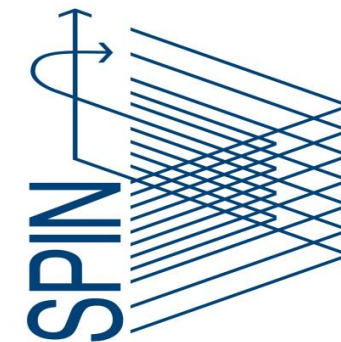


# Mid-Term Review

## 10 December 2018, Brussels



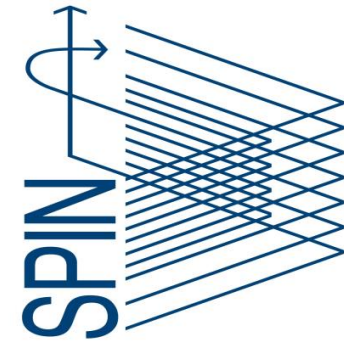
AISHA SABA

ESR6

WP3

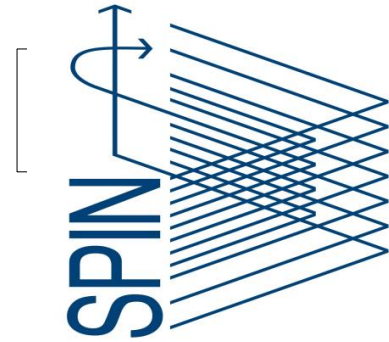


# ESR6, WP3 - Background



- Background:
  - M.Phil. in Physics (Quaid-i-Azam university, Islamabad, July 2017)  
(Thesis: Dielectric properties of thallium based superconductors)
  - M.Sc. in Physics (Quaid-i-Azam university, Islamabad, August 2014)
- Contract start date: 24.04.2018
- Host Institute: CNR-SPIN, Genova, Italy
- EASITrain Supervisor: Dr. Emilio Bellingeri
- Ph.D Supervisor: Dr. Marina Putti





## ESR6, WP3 - Background

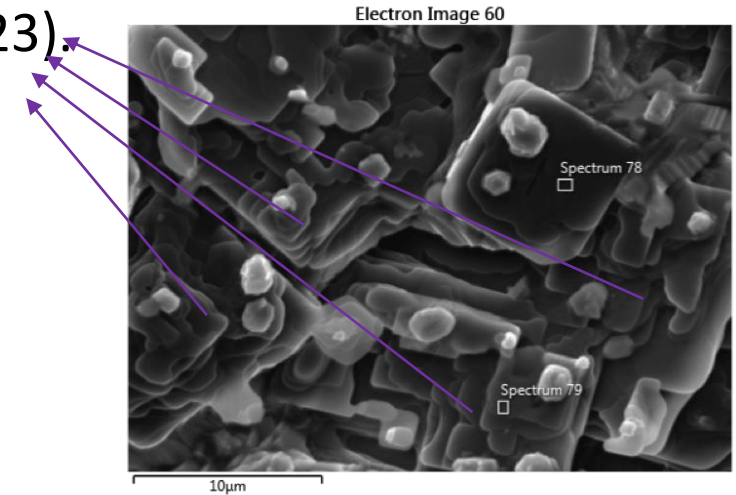
- **PhD Title:** Production of Thallium based high temperature superconducting thin-film coatings.
- **PhD University:** University of Genova
- **Planned secondments:**
  - TUW (USTEM): Tl(1223) advanced characterization (February 2019, 2 weeks)
  - CERN: Design and working of beam screen, working in the presence of magnetic field and high frequency (summer 2019, 2 weeks)
  - Columbus superconductors and ASG: Large scale manufacturing and industrial applications of superconducting MgB<sub>2</sub> wires (May 2020, 2 weeks)



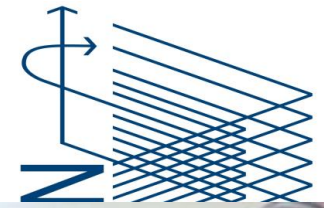
# Role in the Project & Objectives



- Synthetization of bulks and thin films of superconducting phase(1223).
- Use of different techniques: electroplating and ink technique.
- Different substrates with different texture and degree of texture.
- Depositions of silver (PLD, Sputtering)

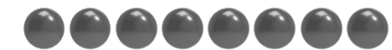


# Research

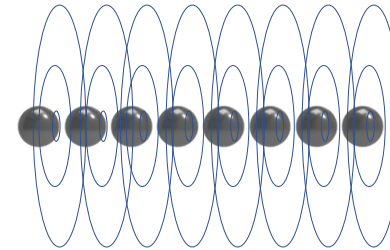


Beam screen to absorb synchrotron radiations

$10^{11}$  protons will circulate in bunches in the ring at  $v \approx c$



$10^{11}$  protons will circulate in bunches in the ring at  $v \approx c$   
Protons are charged  $\rightarrow$  it will produce an EM field

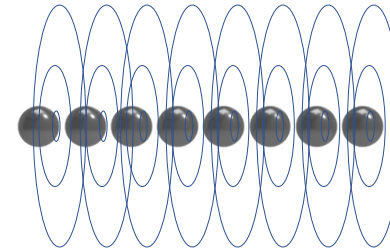


$10^{11}$  protons will circulate in bunches in the ring at  $v$

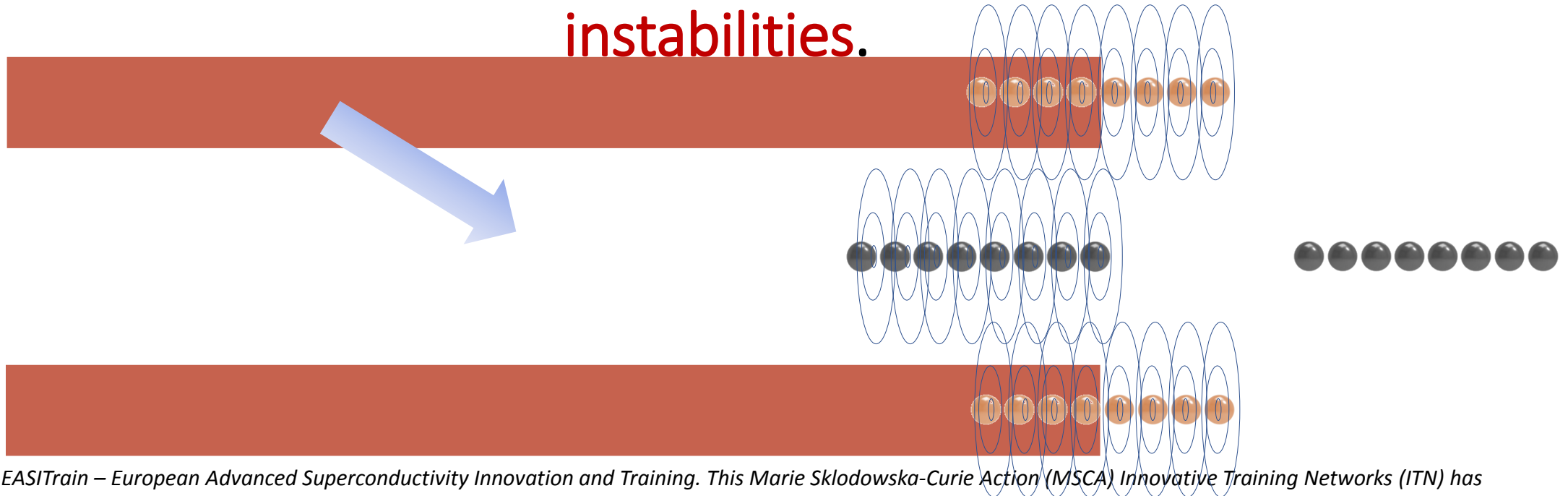
Protons are charged  $\rightarrow$  it will produce an EM field

The EM Field will produce an image current in the screen

**The image current will dissipate energy**



$10^{11}$  protons will circulate in bunches in the ring at  $v$   
Protons are charged  $\rightarrow$  it will produce an EM field  
The EM Field will produce an image current in the screen  
The image current will dissipate  
**Due to the delay, it will affect back the beam causing instabilities.**





The surface resistance of copper at 50 K may not be sufficiently low to guarantee a safe operational margin for the FCC-hh beams, in particular at injection energy



### Requirements

$T=50\text{ K}$

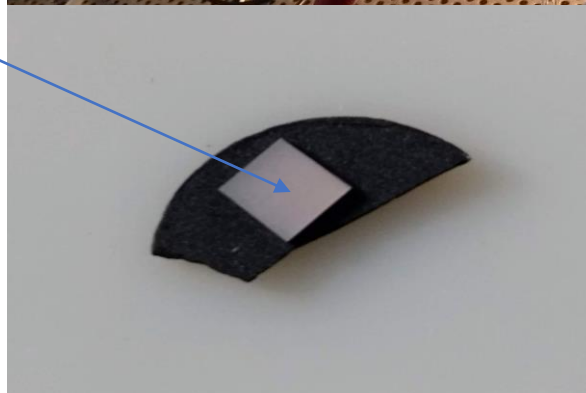
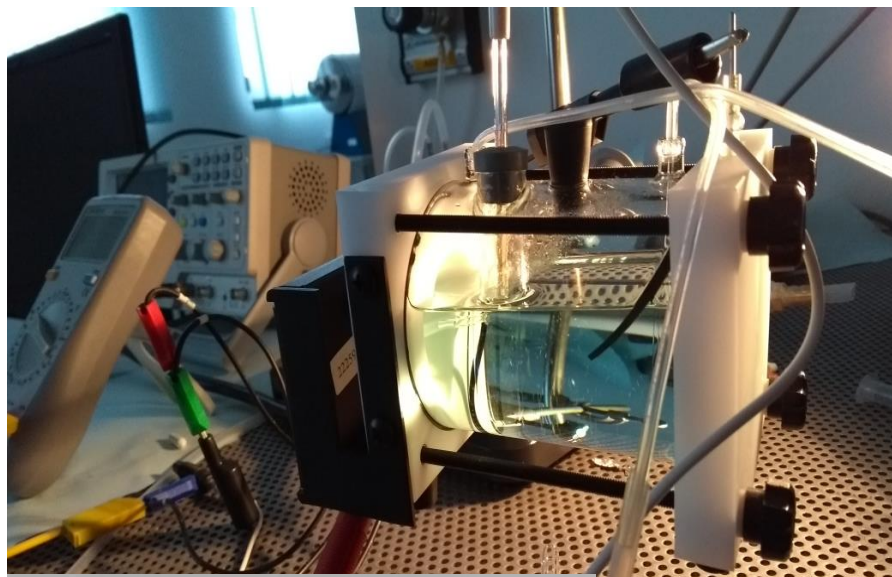
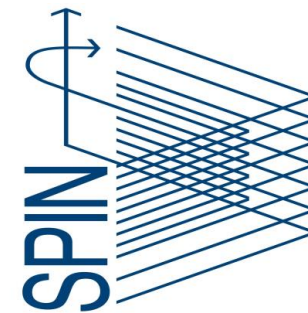
$B=16\text{ T}$

$\nu=1\text{ GHz}$

High synchrotron radiation

Boundary materials with 100 TeV particles

# Methodology



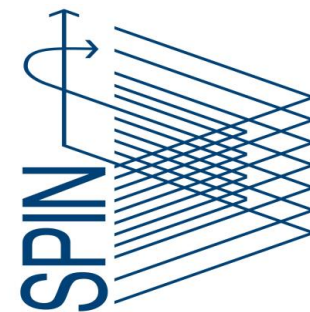
Solution:  
Tl, Pb, Bi, Sr, Ba,  
Ca, Cu nitrates in  
DMSO

Substrates:  
Silver foils, single  
crystal, SrTiO<sub>3</sub>

electrodeposition  
For 5-10 min, -2.8 to -3.3v

Final sintering in oxygen at high  
temperature

## Methodology



### Precursor

Mixing and Grinding of  $\text{SrCO}_3$ ,  $\text{CaCO}_3$ ,  $\text{BaCO}_3$ ,  $\text{CuO}$  powders

1. powder  $900^\circ\text{C}$  in  $\text{O}_2$  for 24h
2. pellet  $980^\circ\text{C}$  in air for 24h

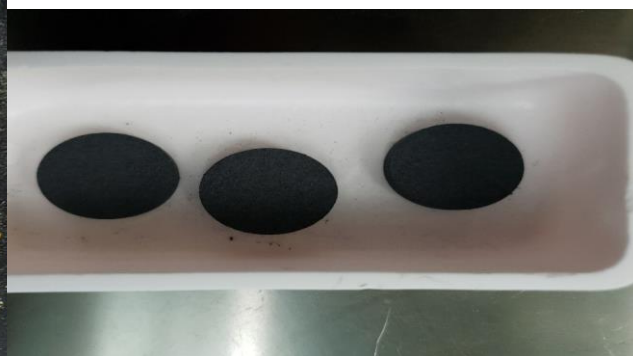
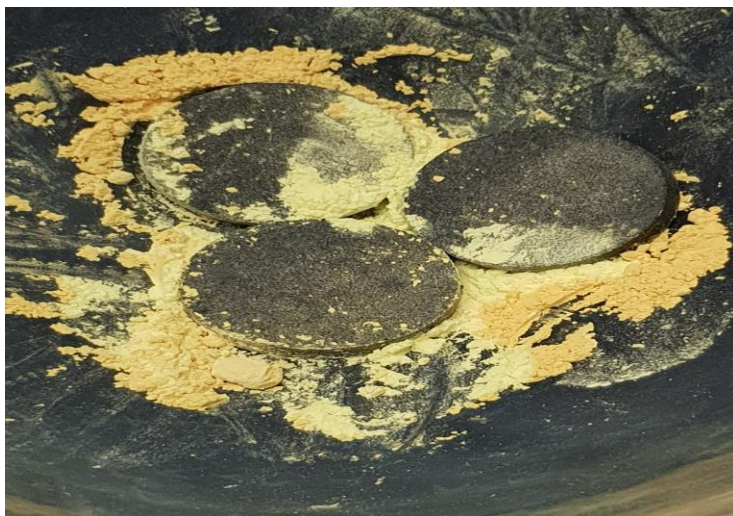
### Addition of heavy metals

Mixing and grinding pellet with  $\text{Bi}_2\text{O}_3 + \text{PbO}$  for homogeneous powder

Adding  $\text{Ti}_2\text{O}_3$  to the powder and manual grinding

Palletisation using hydraulic press

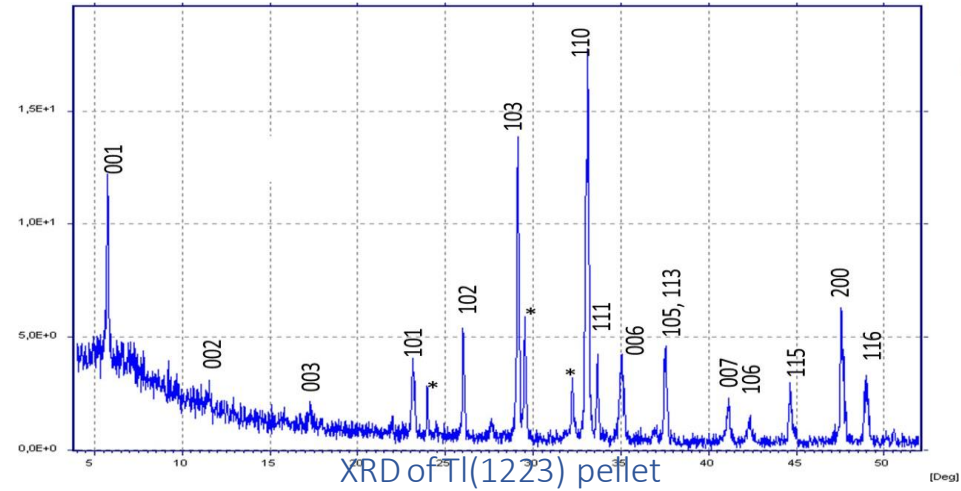
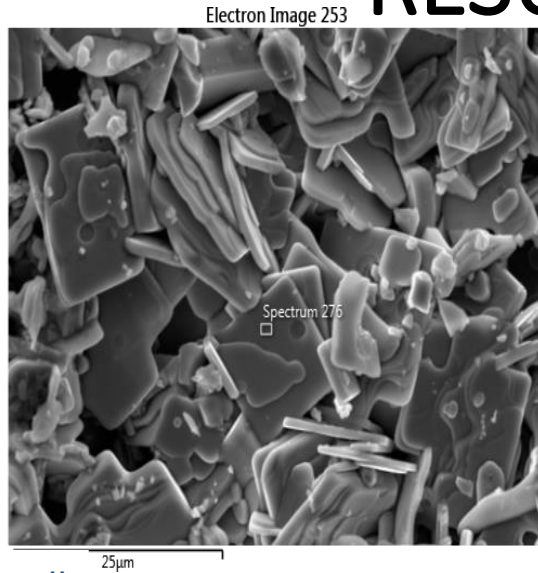
$905^\circ\text{C}$  for 3h in oxygen in gold capsule



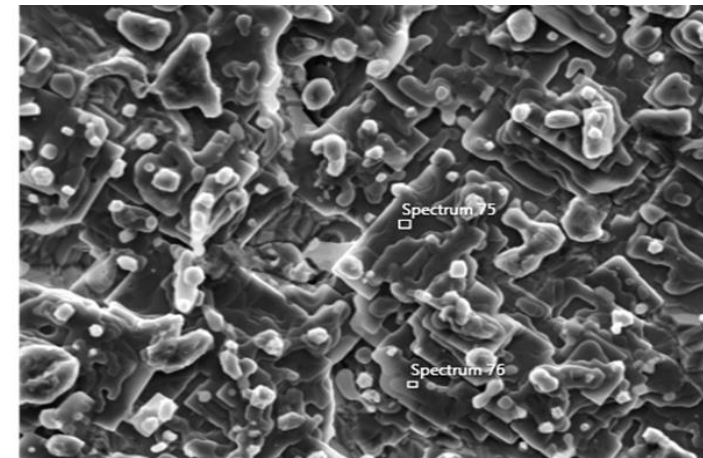
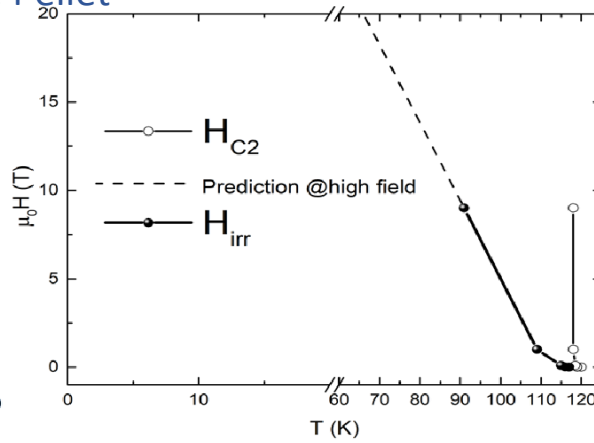
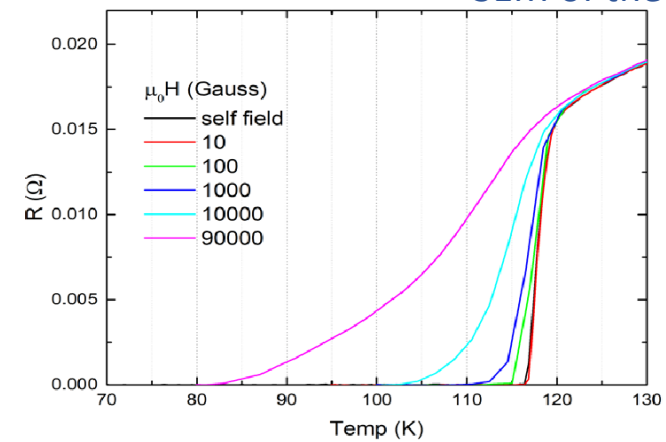
CC BY-NC-ND 4.0 awerpack



# RESULTS



SEM of the Pellet



SEM of the Pellet

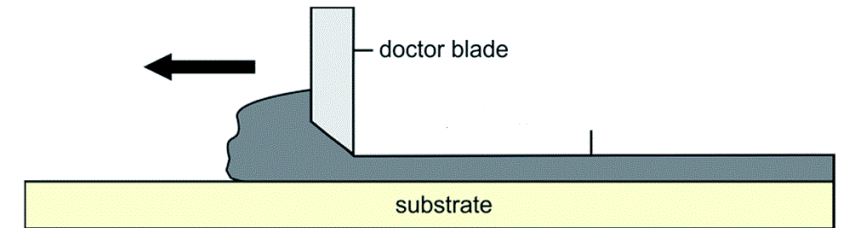
R(T,B) measure: The pellet has 118K (on set)

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

# Next Steps



- Deposition of thin films using ink technique, Spin coating, Dr. blade
- High quality Silver substrate preparation
- Modification of synthesis methods(time,heat,composition)
- High pressure heat treatment.



# Training, Conferences & Workshops



## • Training

- Safety Training(e.g. mechanical hazards, chemical hazards, working safely with heavy metals, fire prevention) at CNR-SPIN.
- Media Training at Terra Mater factual studios on 12<sup>th</sup> September 2018 in Vienna, Austria.

## • Attended EASITrain events

- EASISchool 1 / ESAS Summer School from 3<sup>rd</sup> to 7<sup>th</sup> September 2018 in Vienna, Austria.
- Visit to the Atominstitut (Reactor and Superconductivity Lab) and Social Events



# Training, Conferences & Workshops



## • Seminars

- Superconductivity without doping in iron-based 1111 family: the ThFeAsN case by Toni Shiroka on 10 may 2018 at physics dept. University of Genova.
- MgB<sub>2</sub> thin films for SRF cavity applications by Dr. Xiaoxing Xi on 28 sept. 2018 at CNR-SPIN, Genova, Italy.
- The influence of high field pinning centers and layered structure on critical current density in MgB<sub>2</sub> wires by Daniel Gajda on 3 Oct. 2018 in Genova, Italy.
- Thermomagnetic mechanism for self-cooling cables by Luca de Medici on 20 November 2018 CNR-SPIN Genova, Italy.



# Outreach, Dissemination & Networking



- **Outreach activities**

- MedAustron visit ( Wiener Neustadt, 8 September 2018)
- ALBA Synchrotron visit (Barcelona, 30 November 2018)

- **Dissemination activities**

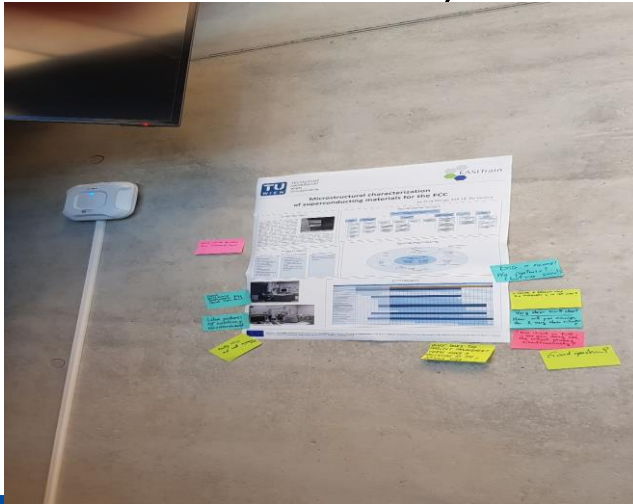
- Presented Poster (ESR 7) at Project Management Vernissage (EASISchool 1, WU Wien – Vienna), 10 September 2018, Title: Production of Thallium based high temperature superconducting thin-film coatings.
- Talk at ALBA Synchrotron (Barcelona), 30 November 2018, Title: Microstructural Characterization of Tl-based superconducting bulks and films



# Outreach, Dissemination & Networking

## • Networking activities

- Group meetings and seminars at CNR-SPIN
- Terra Mater Factual Studios social event
- EASISchool 1 in Vienna (3 - 14 September 2018)
- Conferences, Workshops, Project Meetings & Social



## Science and society

### ○ Research has to serve society

- Knowledge discovery
- The advancement
- Improvement and furtherance of academic excellence, which strengthens the quality of, the positive contribution to our society in generating new ideas and gives raise to employment and economic growth for better future.

### ○ Superconductivity is shaping our future

- Tl-cuprates (Tl-1223 phases) stand out due to their very high critical temperatures about 120 K, surface resistance coating for the FCC beam screen,
- To understand fundamental questions.



## Personal development

### Career

- Coming from different culture, life changing experience.
- Independent, self learning
- learning a new language is a wonderful experience.
- Research, training and knowledge will help to get on a good track.

### Best Experience

Meeting with new people from different culture and knowledge.



THANK YOU

