The FuSuMaTech initiative:

Synergy with Industry and Impact on the Future Superconducting Magnet Technology

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European Union Framework Programme for Research and Innovation Horizon 2020

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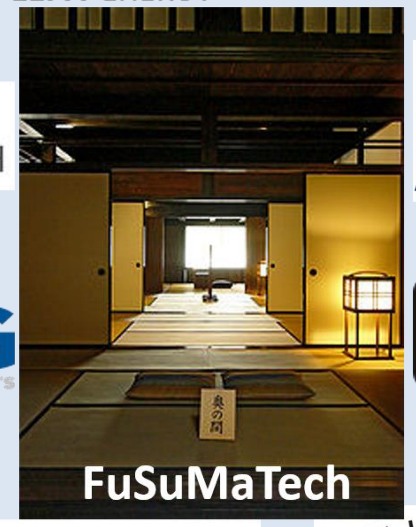


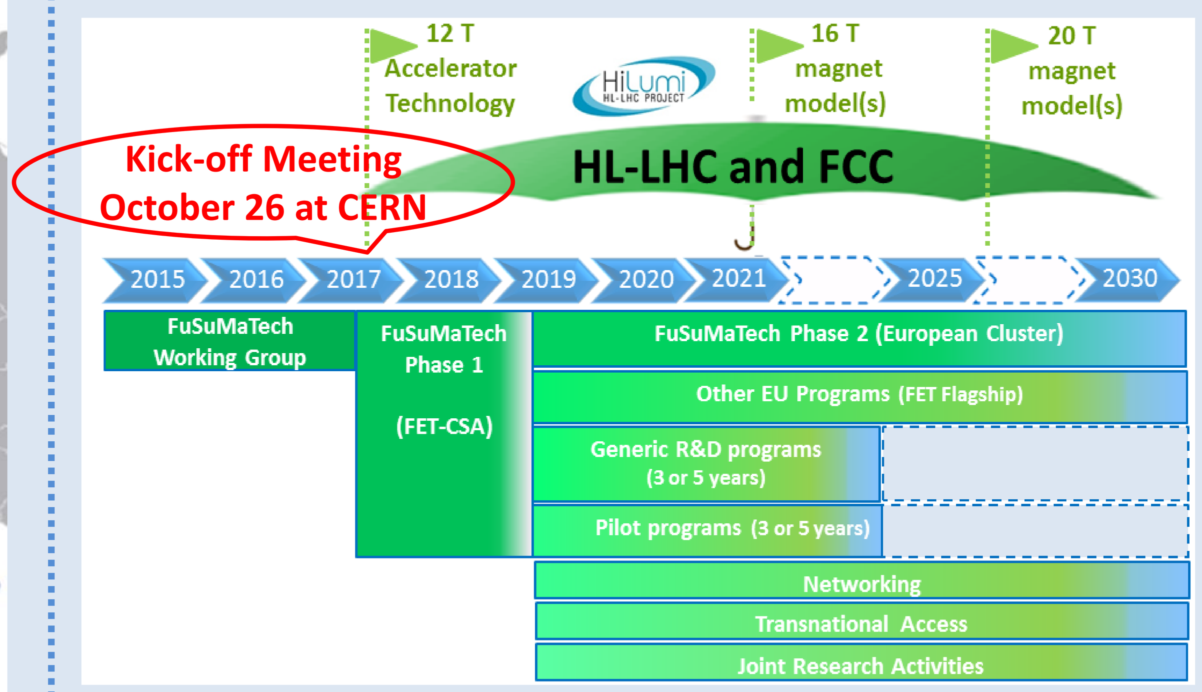
H2020 PROJECT — *Program I.D. number: Thu-Af-Po4.04-01*

The CERN's projects, HL-LHC and FCC, will create a big push in the state of the art of High-Field Superconducting magnets. In the context of Energy's savings, Industry is experiencing a renewed interest in the domain of industrial superconductivity Medical Research shows a strong interest in High-Field MRI, especially for the brain observation.

The working group FuSuMaTech has explored a large spectrum of possible synergies with Industry, and proposed a set of R&D&I projects to be conducted jointly between academics and industry. **Thus the FuSuMatech initiative is a dedicated and large scale silo breaking program which will create a sustainable European Cluster in applied Superconductivity.** It will enlarge the innovative potential especially in High Field NMR and MRI, opening future breakthroughs in the brain observation.

CONSORTIUM PARTNERS

OVERALL ROADMAP



FET-CSA OBJECTIVES

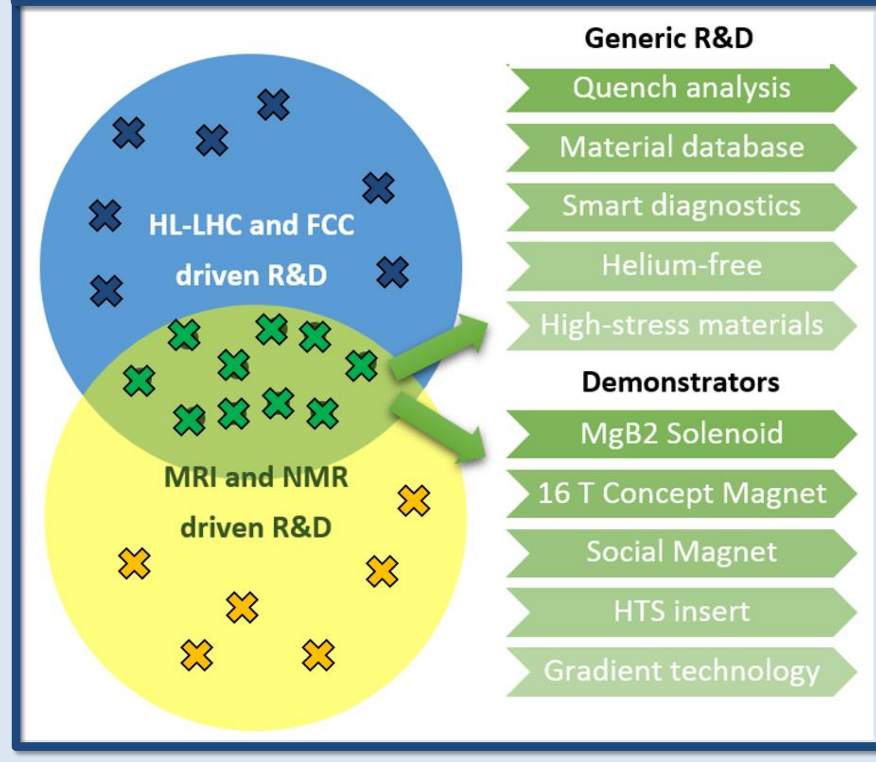
Objective #1 Moving towards a FuSuMatech European Cluster

Objective #2 Building the FuSuMaTech Roadmapping

Objective #3 Defining and Preparing Generic R&D Actions

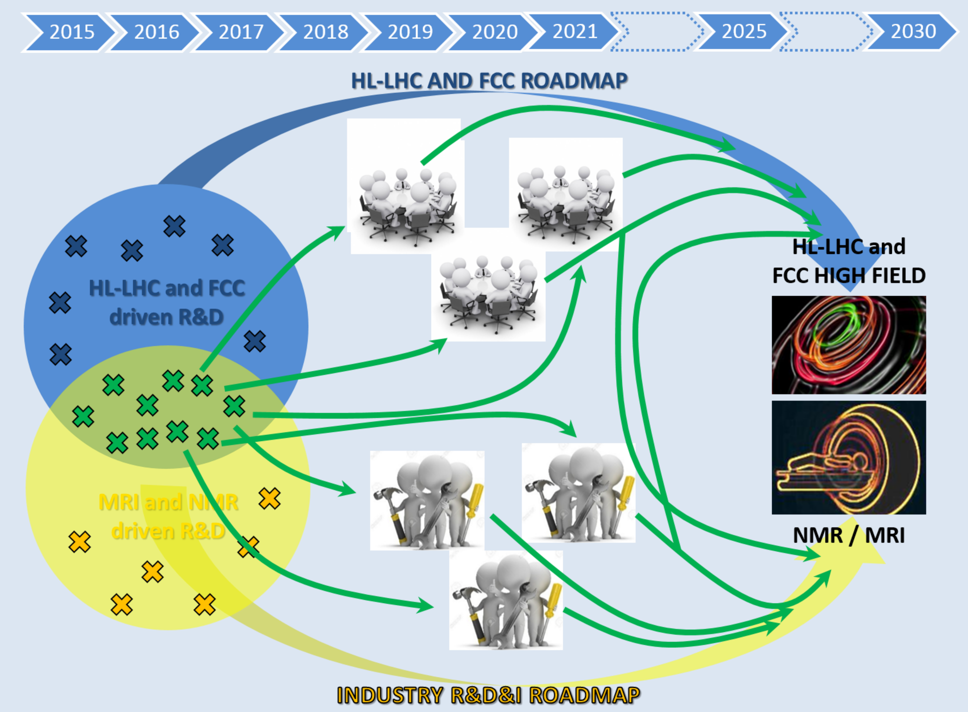
Objective #4 Defining and Preparing Pilot Actions

MOVING TOWARDS A FuSuMaTech CLUSTER



WP4: Five R&D&I subjects

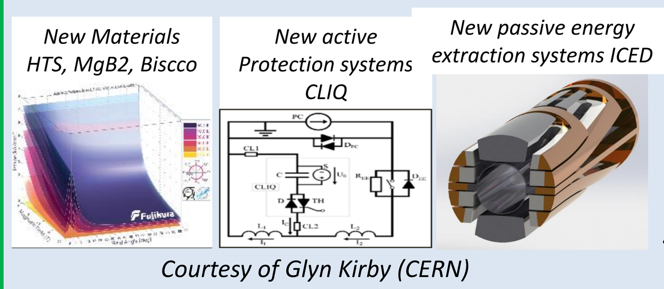
WP5: Five technology demonstrator subjects



The FuSuMaTech Phase 1 is the first step of the FuSuMaTech initiative. It will consist in preparing the detailed description of R&D&I actions, the administrative and legal conditions and the funding scheme for the future.

TASK 4.1 — QUENCH ANALYSIS NEW APPROACH BASED ON NEW COMPUTING CAPABILITIES AND ON MULTIPHYSICS

PSI, KIT, ELYTT



Courtesy of Glyn Kirby (CERN)

For HL-LHC and FCC high field magnets either in LTS or HTS the quench must be predicted with more and more accuracy.

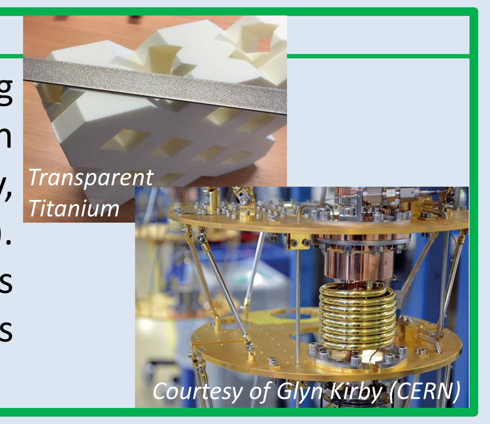
Many tools have been developed and benchmarked on real magnets in the last decades. Numerous computing developments are also presently launched.

The tremendous progress in computing capabilities is an opportunity to support a new approach with challenging targets.

TASK 4.4 — HEAT EXTRACTION AND HELIUM-FREE MAGNETS

CEA, BNG, ELYTT

Heat extraction from future superconducting magnets will need to be optimised depending on many operating constraints (helium availability, power requirements, reliability, cost, heat flux,…). Helium is a rare earth resource and is limited. This pushes the development of Helium free systems and the use of closed cycle refrigerators.



Courtesy of Glyn Kirby (CERN)

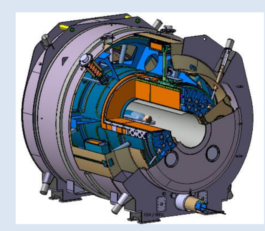
TASK 5.2 — CUTTING EDGE HIGH FIELD MRI CONCEPT MAGNET – WHOLE BODY 16 T

CEA, CERN, Tesla, ASG

In 2008, the Iseult was **the** only 11.7T/90cm/AS MRI project.

Now, one 11.7T/68cm/PS in NIH (damaged), one 10.5T/82cm/PS (on field), one 11.7-14T project in Corea, one 14T project in NHMFL , etc….

In this context, a conceptual study of a whole body 16 Tesla magnet that will require the use of Nb_3Sn wires foreseen for HL-LHC or FCC, would give a long term perspective for new developments in this domain. Such a design study may be used by public medical institutes to launch new projects.



TASK 4.2 — LARGE MATERIAL PROPERTIES DATABASE ASSOCIATED WITH PROPERTIES MEASUREMENTS AT CRYOGENIC TEMPERATURE

STFC, CERN, KIT, PSI, Ox. Inst,

Metals , Plastics, Composites,…
* *Thermal contraction*
* *Conductivity…*

Courtesy of Glyn Kirby (CERN)

To accurately model and predict the performance of advanced superconducting magnets, a materials data base is mandatory and should be in "Open Access".

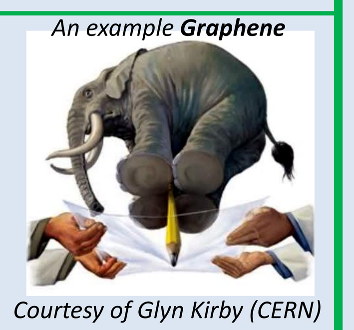
Covering the operating temperature range of the materials from cryogenic to room temperature & high temperature for reaction process of Nb_3Sn and BSCCO is needed.

TASK 4.5 — NEW HIGH STRESS MATERIALS AT CRYOGENIC STRESS TEMPERATURE

KIT, CERN, OI

Development of high field magnets will require the use of high strength materials and superconductors will need additional strengthening elements.

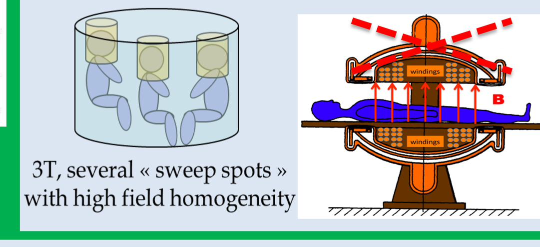
Composite's, are an area of magnets development not yet fully explored. Radiation hard development of composite's is also a concern.



Courtesy of Glyn Kirby (CERN)

TASK 5.3 — SOCIAL MAGNETS: OPEN MRI MAGNET, INTERACTIVE MAGNETIC CHAMBER, MAMMOMAGNET

ELYTT, CNRS, CEA



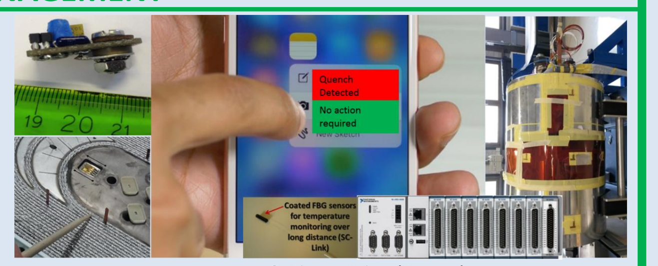
3T, several « sweep spots » with high field homogeneity

3 innovative designs are discussed:
- The « Social Magnet »
- One-side Magnet for clinical applications
- Portable MammoMagnet

TASK 4.3 — SMART DIAGNOSTICS, COLD WIRELESS INSTRUMENTATION, "EMBEDDED INTELLIGENCE" FOR QUENCH DETECTION AND QUENCH MANAGEMENT

CERN, CEA

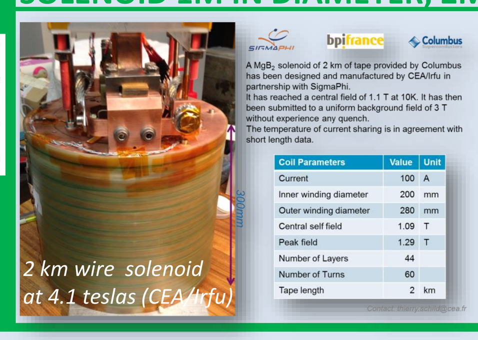
Nowadays embedding "intelligence" inside the cryostat of a superconducting magnet seems possible. Quench management could be completely renewed by using wireless instrumentation.



Courtesy of Glyn Kirby (CERN)

TASK 5.1 — MgB_2 TECHNOLOGY DEMONSTRATOR – SOLENOID 1M IN DIAMETER, 2M IN LENGTH AND 5 TESLA

Sigmaphi, CEA, ASG



Columbus is proposing commercial tape/wire products with a promising R&D roadmap.

An ambitious solenoid project will drive:
- Technological developments for for high field MRI, FCC, High Field Laboratories, etc…
- FCC electron cooling lense is considered

TASK 5.4 — TECHNOLOGY DEMONSTRATOR OF AN HTS INSERT FOR HFML

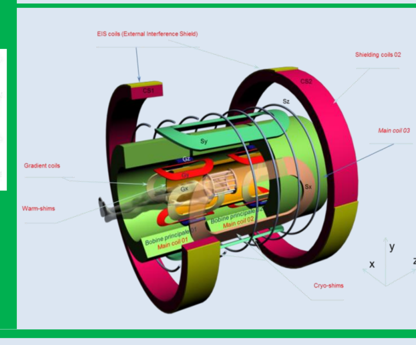
BNG, CNRS, CEA

To support HTS industry, demonstrator driven by academic institute is necessary (CEA, CERN,etc…).

We propose to join EMFL network to support within EMFLnet the development of a common HTS insert.

TASK 5.5 — GRADIENT TECHNOLOGY FOR HIGH FIELD MRI

Tesla, CEA



Gradient performance is critical to improve resolution and sampling time. An EU "Connectome-like" project is clearly welcomed to push ahead gradient technology: Develop a Multiphysics model, Test new kind of winding for gradient, Explore the opportunity to use superconducting material.