DEVELOPMENT OF HIGH TEMPERATURE SUPERCONDUCTOR MAGNET FOR DIFFERENT APPLICATIONS

My research as PhD student is focused on Applied Superconductivity, in particular in the development of a high-performance wire made with Bi-2212, a High Temperature Superconductors (HTS), for the construction of magnet for different applications.

My PhD project is inserted in the project BISCOTTO, born from the collaboration between INFN and CNR-SPIN, whose goal is the development of key technologies to be involved in the design and construction of a superconducting canted cosine theta (CCT) solenoid using HTS conductors. It is worth mentioning that the development of technologies for HTS magnet has a more general value also beyond this specific objective because the use of HTS material for any kind of magnet layout (solenoid, toroids, …) would have a big impact in much wider fields.

In the context of BISCOTTO activities, my research concerns:

- Development and test of Bi-2212 superconducting wires;
- Development of finite element code aimed to study conductor and magnet behaviour;
- Construction and test of small models for supporting the design choices.

Last year, I focused my work on the development of Bi-2212 wires and we achieved some transport properties improvements, rising the Engineering critical Current Density to 600 A mm^{-2} at 7T which is beyond the minimum application requirements, set at 500 A mm^{-2} at the operative magnetic field.

In this second year of my PhD, experimental activities were almost blocked by the pandemic issue related to CoVID-19, so I mostly focus on the development of finite elements codes made in ANSYS. The basic concept of simulations is to understand if there is an optimal architecture that can help the enhancement of the properties of the wire. Since the milestone of the minimum transport properties was achieved last year, now we can think about a suitable design for a cable made with Bi-2212 wires.

During the cabling operations, different kind of mechanical deformations are performed on the wire that can degrade its transport properties. The knowledge of where the forces are located may help in the choice of the design and architecture of the cabled wires.

For this reason, I developed different codes in order to predict stresses accumulation due to mechanical deformation in the wire we develop at CNR-SPIN.

As soon as we could come back to the laboratory, we prepared some samples of cabled-like wire, emulating the mechanical deformation of the cabling process with a flat rolling machine, and we measured their transport properties. This step was crucial because I had important dataset to be compared to the simulation performed in the previous months. Data analysis is on-going to understand and find a correlation between simulations and measurements.

Course attended with exam (all given):

1)Applied cryogenic – Musenich
2) Superconducting Wires, Tapes and Cables Technology - Malagoli
3) Progettazione di magneti superconduttori - Farinon

Event attended:

10/02/2020 – 12/02/2020: Talk "Development of Bi-2212 wires for Canted Cosine Theta Solenoids" at Conference on Superconductivity and Functional Oxides (Santa Margherita Ligure, Italy)

28/09/2020 – 07/10/2020: EASISchool 3 (Genoa, Italy) and talk "State of the art of CNR-SPIN Bi-2212 high performance wire"

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