Mini-rencontre du GDR Meeticc

Vendredi 05 mars 2021
De 13h30 à 15h30

Le lien générique pour vous inscrire à la réunion du 5 mars est le suivant :

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Programme

*Animateur : Victor **BALEDENT**, Laboratoire de Physique des Solides, Univ. Paris Saclay

	Exposé (30 min + 10 min)
13:30 – 14:10	**Structural characterization of nanomaterials through anomal diffraction** Christophe **LEFEVRE** **IPCMS - CNRS - UMR 7504. Université de Strasbourg**
14:10 – 14:30	***Pause / discussion libre***
	Exposés (15 min + 5 min)
14:30 – 14:50	**Complex magnetism in high pressure 3d metal oxides** Elena **SOLANA-MADRUGA** **Univ. Lille, CNRS, Centrale Lille, ENSCL,**
14:50 – 15:10	**Resolving the enigmatic high-field behaviour of $CeRhIn_5$** Sanu **MISHRA** **Laboratoire National des Champs Magnétiques Intenses, Grenoble**
15:10 – 15:30	**Strange metal from incoherent bosons** Anurag **BANERJEE** **Institut de Physique Theorique, CEA Paris-Saclay.**

First NAME : Christophe	last NAME : lefevre
Affiliation : CNRS – IPCMS (UMR 7504)	

Presentation type : *Long (30 min)*	Talk given in : *French* (please prepare the of the presentation in english)
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Structural characterization of nanomaterials through anomal diffraction

Resonant X-ray diffraction (REXS), benefiting from the tunable energy of the synchrotron, consists of recording the intensity of a Bragg reflection as a function of the energy of the scattered photons crossing an atomic absorption edge. It combines diffraction with extended X-ray absorption fine structure (EXAFS) or X-ray absorption near- edge structure (XANES) methods and is sensitive to both the local environment of the absorbing atom through the anomalous process and to the long-range order involved in the diffraction process. Anomalous scattering experiments have shown over the past ten years their capabilities for locating metal atoms on different sites, even in cases of small occupancies, and even in mixed metal situations [1-2] This method is well adapted to probe cristallographic parameters of powder or thin films materials such as atomic occupancies or positions (e.g. in $GaFeO_3$ thin films or in $CoFe_2O_4$ thin films [3-4]). Moreover, it is also possible to take advantage of the possibilities offered by REXS to evidence structural inversions (i.e. the polarization state) of polar structure [5]. Finally, recent numerical approaches show the possibility to evidence the position of light atoms (e.g. oxygen) in these nanomaterials by performing REXS recording in a wide range of energy.

Références :

[1] Hodeau, J.-L., Favre-Nicolin, V., Bos, S., Renevier, H., Lorenzo, E. Berar, J.-F. Chem. Rev. 101, 1843–1867, (2001).

[2] Oeckler, O., Schneider, M. N., Fahrnbauer, F. & Vaughan, G., Solid State Sci. 13, 1157– 1161 (2011).

[3] C. Lefevre, A. Thomasson, F. Roulland, V.Favre-Nicolin, Y. Joly, Y. Wakabayashi, G. Versini, S., C. Leuvrey, A. Demchenko, N. Boudet, N. Viart, J. Appl. Cryst. 49, 1308–1314 (2016)

[4] E. Martin *et. al.*, J. Alloys Comp. 836, 155425 (2020).

[5] C. Lefevre, A. Demchenko, C. Bouillet, M. Luysberg, X. Devaux, F. Roulland, G. Versini, S. Barre, Y. Wakabayashi, N. Boudet, C. Leuvrey, M. Acosta, C.

Complex magnetism in high pressure 3d metal oxides.

Elena Solana-Madruga,[1,2] Cintli Aguilar–Maldonado,[1] Clemens Ritter,[3] Olivier Mentré,[1] J. Paul Attfield[2] and Ángel M. Arévalo–López[1]

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ABO_3 oxides are intensively studied materials as they exhibit useful chemical and physical properties. Amongst these, the use of high-pressure synthesis techniques allows the small Mn^{2+} cation to be located in the A-site with several structures in competition. The presence of Mn orbital, charge and spin degrees of freedom often induces complex magnetic properties, for instance, the spintronic perovskite $MnVO_3$-II or the multiferroic $MnTiO_3$-II with $LiNbO_3$-type structure. [1,2]

Tellurium based oxides M_2MTeO_6 (M = Mn and Co) crystallise with corundum-related structures at ambient pressure and show a variety of complex behaviours: Mn_3TeO_6 is a type-II multiferroic,[3] where two incommensurate magnetic phases (an elliptical helix and a sinusoidal spin density wave) coexist.[4] Co_3TeO_6 has 5 independent Co sites, providing a rich magnetic phase diagram[5,6].

Here we present the high pressure modifications HP_Mn_3TeO_6, HP_Co_3TeO_6 and their solid solutions, prepared under 8-15 GPa and 1173 K using a Walker –Multianvil high pressure apparatus. HP_Mn_3TeO_6 has $P2_1/n$ double perovskite (DPv) structure and is a collinear AFM with k = [½ 0 ½] below 36 K with an unusual large frustration index due to d^{10} Te^{6+}.[7] HP_Co_3TeO_6 [8] crystallises with $R3$ Ni_3TeO_6 (NTO) structure. The strong magnetic frustration arising from stacked honeycomb and triangular magnetic sublattices originates an elliptical helix below 58 K with a k_0 = [0 0 0] and a temperature dependent incommensurate [0 0 k_{z1}] component. Below 23 K, k_{z1} splits and originates a coexisting circular helix magnetic structure with [0 0 k_{z2}] propagation vector.

The HP_$Mn_{3-x}Co_xTeO_6$ oxides show a coherent evolution between DPv (x = 0.5, 1 and 1.5) and NTO (2 and 2.5) solid solutions, as depicted in the phase diagram (Fig.1). The magnetic behaviour of both polymorphs is, however, strongly affected by the presence of Co^{2+} and Mn^{2+} respectively. The clear B-site preference of Co^{2+} among the DPv compounds turns part of the d^5-d^5 magnetic interactions into coexisting d^5-d^7, which modifies the spin arrangement to a new AFM structure with k = [0 0 0]. Among the NTO-type compounds, with complex incommensurate spin structures as that of HP_Co_3TeO_6, the magnetic transition temperature progressively increases with the Mn content, consistently with the preferred cation order. The presence of d^5 Mn^{2+} stabilises the elliptical modulation of the magnetic moments into the helix and prevents the thermal dependence of the [0 0 k_z] propagation vectors and their splitting. Such dramatic magnetic changes among both HP polymorphs reflect the essential role of t_{2g} orbitals in the magnetic interactions of these compounds.

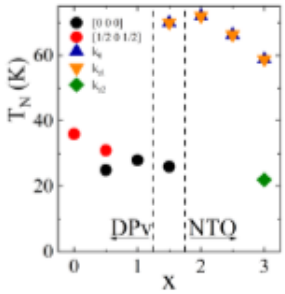

Figure 1. Phase diagram for the HP-$Mn_{3-x}Co_xTeO_6$ solid solutions.

References:

[1] M. Markkula, *et al. Phys. Rev. B.* 2011, 84, 094450,
[2] A. M. Arevalo-Lopez and J. P. Attfield. *Phys. Rev. B.* 2013, 88, 104416.
[3] S.A. Ivanov, *et al. J. Phys. D: Appl. Phys.* 2017, 50, 085001.
[4] S.A. Ivanov, *et al. Mat. Res. Bull.* 2011, 46, 1870.
[5] J.L. Her, *et al. Phys. Rev. B.* 2011, 84, 235123.
[6] C.-W. Wang, *et al. Phys. Rev. B.* 2013, 88, 184427
[7] A. M. Arevalo-Lopez, *et al. Chem. Comm.* 2019, 55, 14470.
[8] E. Solana-Madruga et al. *Chem Comm.* 2020 advance article, doi: : 10.1039/d0cc07487j.

Last NAME: Mishra	**First NAME: Sanu**
Affiliation: Laboratoire National des Champs Magnétiques Intenses (LNCMI), CNRS and University of Grenoble Alpes, France	

Please check

the type of presentation	LONG (30 min)		SHORT (15 min)	✔
The talk is given in	ENGLISH	✔	FRENCH	

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Resolving the enigmatic high-field behaviour of $CeRhIn_5$

The heavy fermion compound $CeRhIn_5$ is a prototypical system to investigate the rich physics of strongly correlated electrons as it can be readily tuned to a quantum critical point by hydrostatic pressure, chemical doping, and magnetic fields. While the pressure-induced quantum critical point is long accepted to be of the Kondo-breakdown type, the one induced by the magnetic field at B_c = 50 T was suggested to be of the spin-density-wave type. This assumption is based on the observation of additional de Haas-van Alphen frequencies deep inside the antiferromagnetic state, above B^*= 30 T, where a novel phase of enhanced in-plane electronic anisotropy emerges [1]. These additional frequencies were interpreted as a signature of an abrupt Fermi-surface reconstruction due to the field-induced itineracy of the *f* electrons at B^* [2].

In this talk, I will present our comprehensive angular-dependent de Haas-van Alphen study of $CeRhIn_5$ and its non-*f* reference compound $LaRhIn_5$, which establishes the localized character of the *f* electrons inside and outside of the antiferromagnetic phase. Our results rule out any significant field-induced Fermi-surface reconstruction, particularly across B^*, and suggest that the field-induced quantum criticality in $CeRhIn_5$ does not conform with the established theoretical models [3]. Further, I will also present our high-field specific heat results, where the observation of a distinct anomaly at B^* suggests it to be a thermodynamic phase transition, probably weakly first-order [4].

[1] F. Ronning, T. Helm, K. R. Shirer, M. D. Bachmann, L. Balicas, M. K. Chan, B. J. Ramshaw, R. D. McDonald, F. F. Balakirev, M. Jaime, E. D. Bauer & P. J. W. Moll, *Nature.* **548**, 313–317 (2017).

[2] Lin Jiao, Ye Chen, Yoshimitsu Kohama, David Graf, E. D. Bauer, John Singleton, Jian-Xin Zhu, Zongfa Weng, Guiming Pang, Tian Shang, Jinglei Zhang, Han-Oh Lee, Tuson Park, Marcelo Jaime, J. D. Thompson, Frank Steglich, Qimiao Si, and H. Q. Yuan, *PNAS.* **112**, 673-678 (2015).

[3] S. Mishra, J. Hornung, M. Raba, J. Klotz, T. Förster, H. Harima, D. Aoki, J. Wosnitza, A. McCollam, and I. Sheikin, *Phys. Rev. Lett.* **126**, 016403 (2021).

[4] S. Mishra, A. Demuer, D. Aoki, and I. Sheikin, *Phys. Rev. B.* **103**, 045110 (2021).

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Presentation type : *15 mins*	Talk given in :*English* (please prepare the of the presentation in english)
I authorize the GDR to record a video of my presentation : *YES*	

Strange metal from incoherent bosons

The breakdown of the celebrated Fermi liquid theory in the strange metal phase is the central enigma of correlated quantum matter. Motivated by recent experiments reporting short-lived carriers, along with the ubiquitous observations of modulated excitations in the phase diagram of cuprates, we propose a model for this phase. We introduce bosons emerging from the remnants of a pair density wave as additional current carriers in the strange metal phase. These bosonic excitations are finite momentum Cooper pairs and thus carry twice the electronic charge, and its net spin can either be zero or one arising from the two spin-1/2 electrons. We show that such a model can capture the famous linear relationship of resistivity with temperature and manifests the Drude form of ac-conductivity with a Planckian dissipation rate. Furthermore, such bosons are incoherent and hence do not contribute to the Hall conductivity. The bosons emerging from the electron pairs of spin-triplet symmetry also reproduce the recently observed linear in-field magnetoresistance[1-3].

Références :

[1] P. Giraldo-Gallo, *et al.* Science 361, 479 (2018)

[2] J. Ayres *et al.*, unpublished (2020)

[3] A. Banerjee, et al. arXiv:2009.09877 (2020)