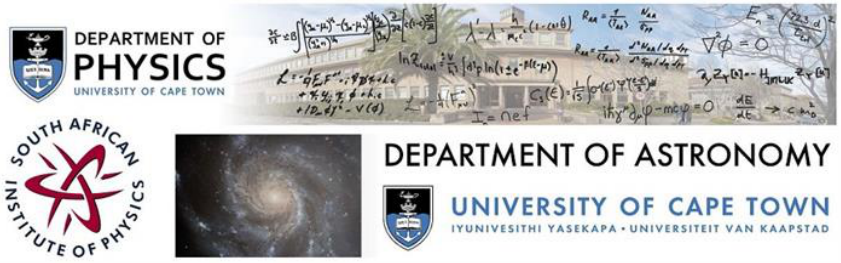

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Ultrafast mapping of structural changes in organic radical salts

Tuesday, 5 July 2016 14:00 (20 minutes)

Abstract content
   (Max 300 words)
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The radical salts of Cu(DCNQI)2 show a wide variety of Peierls transitions, depending on their chemical composition. Upon the Peierls transition - which is a change in the atomic structure of the crystal - the initially metallic crystal becomes an insulator. This dramatic change in conductivity of 8 orders of magnitude, which is known to be ultrafast (20 picoseconds), can be photo-induced. By employing our Ultrafast Electron Diffractometer (UED), we map the ultrafast photo-induced metal-to-insulator transition in both time (femto- to picoseconds) and space (atomic resolution). By doing so, underlying mechanisms of the transition can be investigated. Our UED-machine firstly photo-induces the transition with an ultrashort (150 fs) pump pulse, and probes it with an ultrashort (500 fs) electron pulse. Electron patterns are acquired in transmission from an ultrathin (50 nm) Cu(DCNQI)2 crystal slice by our probe beam. By changing the delay between pump and probe, a full transient of the dynamics is obtained.

Changes in the crystal are observed in the electron diffraction pattern by decreases and increases in Bragg reflection intensities, with the full destruction or creation of a Bragg peak as an extreme case. The new data analysis method that we developed, processes and displays these intensity changes. By comparing the changes observed in an experiment with simulated electron diffraction patterns, changes in the positions and orientation of the crystal planes in real space can be reconstructed. Our ultimate goal is to reconstruct a full transient of the real-space changes in the photo-induced metal-to-insulator phase transition in Cu(DCNQI)2, thereby creating a ‘molecular movie’.

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Prof. Heinrich Schwoerer, heso@sun.ac.za, Stellenbosch University

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Primary author: Mr SMIT, A. Bart (Stellenbosch University)

Co-authors: Prof. SCHWOERER, Heinrich (Stellenbosch University); Ms PAYNE, Nancy (Stellenbosch University); Mr OLAOYE, Olufemi (Stellenbosch University)

Presenter: Mr SMIT, A. Bart (Stellenbosch University)

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