Theme-based objectives and endpoints

Conception and design of innovative electromagnetic devices going beyond the limits of existing systems: energy efficiency, environment, compactness, new functionalities ...

Multidisciplinary approach from materials to applications including physical analysis of phenomena, model building and experimentation at different scales

MADEA+

MATERIALS AND ADVANCED ELECTROMAGNETIC DEVICES

Scientific activities

Functional materials for Electrical Engineering

Magnetic materials, superconductors, magnetocalorics, coupled magnetic materials, etc.
In close cooperation with Grenoble-based physics laboratories

- Study and enhancement of properties and exploration of new functionalities
- Model building of static, dynamic and multi-physical behaviours
- Characterisations of giant EMC materials at atmospheric temperature
- Magnetic materials treated in intense fields

Conversion and processing of energy

Innovative converter devices

- Design and sizing considering actual operating conditions and the environment
- Analytical and semi-analytical modelisation for design and optimisation
- High critical temperature superconductor magnets (HTS)
- High performance actuators and machines
- Magneto and electro-caloric systems
- Fault current limiter

Information conversion and processing

Original information processing structures

- Implementation of materials and use of multiphysics couplings
- Instrumentation, signal processing and specific model building
- Giant magneto-impedance sensors (GMI)
- Innovative CEM filters for aeronautic systems
- Low field N.M.R systems

Design of immersed transformer-connector for sea turbines (collaboration DCNS and M PRIME Energie)

NMR and GMI sensors

Magnetic refrigeration devices

Experimental facilities

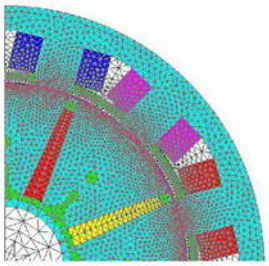
- Characterisation benches for magnetic materials: losses and hysteresis different wave shapes, high and low frequencies, mechanical stresses, etc.
- Electromagnets for fine characterisation of hard and soft materials
- Characterisation benches to determine critical parameters of superconductors
- Helmholtz coils, sensor calibration, magnet characterisation
- Low field NMR sources
- Magnetic refrigeration devices to study active regeneration thermal cycles (AMR)
- Automatic rotating machine test bench (50kW, 500Nm, 10000rpm)
- Furnace for magnetic annealing treatment under magnetic field (0.1 T, 900°C)

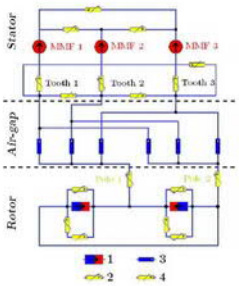
Studies

- Analytical calculation of interactions between permanent magnets
- Magneto-mechanical coupling at high frequency in ultra-soft materials

Achievements

- HTS superconductor magnets
- Magnetic refrigeration prototype
- Temperature sensor deposited on a YBaCuO ribbon
- NMR measurement probe working in low fields
- Superconducting current limiter
- Planar magnetic component integrated on to PCB with meander core geometry and ultra fine (20mm)FeNiCrCu magnetic ribbons

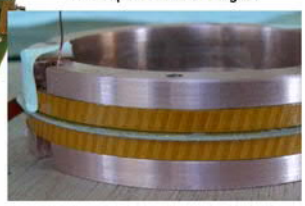




Design Optimization of Permanent Magnet Synchronous Machines for Electric Vehicle

Superconducting Fault Current Limiter

HTS superconductor magnet



Collaborative projects

Industry

Absolut System, Air Liquide, Aperam, ARaymond, ArcelorMittal, Alstom, Chauvin-Arnoud, Cooltech Applications, CIH, DCNS, Dymeo, EDF-DTG, Enerbee, IDEA, Mitsubishi, MPrime Energie, Nexans, Renault, Schneider Electric, Thalès, Valeo, ST Microelectronics, Zodiac Aerospace

National

AMPERE, CEA-LITEN, CEA-SACM, CRETA, CRISMAT, DGA, ICMCB, Institut Néel, ISL, Gipsa-lab, LAPLACE, LEPMI, GEEPS, LMGP, LMT, LNCMI , IMP-INSA LYON

International

LIA-LAS2M, CAPS, IZFP, HEIG-VD, Tech-Inst. of Bandung, Ecole Polytechnique Montréal, KIT, EPFL, Tohoku Univ.