Mid-Term Review
10 December 2018, Brussels

Mattia, ORTINO

ESR13, WP2

EASITrain – European Advanced Superconductivity Innovation and Training. This Marie Sklodowska-Curie Action (MSCA) Innovative Training Networks (ITN) has received funding from the European Union's H2020 Framework Programme under Grant Agreement no. 764879

ESR13, WP2 - Background

- Background:
  - B.Sc in Mechanical Engineering (Cosenza, IT)
  - M.Sc in Nuclear Engineering - Physics for Nuclear Systems (Milano, IT)
  - 14 + 2 months Technical Student @ CERN (Vacuum, Surfaces and Coatings group) , Geneva
  - 6 months Project assistent @ TU Wien (Low Temperatures Physics and Superconductivity group), Vienna (AT)

2010 → 2017

- Contract start date 01.10.2017
- Host institute: TU Wien, Atominstitut
- EASITrain Supervisor(s) M.Eisterer (TU Wien), S.Hopkins (referring scientist @ CERN)
- PhD Title: "*Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires*"
- PhD University: TU Wien (Vienna, AT)
- Planned secondments:
  - 1. Columbus Superconductors (Genova, It), MgB_2 manufacturing methods, October/November 2019, 2 weeks (possible iteration with other 2 weeks)
  - 2. Noell Bilfinger GMBH, Magnets manufacturing technologies, August/September 2019 or January/February 2020 (to be decided)

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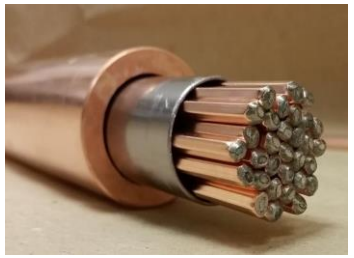
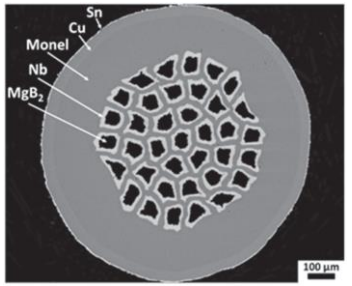
Role in the Project & Objectives

The ESR13 receives the superconducting samples manufactured by the companies inside the network (or inside the FCC-collaboration), with the aim of characterizing and understanding how to improve their performances

- In-depth characterisation of new ternarary and quaternary Nb_3Sn wires pointing to the standards requested by the next 16T CERN-FCC dipole magnet



- Identification of new MgB_2 wires performances for next generation 10T magnets and high current links provided by Columbus Superconductors SpA (collaboration with ESR #7)



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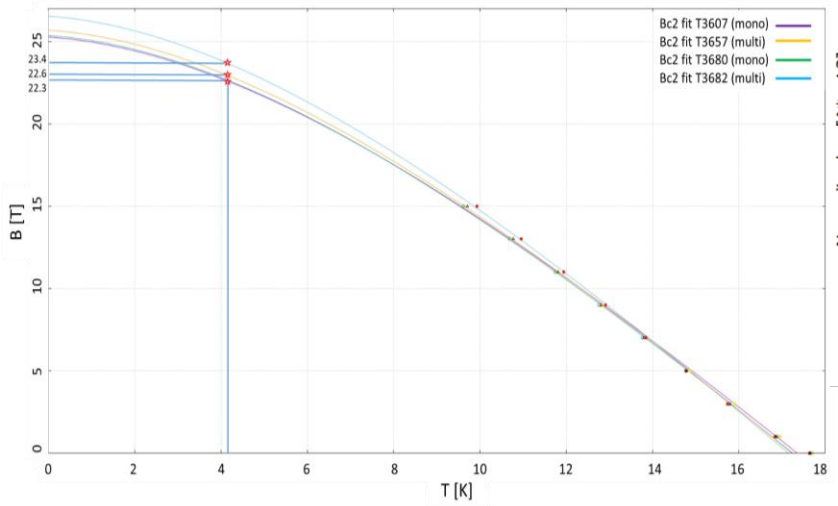
Research, Methodology, Results & Next Steps

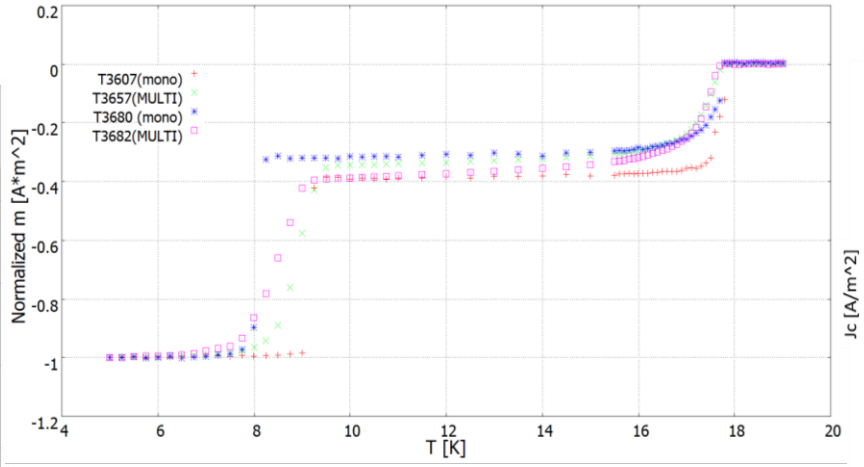
- Nb_3Sn

1. Four Ternary (with *artificial pinning centers*) Tube-Type (TT) wires from The Ohio State University have been analyzed trying to correlate the superconducting and microstructural features

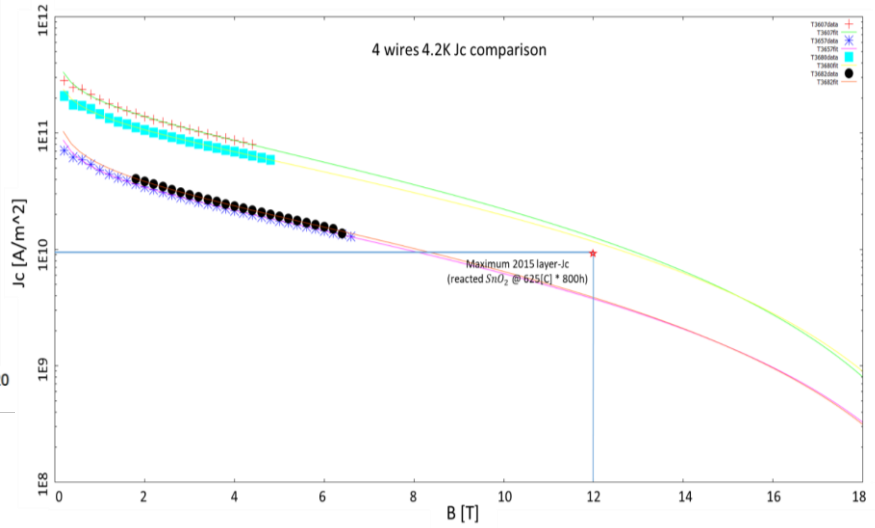
1.a Resistive measurements (Tc and Bc2 via standard 4 points technique)



1.b AC-susceptibility measurements



1.c Magnetization measurements



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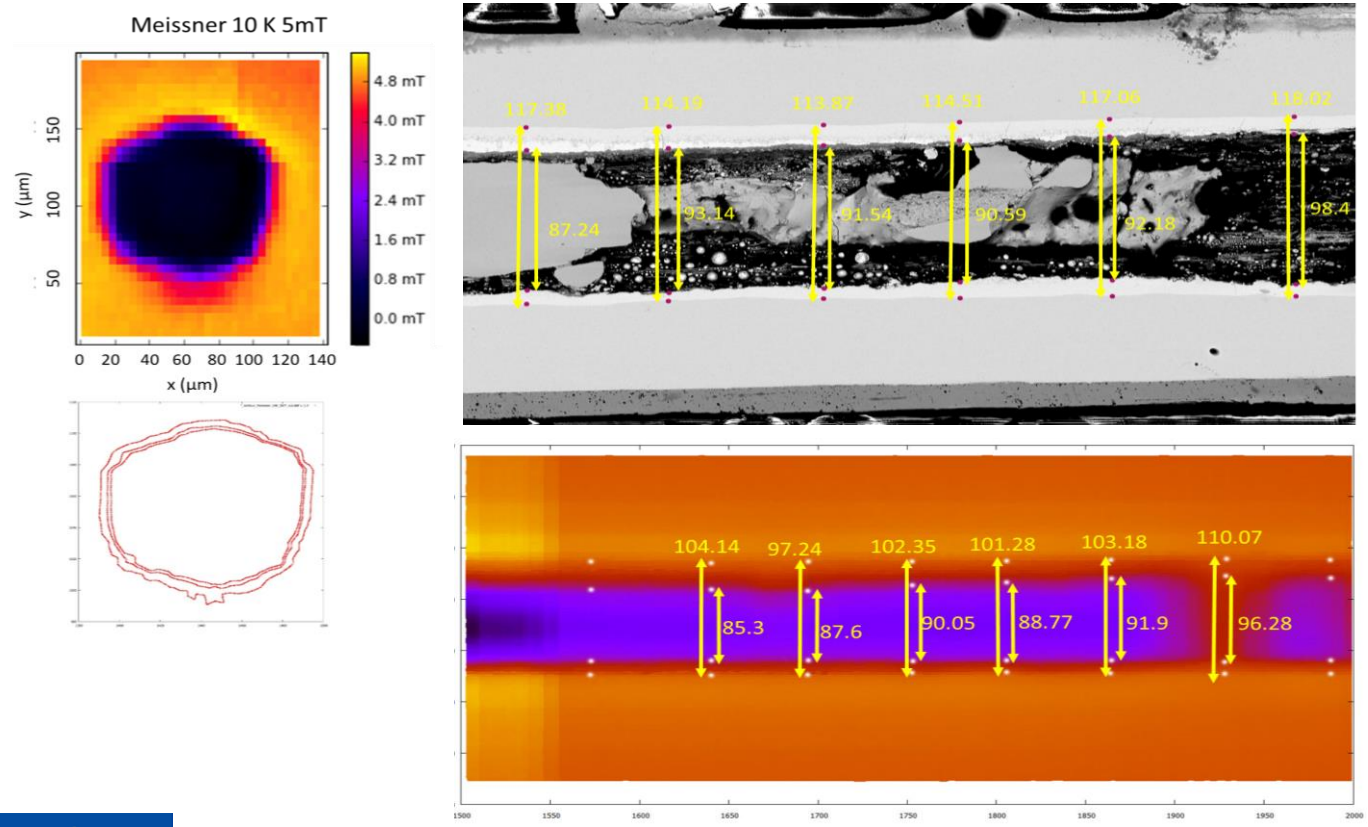
1.d Scanning Hall Probe Microscopy (SHPM) + SEM/TEM comparison



Next steps

- New wires coming: ternary and quaternary samples with the aim of a further non-Cu J_c improvement and a higher Bc_2;
- Potential irradiation campaign to be performed on the old and the new wires, assessing the additional artificial pinning effects;
- Further SHPM investigations (*currents evaluation via Biot-Savart inversion*) and comparison between the two generations of wires

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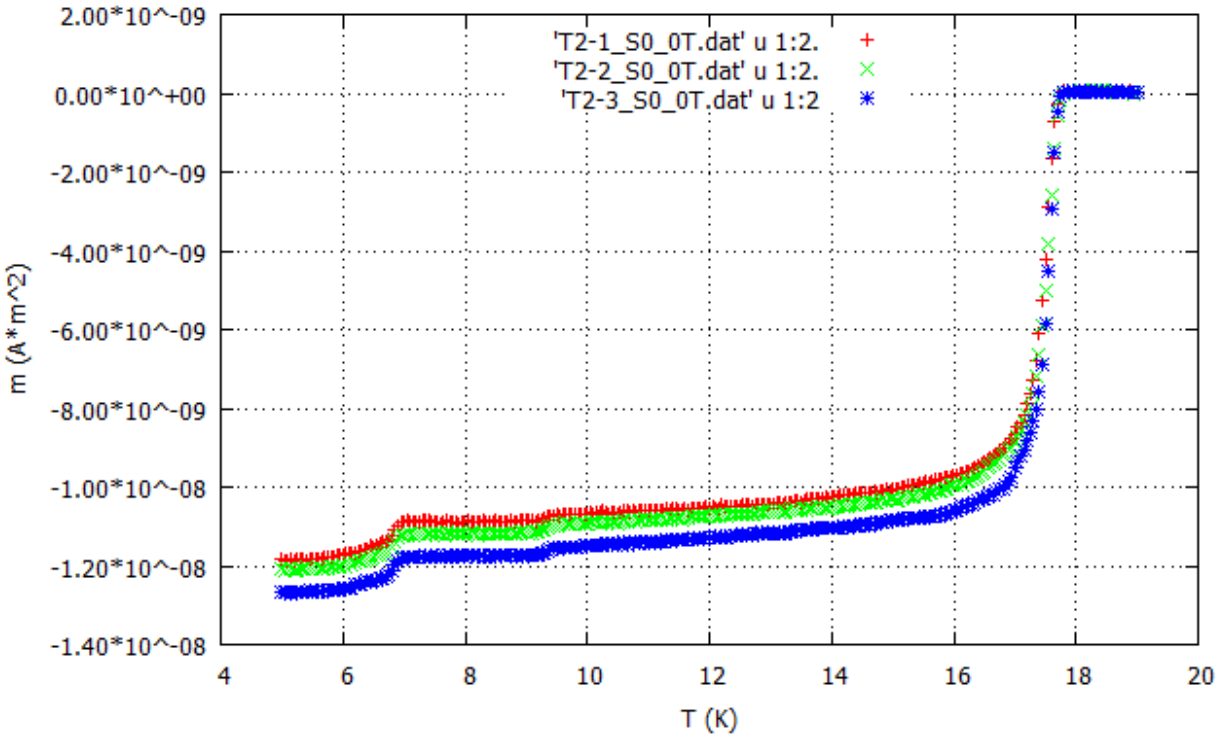
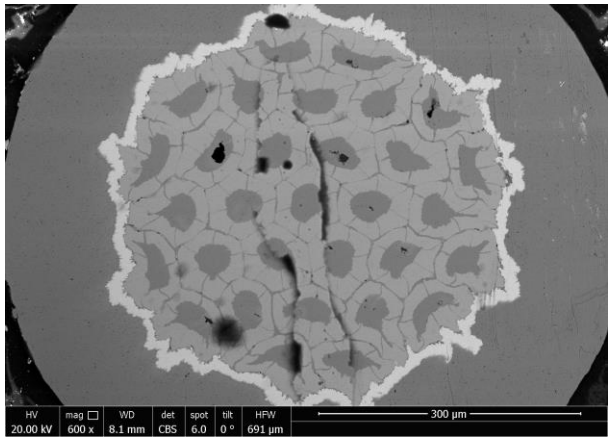
Research, Methodology, Results & Next Steps

- Nb_3Sn

2. 8 Internal-Tin (IT) wires from BOCHVAR INSTITUTE OF INORGANIC MATERIALS JSC VNIINM have been recently received and partially analyzed





- Analysis of the A-15 phase inhomogenities via AC susceptibility ongoing;
- SHPM measurements to be provided (coupled with SEM by ESR12) ;

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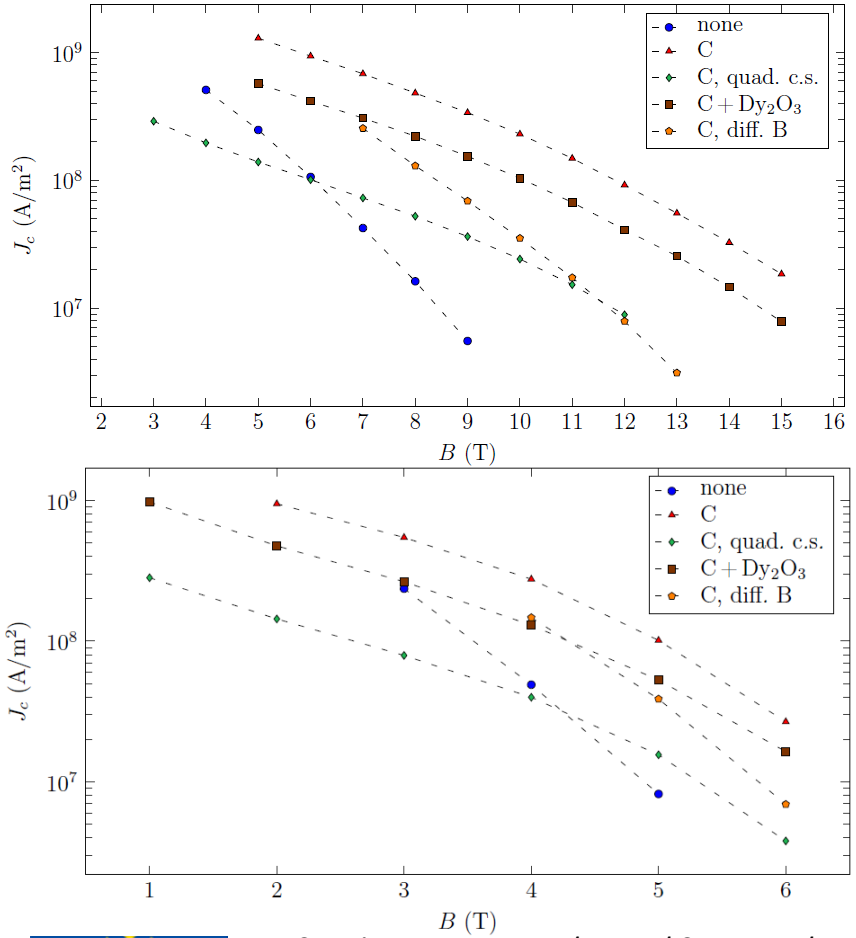
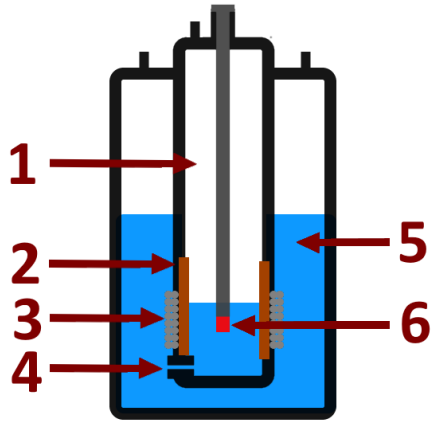
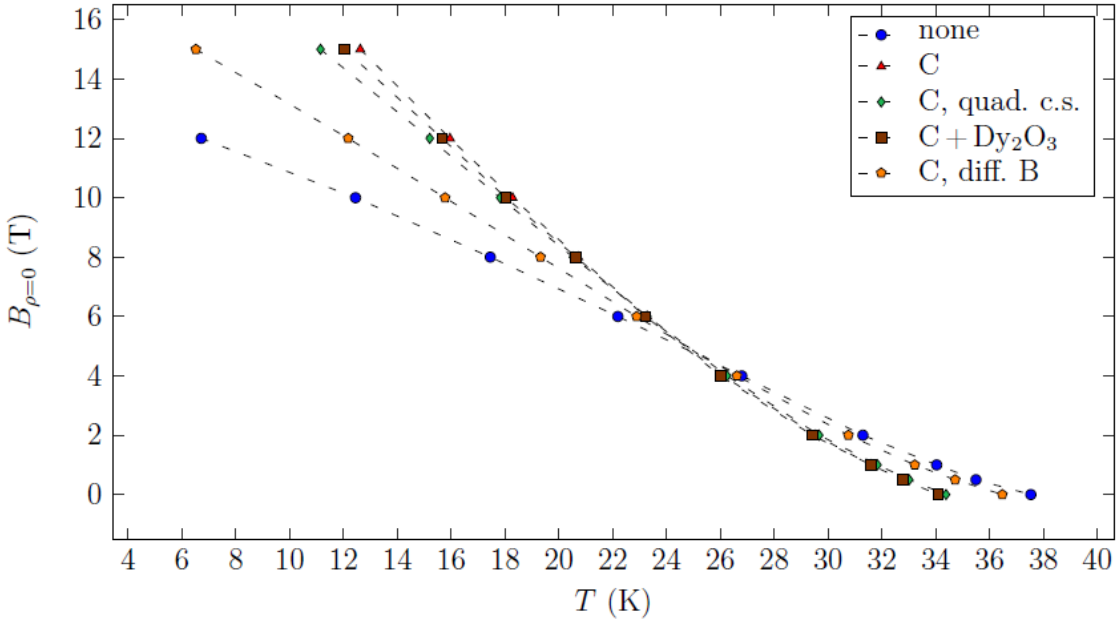
- MgB_2 5 wires with different additives from Hyper Tech Research, Inc. have been analyzed: resistive measurements





Schematic drawing of the 17T cryostat @ Atominstitut.
1: sample space
2: heater
3: superconducting magnet
4: needle valve
5: helium bath
6: sample

Zero-resistivity field $B_{\rho=0}$ Transport current Jc



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Training, Conferences & Workshops

- Training
  - ✓B1.2 German course (language training, Deutschinstitut Wien, 03.01.18-28-02-18.)
  - ✓B2.1 German course (language training, Deutschinstitut Wien, 01.11.18-21-12-18.)

- Conferences
  - ✓ FCC Week (conference, Amsterdam, 9-13/4/2018)

- Attended EASITRain events
  - ✓CERN Spring Lectures, CERN (Geneva, CH), 05-23.03.2018
  - ✓Summer School (Vienna, AT), 03-14.09.18

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Outreach, Dissemination & Networking

- Outreach activities

✓ Attending with lecture to *" FUTURA COSENZA- Magna Grecia 4.0"* (17-18.10.18, Cosenza, IT)

An event organized for the high-school students in the ESR home town (Cosenza, IT), where the ESR meets young pupils presenting his experience as a viable early stage scientific career path.

✓ Participation to the event: "*Forschung! Was geht mich das an?"* in Vienna, AT (08.09.18, Vienna, AT).

The ESR toke part to an event with Austrian scientists, politicians and the 1987 Nobel Price Mr.Bednorz organized in the Naturhistorisches Museum.

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- **Dissemination activities**
  - ✓ FCC-Week 2018 presentation: outline of the work to be done by the ESR within his project
  - ✓ ASC 2018 co-authorship on MgB2 paper (under review)

- **Networking activities**
  - ✓ Inspiring discussions with the 1987 Nobel Laureate Mr.Bednorz through the ESAS Vienna Summer School (Vienna, AT)
  - ✓ Collaboration with other PhD Students from CERN (CH) and UNIGE (IT) on a project related to possible lunar transport systems using superconductors (abstract for paper under further development). The project follows the work done at the Superconductivity Hackathon (Geneva (CH), 09.2017)
  - ✓ Networking possibilities with international field experts via EASITrain-organized activities
  - ✓ Started collaboration as a contributor on https://magazine.impactscool.com/en/

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Impact

- The ESR13 work foreseen a long-term social-relevant impact. Pushing forwards the limits of Low Temperature Superconductors (LTS) has nowadays possible relevant weight in specific niche markets (NMR/MRI, energy storage systems, high energy physics).

- MSC fellowship individual impact:
  - Experience: new nation, new language, new customs. Being moreover in a capital (Vienna) helps finding the ESR path into that culture via different possibilities.
  - Understanding the differences, PROs and CONTROs of both academia and industry;
  - Less time for *pure* scientific production than a «standard» PhD path but wider range of learning opportunities
  - Responsibility

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Thanks for your attention!

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