

## Theme-based objectives and endpoints

Characterization of low-level and low-frequency magnetic fields (DC-3kHz,  $\mu\text{T}$ - nT)

Identification of electromagnetic sources from external field measurements by resolution of inverse problems

Attenuation of fields by control of sources and / or by design of passive or active shieldings



## ERT- CMF

Équipe de Recherche Technologique  
Champs Magnétiques Faibles

### Scientific activities

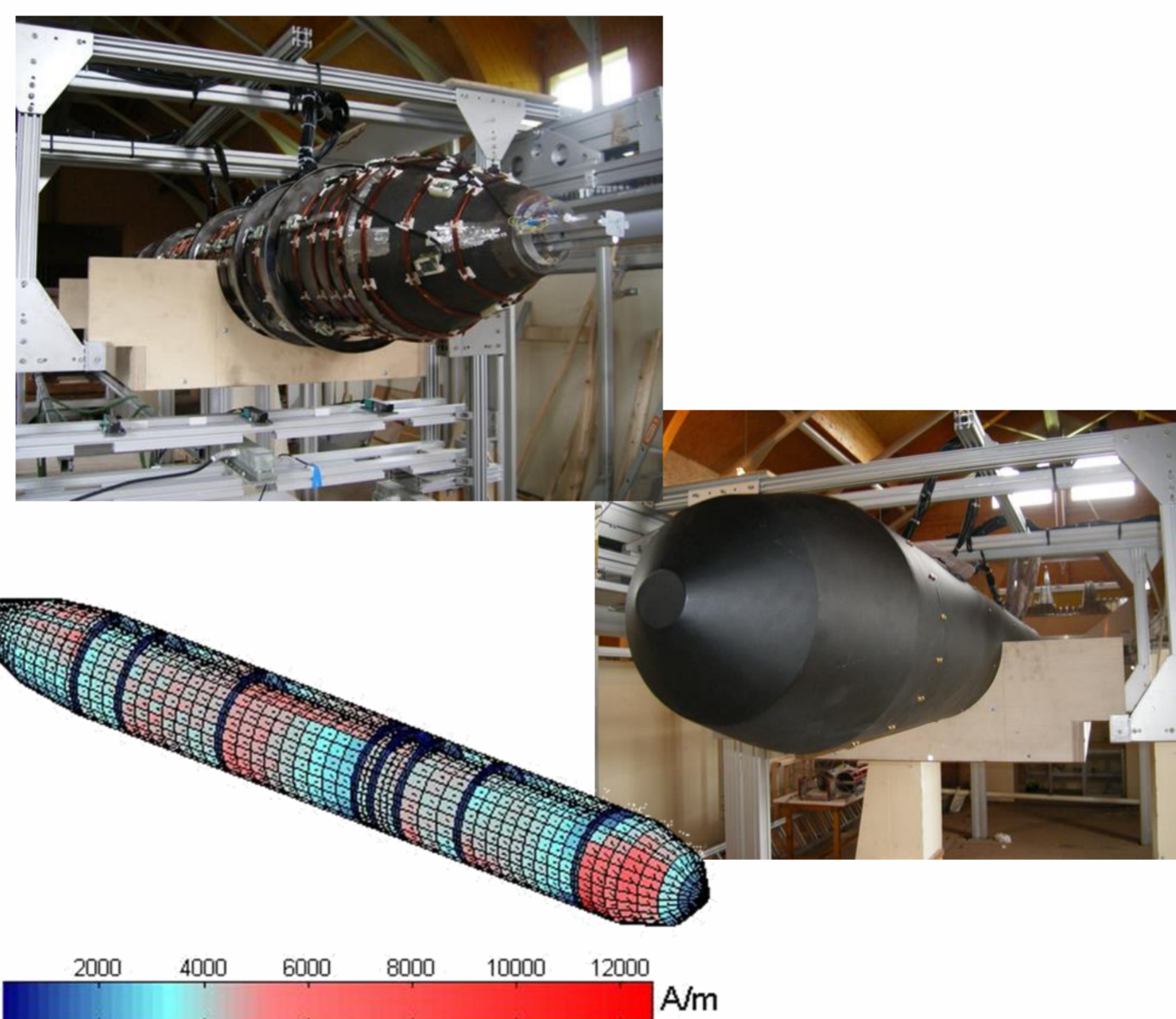
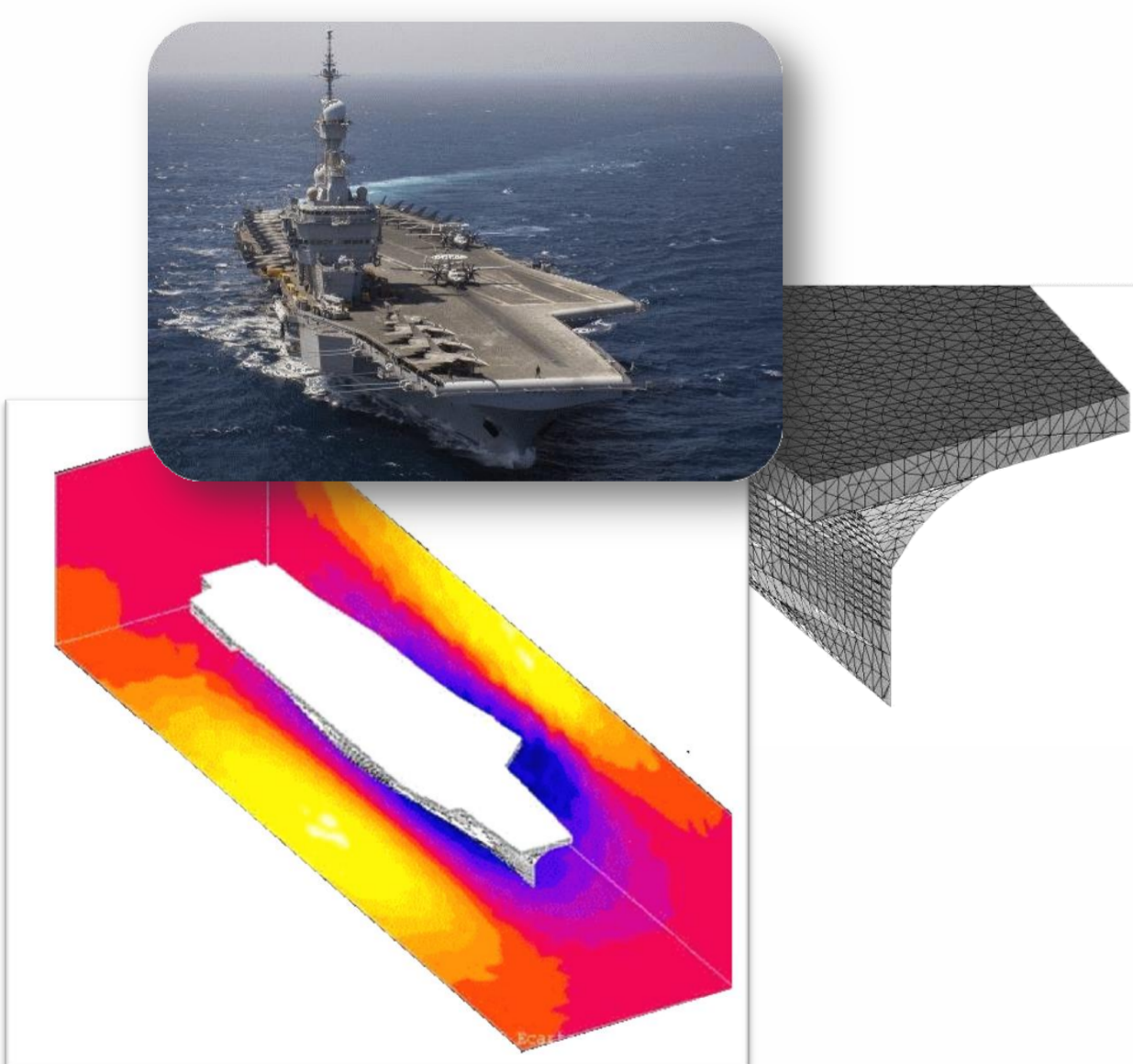
- Electromagnetic discretion of ships,
- Magnetic discretion of electrical equipments (electrical machines, etc.),
- Reduction of stray fields by passive or active shielding,
- Measurement of low-level and low-frequency magnetic fields,
- Monitoring and calibration of sensors
- Diagnosis of electrical systems (alternators, transformers, fuel cell) with leakage magnetic field analysis,
- Diagnosis of corrosion using electric potential measurement
- Prediction of magnetization variations due to the effects of stresses (magnetoelastic model),
- Electromagnetic bioprocess for sewage problems

### Specific equipment

Low Magnetic Fields Metrology Laboratory (LMMCF) located in Herbeys (10 km from Grenoble, in a magnetically stable environment ) and shared with the CEA-LETI

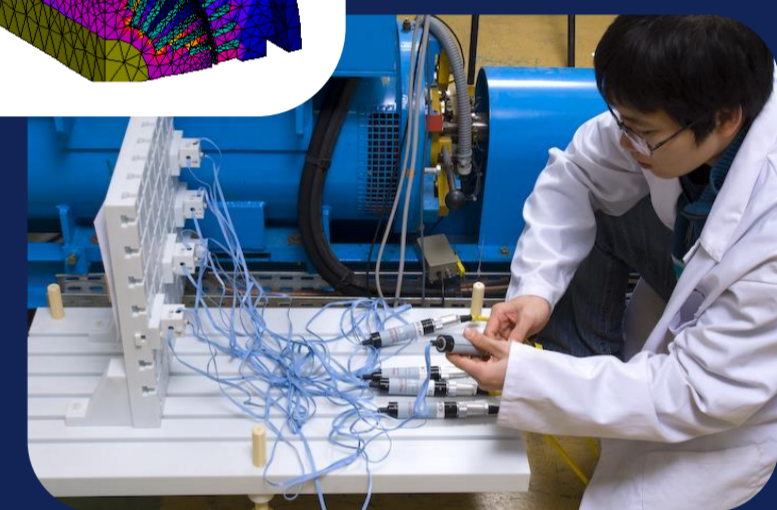
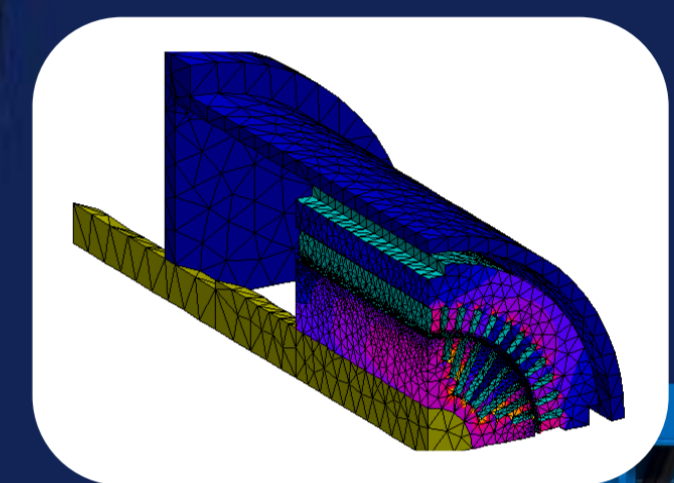
- Magnetic field simulator (2 m diameter, 15 m long) with a very good homogeneity (better than 0.1 %).
- Deperming equipment: 10 square shake coils (1 meter cross section, 4800 A/m) with a frequency from quasi-static (0.01 Hz) up to 40 Hz.
- 100 magnetometers and gradiometers, mostly of fluxgate type (vector measurements), and a high performance data acquisition system is available.
- Metrological Magnetic Characterization Laboratory (LCM).
- A whole set of autonomous and portable equipment to take magnetic measurements on the field.

Magnetic State of a aircraft carrier in a earth magnetic field (FLUX software)

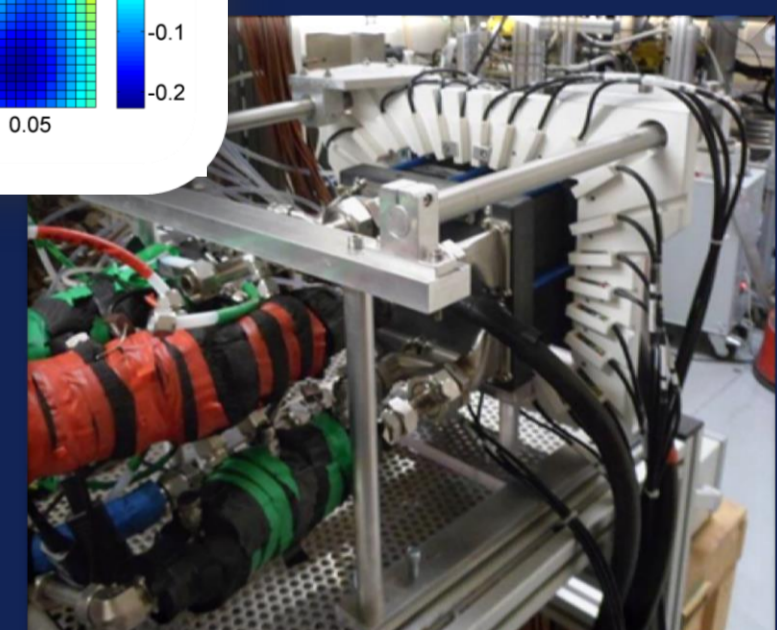
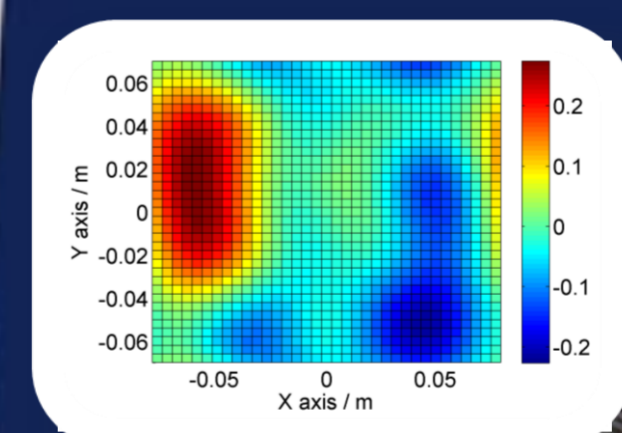


Closed Loop Degaussing of a submarine : Identification of the magnetization form internal magnetic measurements (LOCAPI software)

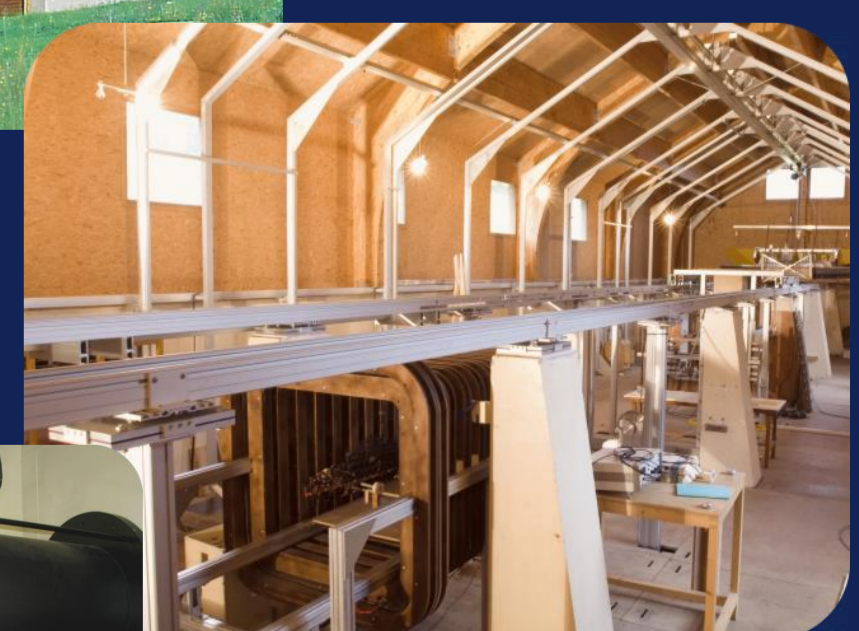
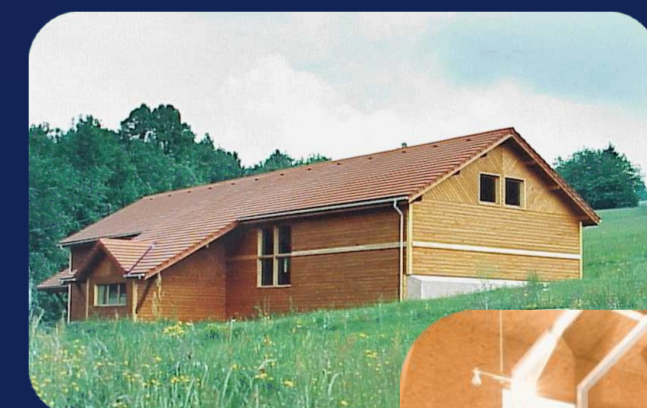
Modeling and diagnosis of electrical machine by external magnetic measurements



Fault monitoring of electrical machine with leakage flux analysis



Current distribution identification in fuel cells stack by measurements of external magnetic field



LMMCF facilities in Herbeys (Grenoble INP / CEA-ETI) Field Simulator and LCM equipment for magnetic characterization

### Collaborative projects

#### University and Publics Agencies

French Ministry of Defence (DGA), Atlantic Submarine Study Groupe (DGA-TN), CEA-LETI, CEA-Liten, GIPSA-lab, LEPMI, LOCIE

#### Corporate

DCNS, CEDRAT, GeoEnergy, Schneider Electric, Arcelor / Imphy, MécaMagnetic, CNES, Alcan, Alstom, EDF-DTG, Somfy

#### International

NSWC (USA), Fincantieri (Italy), WTD71 (Germany), MoD/DSTL (UK), CTMSP (Brazil)

