

Announcement of seminar

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High-temperature superconducting copper oxychlorides: a 2D model for cuprates

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The cuprate oxychloride $\text{Ca}_2\text{CuO}_2\text{Cl}_2$ is an oxometallate with planar coordination (1) that can be doped with sodium (2), vacancies (3), or potassium (4) on the Ca site. The doping requires high pressure of up to 5 GPa, and we have recently optimized its synthesis and crystal growth in press with a toroidal anvil (5).

$\text{Ca}_2\text{CuO}_2\text{Cl}_2$ is a high-temperature-superconducting cuprate isostructural to La_2CuO_4 in the high-temperature tetragonal phase ($I4/mmm$), but with apical oxygen replaced by chlorine ions (2,6).

Cuprate oxychlorides are very promising to bridge the gap between theory and experiment in high-temperature superconductors since they lack high Z atoms, have the simplest crystalline structure for cuprates, stable at all doping and temperatures, and have a strong 2D character due to the replacement of apical oxygen with chlorine. Therefore, advanced calculations that incorporate correlation effects, such as quantum Dynamical Mean Field Theory (DMFT), are easier.

However, relatively little is known about their electronic structure and collective excitation from an experimental point of view. We are now filling this gap with a comprehensive experimental investigation covering the entire phase diagram, with a study of the vibrational (7) and magnetic excitation (8), as well as their electronic structure (9). Our current research tries to unveil whether the superconductivity itself is of 2D character in these compounds, but their physical properties need to be disentangled from their crystalline texture.

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(5) C. Fawaz, T. Singar, S. Schulte et al., in preparation.

(6) B. Baptiste, M. Azuma, R. Yu, et al., *IUCrData* 3 (2018) x181645.

(7) L. Chaix, B. Lebert, H. Miao, et al., *Phys. Rev. Res.* 4 (2022) 033004.

(8) B. W. Lebert, B. Bacq-Labreuil, M. P. M. Dean, et al., *Phys. Rev. B* 108 (2023) 024506.

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Matteo d'Astuto is "Director of Research" of CNRS at Institut Néel, Grenoble, where he works on collective magnetic and vibrational excitations in superconductors and systems with strong electron correlation. He is an expert in inelastic scattering of x-rays, both resonant and non-resonant, and neutrons.

He has defended his PhD in 1999 at the University of Orsay, on a research at the neutron scattering center Léon Brillouin in Saclay, and his "Habilitation" at the University Pierre et Marie Curie (Paris) in 2010, where he was working as CNRS researcher, before moving to Grenoble in 2017.

He has been visiting professor at the Tokyo Institute of Technology from 2019 to 2022.