Postdoc position : Crystallography and lattice dynamic of superconducting nickelates

Scientific background

The mechanism of unconventional superconductivity remains one of the great enigmas of condensed matter physics. These superconductors are found next to an ordered phase (magnetic, charge density wave (CDW) or other one), sometimes coupled with a structural distortion, whose fluctuations possibly contribute to such a mechanism. Superconductivity in layered nickel-based oxides was first suggested 25 years ago based on similarities of the electronic configuration of the transition element (d^9) with the high-T_c cuprates one. Only in 2019 a superconducting state was reported, first, in a thin film of $(Nd_{0.8}Sr_{0.2})NiO_2$ and later in thin films of other related compositions Intriguingly, superconductivity was recently also found under pressure in bulk samples of other perovskite-based layered nickelates, $Ln_{n+1}Ni_nO_{3n+1}$ with a different d^7/d^8 configuration: i.e. in the bilayer $La_3Ni_2O_7$ and three-layers $La_4Ni_3O_{10}$ compounds with maximal T_c values of 80 K (respectively 30 K) above 14.0 GPa. Interestingly, the superconductivity appears above a structural transition corresponding to the suppression of the NiO_6 octahedra tilting. Moreover, before the onset of superconductivity, competing CDW and/or possible spin density wave states are suggested to disappear under pressure.

Context

The consortium of the ANR project "SuperNickel" including French laboratories in Caen (CRISMAT), Versailles (GeMAC), Paris (ISMO), Bordeaux (LOMA), and Grenoble (NEEL), aims to understand the microscopic origin of the superconductivity in the nickelates. The "Magnetism & Superconductivity" (MagSup) and "Materials Radiation Structure" (MRS) teams of Néel Institute have long-standing expertise in the study of superconductors, combining thermodynamic, magnetic, and conventional or contactless electronic transport techniques on small single crystals often under extreme conditions (very low temperature, high pressure and high field). Nanofabrication tools are also available in the laboratory for electrode deposition on tiny samples. New environments are also developed. For example, a cryostat that can cool down 4 K dedicated for use on a 4-circle X-ray diffractometer is currently being developed. On the other hand, the laboratory benefits from its proximity to synchrotron radiation facility (ESRF), neutron source (ILL), and intense magnetic field (LNMCI).

Postdoc profile

The postdoc will join the MagSup team of Neel Institute and work closely with MRS group. She/he will be in charge of the crystallographic studies of this $Ln_{n+1}Ni_nO_{3n+1}$ nickelate family and lattice dynamics investigations by inelastic X-ray scattering as a function of temperature and pressure (performed in diamond anvil cell). Other kinds of synchrotron facility-based measurements may also be undertaken. Depending on the skills of the candidate, opportunities will be given to participate to advanced laboratory measurements including Raman spectroscopy, thermodynamic, and electrical transport measurements under extreme conditions. Finally, she/he could be involved in the improvement and ambient pressure characterization of synthesized single crystals and in the exploration of potential new compounds of the family. The postdoc will also interact with theorists of the consortium and beyond.

Required profile:

The candidate must have a PhD degree with a strong background in experimental bulk solid-state physics or crystallography. Additional experience in high pressure science and/or large-scale facilities is not mandatory but could be also advantageous. A track record of working in collaboration with multiple researchers is also desirable.

Foreseen start for the grant: as soon as possible
Amount: between 2991€ and 3417€ gross monthly salary
Duration: 12 months
Application: CV, motivation letter and references (pdf format) have to be sent at the following link:
https://emploi.cnrs.fr/Offres/CDD/UPR2940-ELOBER-107/Default.aspx?Lang=EN

If required, further information can be asked at one of the following contacts:
pierre.rodiere@neel.cnrs.fr
pierre.toulemonde@neel.cnrs.fr