



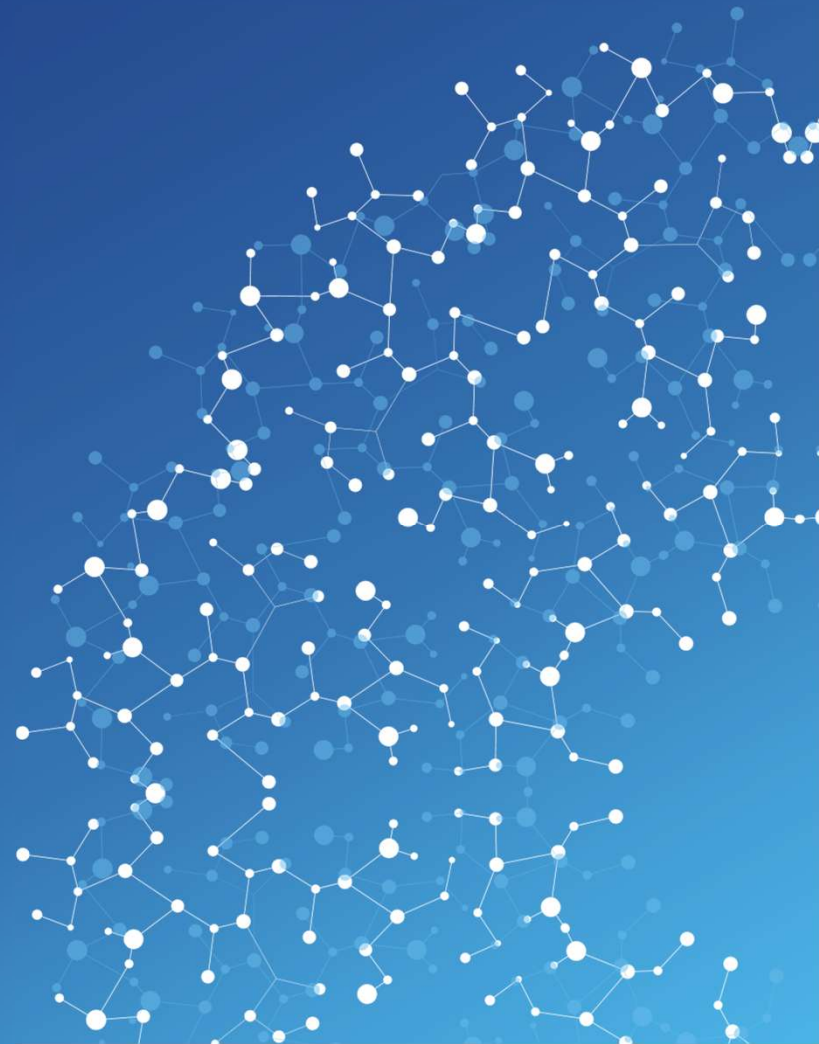
Superconducting High Field Magnets and Science Discovery

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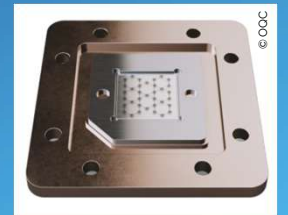


Why “Science Discovery”, and why does it matter?

High field (and low temperature) physics sits behind all the advanced electronic materials that underpin economic growth, and benefit humanity

- **Semiconductors** for next generation, lower power (mobile), faster devices
- **Superconductors** for secure, sustainable energy
- **Quantum devices** for quantum computing, communication, and sensing

→ This is not ‘just’ curiosity-driven science – to engineer **materials** into **devices**, you need to understand their **physics**



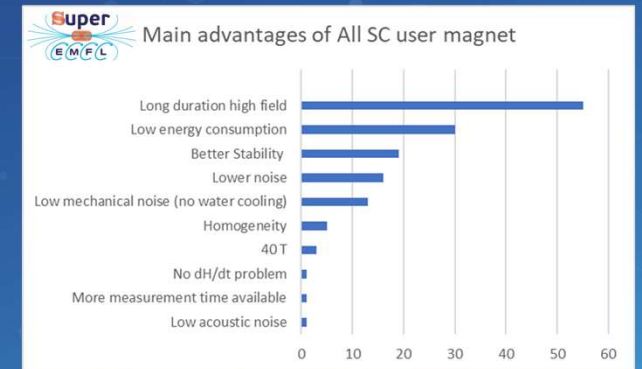
Why does “superconducting” matter?

Research benefits

- Lower noise - unlock some effects at lower fields due to improved S:N
- High homogeneity possible for resonance methods
- Larger sample space sizes (cryogenic design efficiency)
- High uptime, in principle can be available 24/7

Host facility benefits

- Compact physical footprint and easy service provision
 - Need to allow magnetic footprint
- Lower total lifetime cost when backed by efficient helium recovery and reliquifier capability

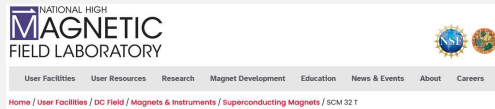


The SuperEMFL project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 951714. Any dissemination of results reflects only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

State-of-the-art in superconducting high field (>20 Tesla) user magnets

NHMFL, Tallahassee, FL

- World first, 32 T
- User magnet from outset
- 40 T development



32 Tesla Superconducting Magnet (SCM-32T)



The 32 T magnet is the first in a new class of high-field superconducting magnets materials

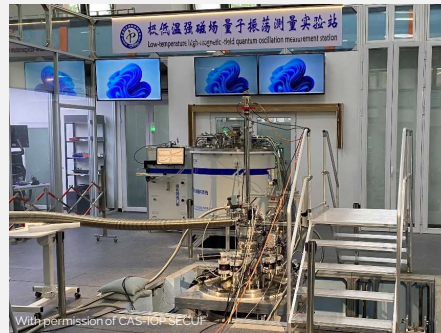
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SECUF, CAS-IOP, Huairou, CN

- 28-30 T
- 26 T "NMR grade"



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LNCMI, Grenoble, FR

- 30 & 40 T goals
- Project in progress



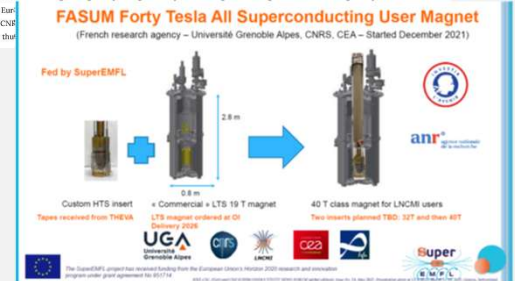
FASUM project financed by French ANR EQUIPEX program

15 October 2021 par Super Administrateur



FASUM – a 40 T all-superconducting magnet project (coordinating institution: Université Grenoble Alpes – with CNRS and CEA as partners) is financed by French ANR EQUIPEX program – 4.32 M€.

The FASUM (Forty Tesla Superconducting User Magnet) project aims at keeping France as one of the leaders in experimental research in intense magnetic fields and to facilitate the use of intense field experimentation for as many researchers as possible. The project consists of building, testing and operating an all-superconducting 40 Tesla magnet based on the design study carried out as part of a Eur (LNCMI-CNRS magnet), that



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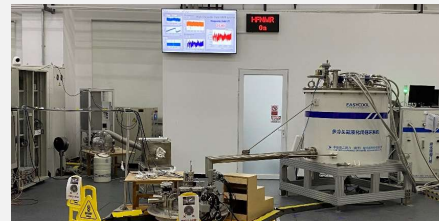
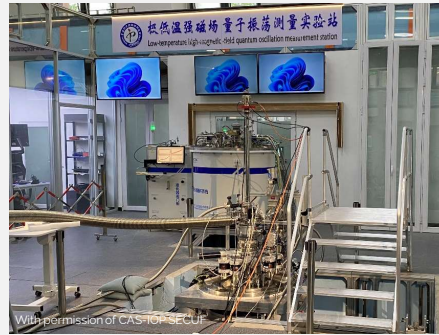
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- High field lab – commercial partnerships
- "In-house" HTS insert coils backed by commercial (Oxford Instruments) LTS outsert magnets

The critical role of National Laboratories

The dual role of National Laboratories is key

- User facilities – ensure technology meets real needs
- Technology development – leverage in-house expertise in what is **new**

Use commercial expertise for risk mitigation

→ Commercial partnerships with National Labs supports goals of high field technology and access

1 March 2023

Oxford Instruments and MagLab's Applied Superconductivity Center Partner on High-Temperature-Superconducting Materials for High Field Research Magnets



Magnetic field dissemination and research acceleration

To accelerate “Discovery Science”, wider access to high field is needed

- Get researchers without field capability onto the ladder, c. 14 T
- Enable researchers now limited at 14 T to get to 20-25 T in their own/close lab
- Release greater National Laboratory capacity via all-sc magnet investment

→ Funding

→ Partnerships (also funding)



Side note: It's not only about magnetic field – low (1-4 K) and ultra-low (mK) temperature sample environment is needed in combination

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Thank you

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