# EU-Horizon INFRA-2024-TECH-01-01

Towards a proposal

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+ on-going discussions

LEAPS WG2 Meeting

Synchrotron SOLEIL, Orsay, 18 October 2023

# The call

- Research and Innovation Action
- Total budget estimate: 62 MEUR
- EU contribution per proposal: 5…10 MEUR
- Eligibility: *Consortia must include at least **3 different research infrastructures**, each of them being an ESFRI infrastructure, and/or a European Research Infrastructures Consortium (ERIC) or another research infrastructure of European interest*

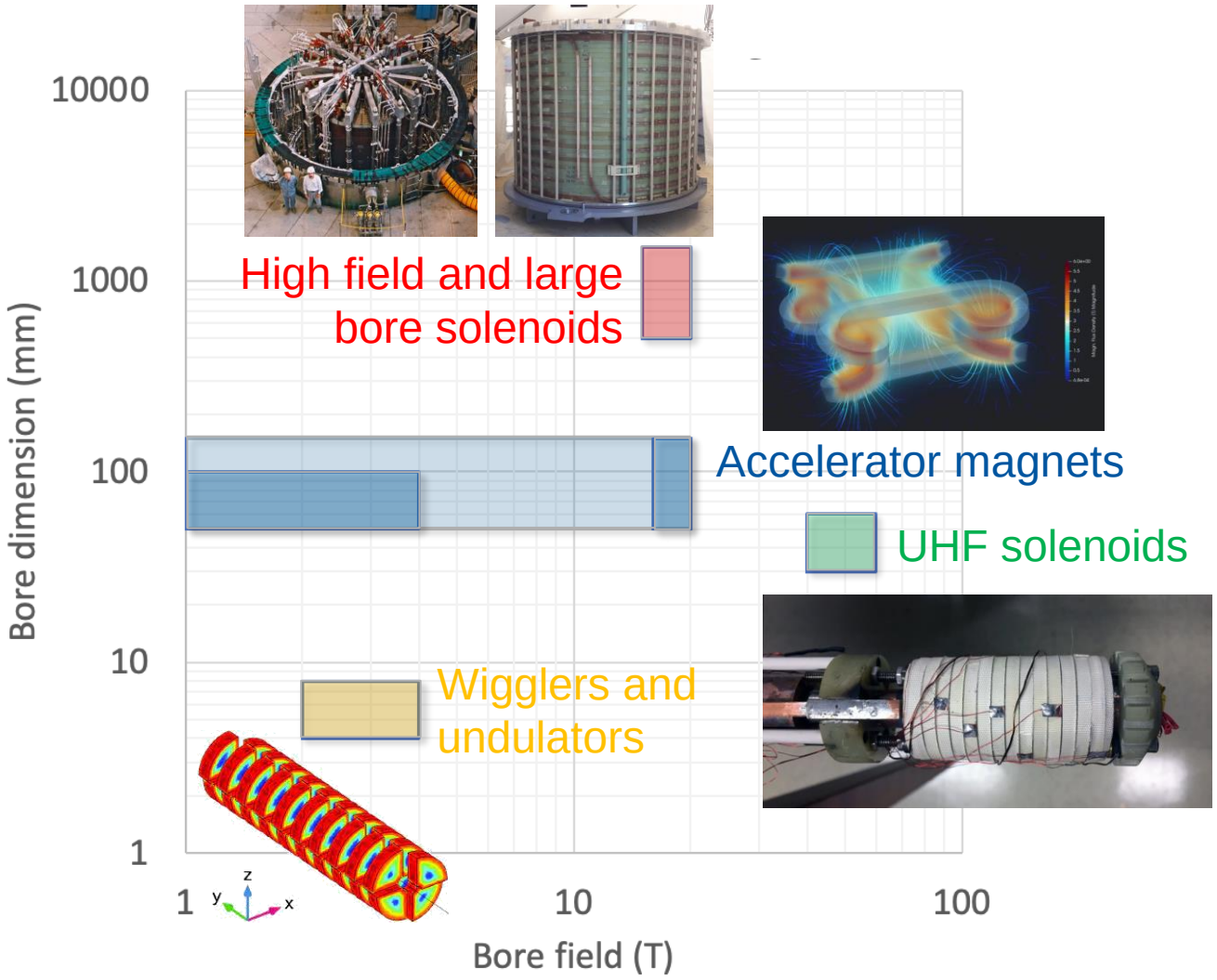
# The proposal

- Focus on HTS magnet technology for science and societal applications:
  - Science – HEP, NP, LS&FEL, HFM
  - Energy – fusion, generators
- Bridge the gap between laboratory realizations and deployment by (advance TRL by 2…3 units):
  - Developing the technology bricks still required for the next step in HTS magnets (TRL3 to TRL4)
  - Building and testing a selected number of demonstrators that will provide the engineering templates for the first-of-a-kind of a production, and possibly be “usable” in field (TRL4 to TRL5/6)

# Four HTS magnets challenges

- **Ultra-high field solenoids** (from 40 T up to 60 T)
  - Material science in high field
  - NMR and life sciences
  - Muon collider (muon beam cooling)
- **High field/large bore solenoids** (up to 20 T, 1 m bore)
  - Fusion
  - Muon collider (muon beam production)
  - Hybrid (SC/NC) high field magnets
- **High field/low consumption/compact accelerator magnets** (up to 20 T, up to 150 mm bore, up to 20 K)
  - FCC-hh: 16 T…20 T
  - Muon collider (collider ring): 16 T…20 T, 5 W/m
  - Low consumption beam line magnets, also medical applications: 1 T…4 T
  - Low consumption light source main ring magnets: ≈ 1 T
  - Light source super-bends: ≈ 10 T peak, ≈ 1 Tm integral
  - Generators
- **High field undulators** (up to 3 T gap field, 5 mm gap, short period)
  - Synchrotron light sources
  - Free Electron Lasers

# Four HTS magnets challenges



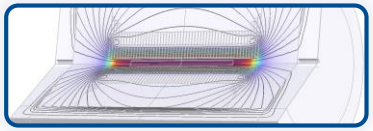
# Technologies crucial to HTS

- **Energy efficient and sustainable cryogenic technology**
  - Cryogenic fluids and cycles for high temperature (20 K)
  - Heat management (dry, indirectly cooled, gas cooled,…)
  - Minimal cryogen (reduced fluid inventory)
- **HTS cables and conductors technology**
  - High current cables and conductors (10…50 kA)
  - Cables for DC and ramped (AC) magnets
- **HTS winding technology**,
  - 3D shapes (non-planar coils)
  - Interturn insulation/resistance control
  - Joints and terminations
- **Diagnostics, sensors and control technology**
  - Quench detection and quench protection (voltage an other techniques)
  - Field control (field shaking, field feedback)
- **Radiation properties and radiation hardness**
  - HTS superconductors
  - Insulators

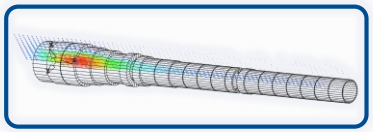




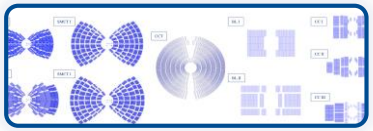
| Energy Efficient Cryogenics | HTS Cables and Conductors | HTS Winding | Diagnostics and Controls | Radiation Hardness |
|---|---|---|---|---|



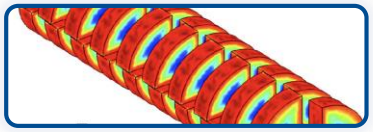
## Ultra-High Field Solenoids



## Large Bore High Field Solenoids



## Accelerator Magnets

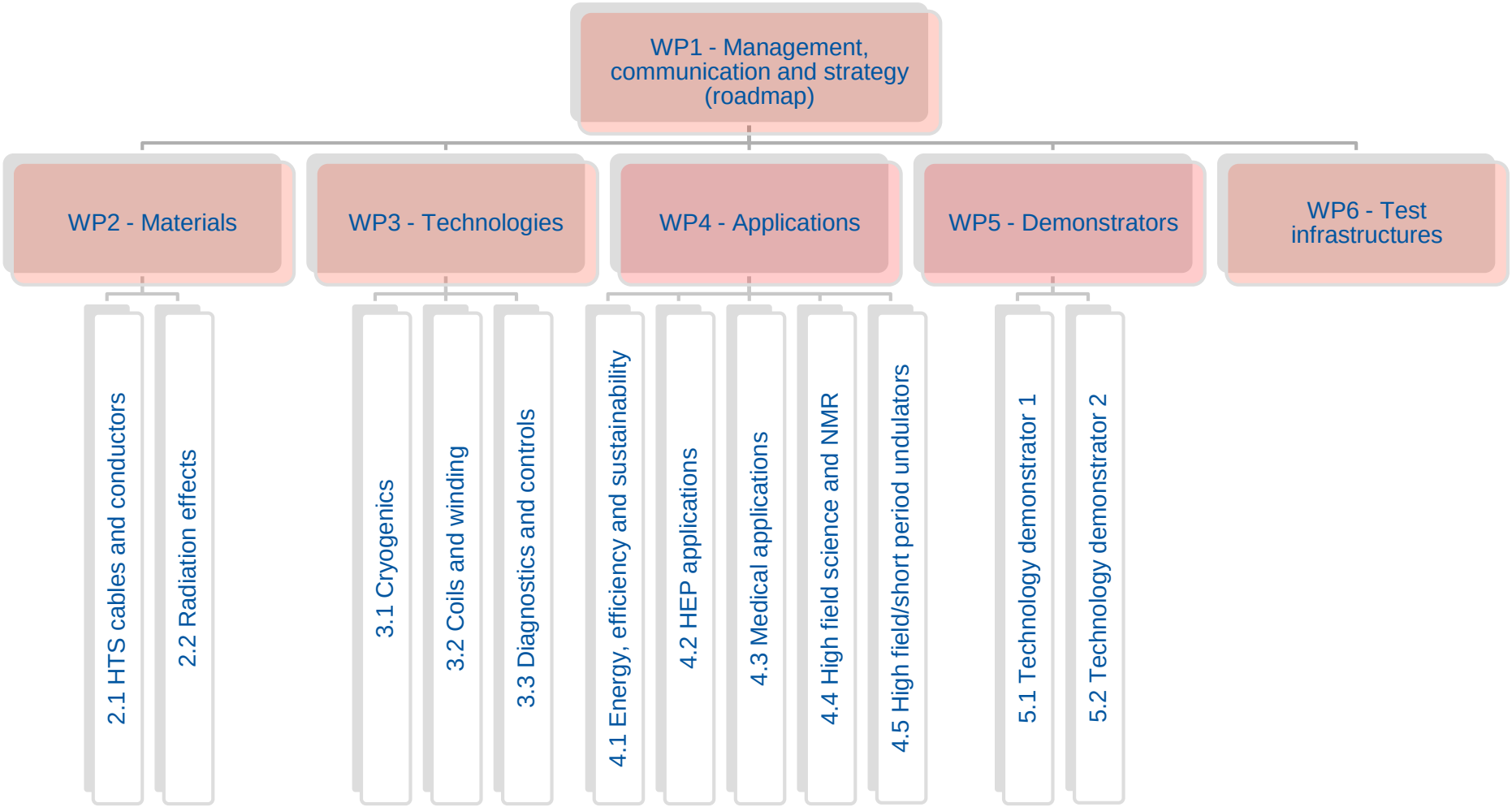


## Undulators and Wigglers

# Demonstrators (ideas)

- Application specific engineering design, construction and test of demonstrators. Options:
  - Demonstration towards an all-superconducting user facility for ultra-high field: 40 T, 50 mm bore **HTS solenoid insert** for test at EMFL (LNCMI) [overlap to SuperEMFL ?]
  - Standalone background field for laboratory testing or as instrument in a beam line: 10…20 T, 500…50 mm bore, split **all-HTS compact solenoid**
  - Demonstration of large-scale magnet technology: 20 T, 1 m bore, gas-cooled HTS **solenoid model coil** (or insert)
  - New EU test station, beyond FRESCA, SULTAN and EDIPO: 20 T, 100 mm x 150 mm bore, 1 m long **background field dipole** operating with minimal cryogen and/or at temperature higher than liquid helium
  - Small period undulator beyond the state of the art: 3 T gap field, 8 mm period, 5 mm gap **HTS demonstrator** for next generation synchrotron light sources and FEL

# Packaging


WP1 - Management, communication and strategy (roadmap)
WP2 - Materials
WP3 - Technologies
WP4 - Applications
WP5 - Demonstrators
WP6 - Test infrastructures
2.1 HTS cables and conductors
2.2 Radiation effects
3.1 Cryogenics
3.2 Coils and winding
3.3 Diagnostics and controls
4.1 Energy, efficiency and sustainability
4.2 HEP applications
4.3 Medical applications
4.4 High field science and NMR
4.5 High field/short period undulators
5.1 Technology demonstrator 1
5.2 Technology demonstrator 2