

### High temperature superconducting oxchlorides: a light element model for cuprates

**General Scope:** Cuprates were discovered in 1986 to show superconductivity at the highest temperature at ambient pressure, a record they still detain (see figure), but their phenomenology apparently cannot be grabbed by present theory, so that they are considered among the main unsolved problems in physics today. In this context, the discovery of the Na and vacancy doped  $\text{Ca}_2\text{CuO}_2\text{Cl}_2$  oxchloride is very promising indeed to bridge the gap between theory and experiment since it: lacks high  $Z$  atoms; has a simplest crystalline structure for cuprates, stable at all doping and temperatures; and has a strong 2D character due to the replacement of apical oxygen with chlorine. Therefore, advanced calculations that incorporate correlation effects, such as quantum Monte Carlo are easier, but relatively little is known about  $\text{Ca}_2\text{CuO}_2\text{Cl}_2$  from an experimental point of view. We are now filling this gap by a comprehensive experimental study covering the whole phase diagram, in particular of the magnon and phonon dispersion as well as their electronic structure, using advanced approaches based on synchrotron radiations and laboratory spectroscopies.

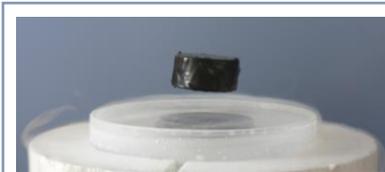


Figure 1: Cuprates allows exploiting magnetic levitation above the liquid Nitrogen temperature, as shown in the picture (Mai-Linh Doan wikimedia commons, © Creative commons).

**Research topic and facilities available:** During the internship we will measure, at the Institut Néel, point contact spectroscopy, in collaboration with H. Cercellier, and/or magnetic penetration depth, in collaboration with P. Rodière, depending on the length and schedule of the internship. Preparation of these experiments will require special care, as the materials are sensitive to air, so that a special glove box is under installation at the Néel institute, and we will use its facility also for crystalline (x-ray diffraction) and superconducting (magnetometry) characterisation.

**Possible collaboration and networking:** Interpretation of the results will be made in collaboration with group performing *ab-initio* electronic structure calculation including correlation effects in Paris (S. Biermann, Ecole Polytechnique).

**Required skills:** A good background in electronic properties of material. Team work will be an essential part of the project success.

**Starting date:** from winter 2019

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