

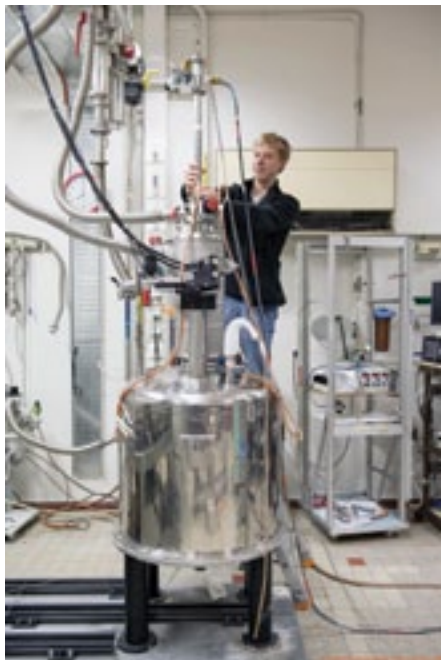
ALLIANCE 5: ADVANCED SUPERCONDUCTIVITY, FROM BASICS TO APPLICATIONS

Research axes and facilities

The partners of LANEF have always been strongly involved in the field of superconductivity, covering the whole spectrum from materials/crystal growth, basic research involving a strong interplay between theory and experiments under extreme conditions of low temperatures, high magnetic fields or high pressure, and innovation for advanced applications. Nowadays, basic research on superconductivity can only be conceived in the more general framework of the search for new states of matter in strongly correlated electron systems. LANEF takes advantage of the strong experimental basis in low temperature physics and instrumentation development in the Grenoble area, together with its unique large scale facilities: the Institut Laue Langevin (ILL), the European Synchrotron Radiation Source (ESRF), or the high magnetic field facility (LNCMI). On the application side, a major challenge is to succeed in using the high- T_c cuprate superconductors for general public applications, and/or to discover new materials allowing for such applications. Since a long time, Grenoble has a strong position in applied superconductivity with numerous activities on SC devices for energy, several groundbreaking demonstrators and modelling works and an original activity on materials dedicated to applications, backed by long standing industrial collaborations.

Actions within LANEF

Innovative applications. Optimized High- T_c superconductors for cables are a major challenge for industrial applications: in addition to the fundamental work on fabrication (applicable to other areas like photovoltaic), characterization tools have to be developed and devised to follow the in-line industrial processes, in close interaction with our partners Nexans and Arcelor-Mittal. LANEF will also participate in Smart Colossus, a smart grid project which integrates a 900 m demonstrator of a 60 000 ampere DC superconducting cable. This aims at interconnecting the laboratories of the Polygone Scientifique involved in high magnetic field production, and power storage and management, to optimize the sharing of 36 MW of electric power. Smart Colossus will be a world class technological show-case for future electrical networks, and a unique opportunity for training.



Researcher adjusting a Raman scattering probe in a cryostat equipped with a 14 T superconducting magnet

High- T_c Superconducting magnets for high fields. A main cornerstone of our project is a new hybrid magnet reaching 43 T, which - together with existing superconducting magnets - will offer a facility which is exceptional in terms of the field strength, field volume and field gradients available. This facility opens new possibilities for basic research and developments in magnetic field science and technology.



Crystal growth of UCoGe in a new tetra-arc furnace, a recently discovered ferromagnetic superconductor, for high pressure and high field investigations

Extreme conditions and large scale facilities for new superconductors. Studies on quantum matter, most often under extreme conditions like low temperatures, high pressures or very high fields, are at the forefront of discoveries of new states of matter, and are essential in the search for new superconductors. This field is typically "materials driven physics": new materials are the main source of new concepts and innovation, and we continuously reinforce our crystal growth and characterization tools. We also develop a new generation of experiments, with special emphasis on extreme conditions, imaging tools (scanning tunneling microscope and magnetic microscopy) and instrumentation for large scale facilities: besides the hybrid magnet, we also develop, in collaboration with ILL, very high pulsed magnetic fields for neutron scattering (up to 40 T), and very high resolution (inelastic scattering) spectrometers using spin-echo techniques, at the cutting edge of today's technological possibilities.

KEY FIGURES: 52 Permanent scientists from G2Elab, INAC, LNCMI, NEEL
26 PhD students and postdocs
Strong collaborations with Europe, Japan, China, USA, Canada
R&D and industry: EXANS, APERAM, COLUMBUS