Mattia Ortino

ESR # 13 @ ATOMINSTITUT – TU Wien

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

Tieftemperaturphysik und Supraleitung group

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

Where, who

Wien

Atominstitut (Tu Wien)

M.Eisterer

Extra: contact person @ CERN = Dr. Simon Hopkins

Outline

1) research description
   - Main goals
   - Tasks and milestones

2) working plan
   - 1st year
   - 2nd year
   - 3rd year

3) challenges

4) risks

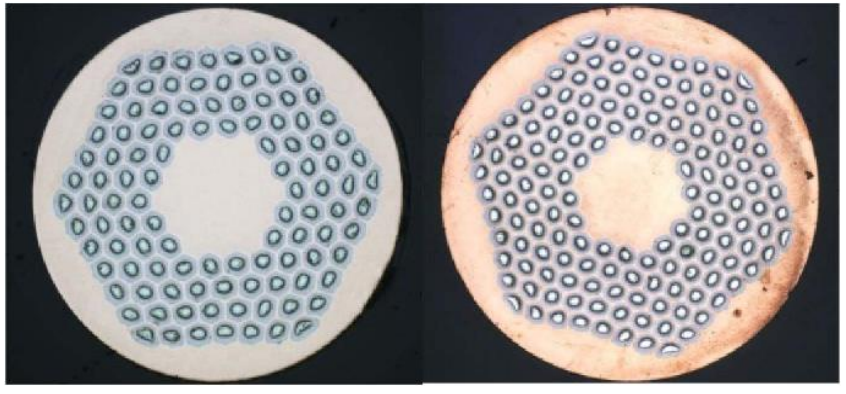
5) state of the art

ESR #13 research description

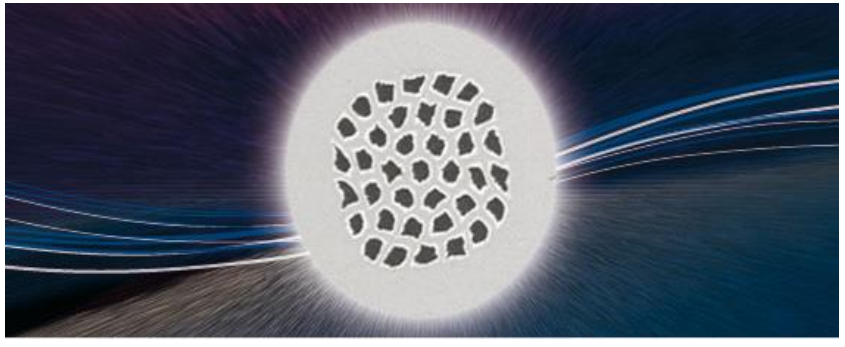
"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

1. Main goals

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



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



ESR #13 research description

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

1. Tasks and milestones

- Deep understanding of the state-of-the-art Nb_3Sn wires (with and without APC) & MgB_2 wires;
- Assessment of local properties pre/post high-energy neutron irradiation;
- Examination of micro-nanostructure by SEM/TEM to facilitate correlation between material features and superconducting properties. To be done @ USTEM (TU Wien)
- Development of self-built devices for further characterization (VCM, laser calorimeter)

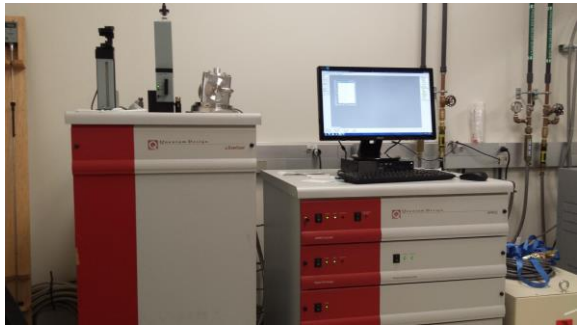
ESR #13 working plan

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

1st year

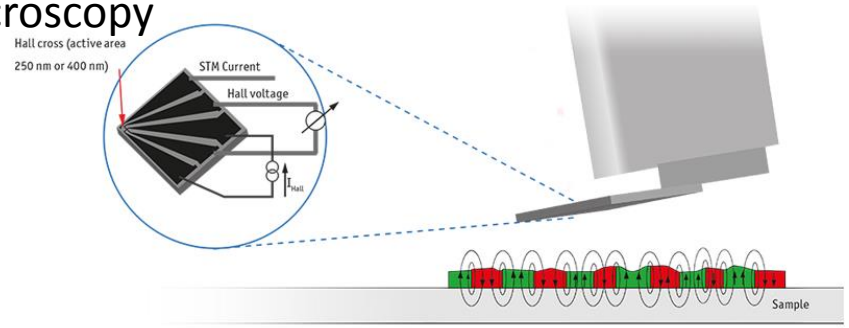
- Acquisition of experimental techniques knowledge

Squid magnetometry



Transport current measurements

Scanning Hall Probe Microscopy (SHPM);



SEM/TEM

- Focus on artificial pinning centers rich (APC)-Nb_3Sn wires characterization → The Ohio State University

- Development of a reliable self-built Vibrating Coil Magnetometer (VCM) (to be used as valuable device for magnetization measurements)

ESR #13 working plan

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

2nd year

Work to be done @

ATOMINSTITUT

(TU Wien)

- Nano-included Nb_3Sn wires characterization of different samples
- No APC Nb_3Sn wires characterization of different samples
- MgB_2 wires characterization

→ The Ohio State University

→ EASITrain network

→ Further collaborating partners

→ Columbus Superconductors

Possible secondments

- RRR measurements
- Heat treatments on unreacted wires

→ CERN

Production process training/ hands on → Columbus Superconductors

ESR #13 working plan

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

3rd year

Work to be done @ ATOMINSTITUT (TU Wien)

- Nano-included Nb_3Sn wires characterization of different samples
- No APC Nb_3Sn wires characterization of different samples
- MgB_2 wires characterization

Collection and evaluation of results (comparison, improvements, validation)

Possible secondments

?

Same or further partners

And finally….

ESR #13 working plan

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

3rd year

…Ph.D. THESIS WRITING!!

ESR #13 working plan

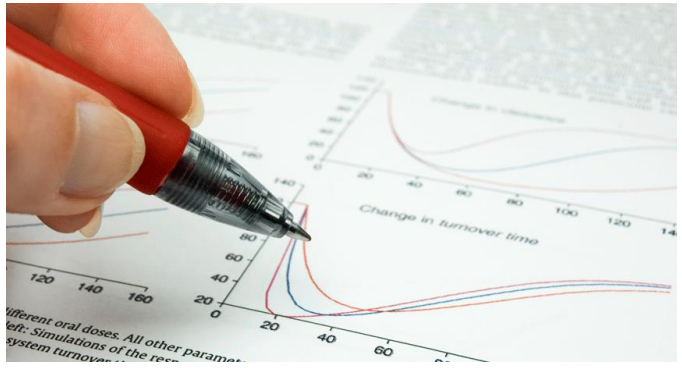
"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

Meanwhile, through the 3 years…

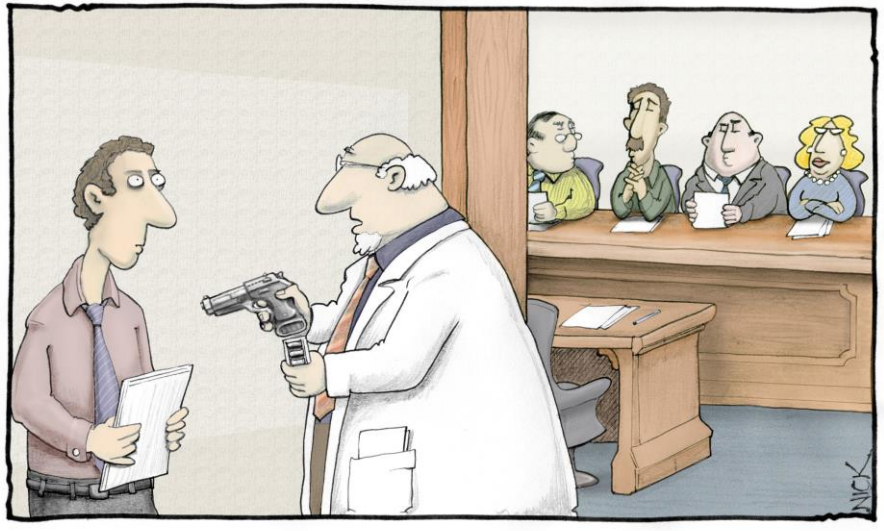
- Training (EASITrain, schools, ecc)

- Scientific dissemination (conferences, public events, high schools)

- Possible publication of the works



- Grants and/or patents hunting (if and when possible)



"Change of plan. The policymakers say they're only willing to listen to the science if we can present our ideas in simple bullet-point format."

ESR #13 challenges

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

1. Managing of two different topics together with devices development → = strict time organization required

2. Out-of-box (market potential) constant outlook → Do not focus just on our own work, do not lose curiosity for other SCs and/or related physics projects (events such as SC-Hackathon extremely important)

3. Efficient communication (companies, colleagues, administration) → e.g. "German is better than English @ work!"

ESR #13 risks

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

1. Samples delivering delays → Overall the highest risk

2. Dissemination obstacles → Industry/Academic partners possible disagreements (possible collaborations outside the network need to be evaluated)

3. Ph.D thesis delays → The amount of work needs to fit with the times of standard Ph.D career path (6-months delay acceptable)

ESR #13 work state-of-art

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

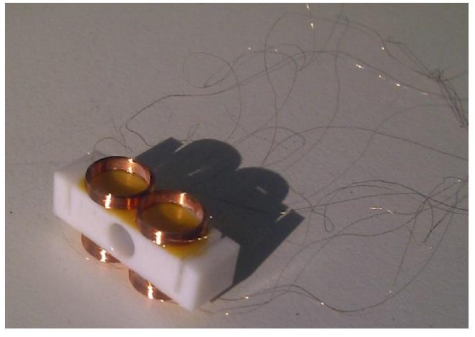
- Literature review

- VCM further development

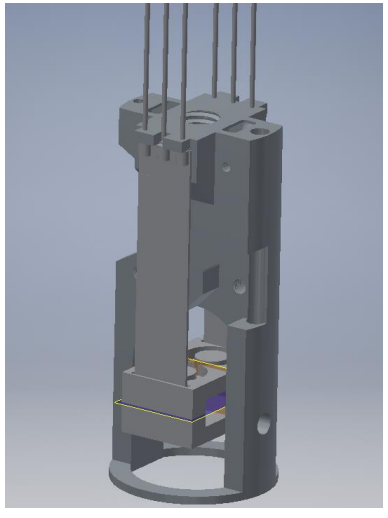
Implementation of a reliable feedback-signal via piezo-back voltage

assembling

winding



modeling

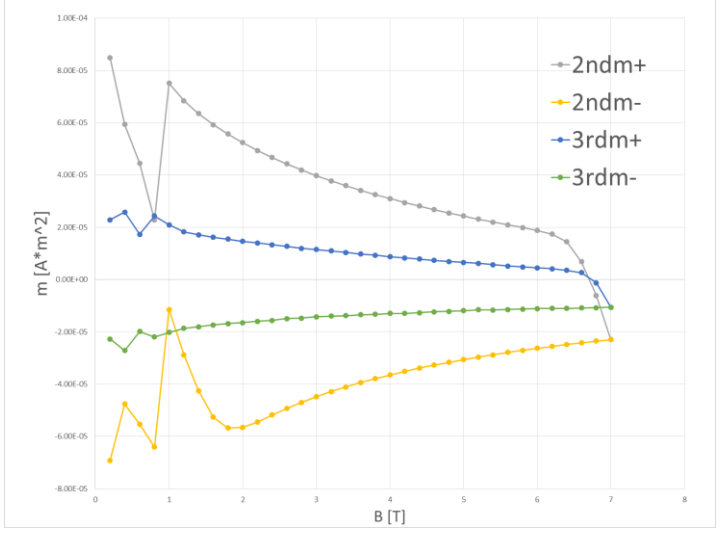


ESR #13 work state-of-art

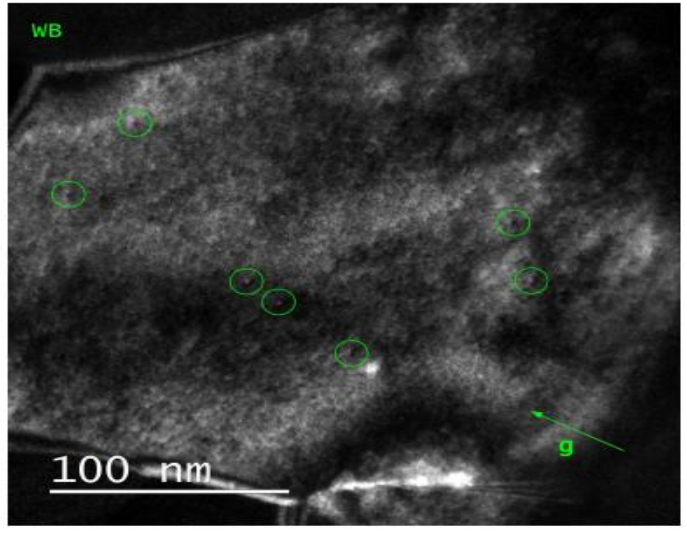
"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

- Preliminary characterization of the APC wires (The Ohio State University) already done (mono, multi- filamentary) ✓

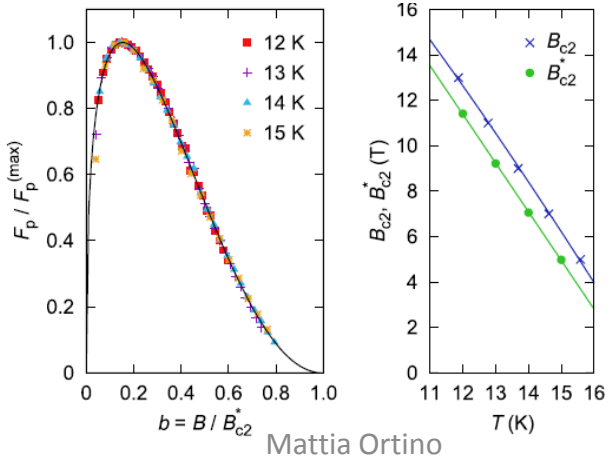
Magnetization measurements



TEM



Pinning analysis



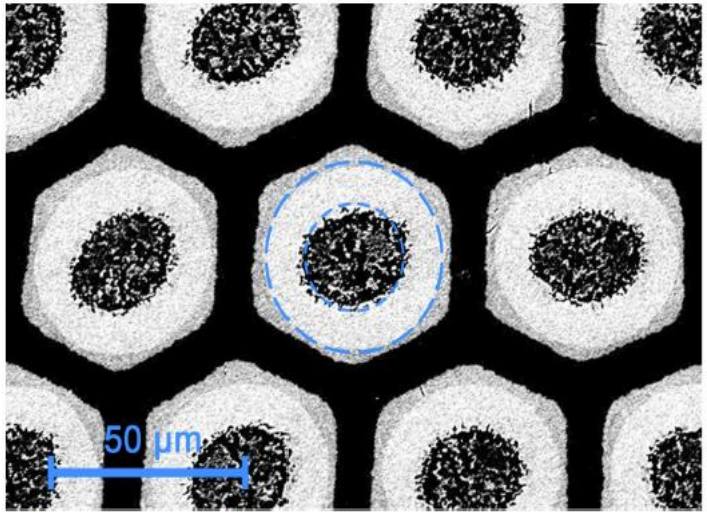
Courtesy of T.Baumgartner, TU Wien

ESR #13 work state-of-art

"Characterization of superconducting properties of the next- generation Nb_3Sn and MgB_2 wires"

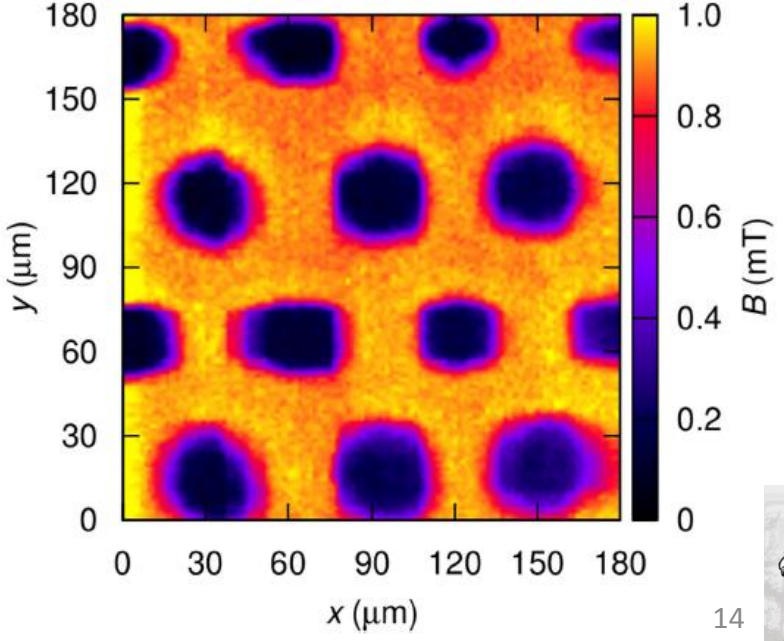
- Preliminary characterization of the APC wires already done (mono, multi- filamentary) ✓

SEM



Courtesy of S.Pfeiffer, TU Wien

Scanning Hall Probe Microscopy (SHPM)



.....Thanks for your attention!

..Any question?