used these bunches to produce high-quality transmission diffraction patterns in a single-shot of gold, aluminium, silicon and graphite.

Ultrashort electron bunches are traditionally generated by pulsed photoemission from metal cathodes. The coherence of the resulting beams is however limited and in fact insufficient for, e.g., studies of protein samples. We have developed a new, ultracold pulsed electron source, based on near-threshold photo-ionization of a laser-cooled gas, which is characterized by effective electron temperatures three orders of magnitude lower than conventional sources. The vastly improved coherence properties should enable single-shot, femtosecond studies of the structural dynamics of macromolecular crystals. By reducing the number of electrons per pulse the source temperature may be lowered even further, eventually resulting in fully coherent electron beams. This would enable time-resolved holographic and coherent diffractive imaging with electrons.

**Ort: Max-Born-Saal, MBI**

**Max-Born-Str. 2 a**

Interessenten und Gäste sind herzlich eingeladen

Prof. Dr. T. Elsässer