Exploring the evolution of the orbital and magnetic ordering in Ca_2RuO_4 under an applied field

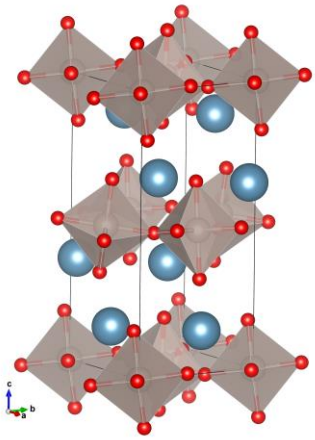
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Abstract: 300 words

Despite researchers developed a very good understanding of metallic and insulating states in condensed matter systems, the situation changes dramatically in the proximity of a metal-insulator (MI) transition [1]. In fact, difficult to model electronic correlations are very often at the origin of such abrupt change that the whole model to describe the system properties and excitations need to be adapted to the different electronic behavior. MI transitions are also peculiar as it is not straightforward to identify a primary order parameter. Recently a lot of interest arose around 4d based materials, where the occupancy of the 4d shell is a critical element in establishing the electronic correlations [2]. Ru based materials are often in a metallic state, however a notable exception is represented by Ca_2RuO_4 (fig.1), this distorted Ruddlesden Popper system, is in an insulating state at room temperature, however the transport properties can be easily modified increasing the temperature [3] or the pressure [4], or as more recently demonstrated applying an unprecedently low voltage to the system [5]. Resonant X-ray scattering (RXS) offers a unique opportunity to monitor the structural, magnetic and electronic properties of this fascinating material by following the evolution of the diffraction peaks related to the orbital, magnetic and structural properties of the system as function of the temperature and of an applied field. In this talk, after a brief introduction to the RXS technique, we will review the current understanding of the system behavior and present our new insight about the evolution of the electronic properties of the system [6]. The most exciting result being the fully reversible suppression of the orbital ordered before the destructive IM transition is completed.

Image:



Recent Publications:

1. Conductor-Insulator Quantum Phase Transitions Edited by V. Dobrosavljevic et al. Oxford University Press (2012).
2. A. Georges et al. Strong Correlations from Hund's Coupling. Annu. Rev. Condens. Matter Phys. 2013, 4:137-178.
3. M. Braden et al. Crystal and magnetic structure of Ca 2 RuO 4 : Magnetoelastic coupling and the metal-insulator transition. Phys Rev. B 56, 2916 (1997)
4. Ishikawa et al. Control of the electronic states of Ca2RuO4 by uniaxial pressure Journal of Physics: Conference Series 022036,400 (2012)
5. Nakamura et al. Electric-field-induced metal maintained by current of the Mott insulator Ca2RuO4. Scientific Reports 3, 2536 (2013)
6. 5. D.G. Porter, A. Bombardi et al. in preparation.



Biography:

Alessandro Bombardi contributed to build and design the I16 materials and magnetism beamline at the Diamond Light Source. He is an expert in resonant x-ray diffraction applied to the study of complex materials like multiferroics, frustrated magnets and strongly correlated electron systems. He has a strong interest in programming applied to data analysis and instrumentation control. He is a Diamond Research fellow and a visiting lecturer at the University of Oxford.

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