

FCT

Fundação
para a Ciência
e a Tecnologia



FCT Trainee Program 2019

Follow-up meeting



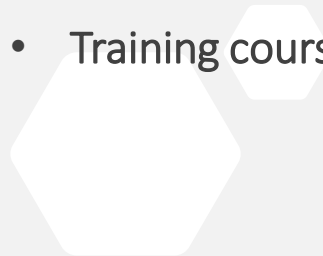
1. Background & CERN

Background:

- **Name:** Daniela Fagundes de Sousa
- **Education:** Universidade Nova de Lisboa – Faculdade de Ciências e Tecnologia
- **Degree:** Master degree in Chemical and Biochemical Engineering (ended 2017)

Cern Project:

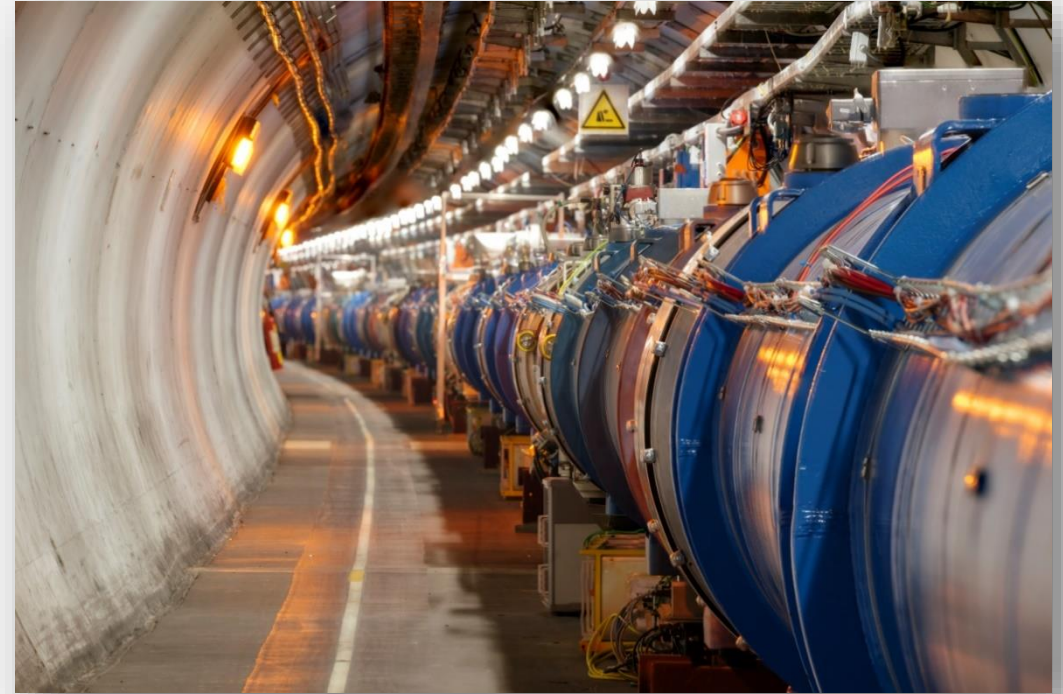
- **Start date:** November 2018
- **Supervisor:** Sandra Tavares
- **Department/ Group/ Section:** Polymer Lab, TE-MS-C-MDT
- **Project:** Characterisation of Polymers and Composite Materials for the Development of Magnet Insulation Systems
- **Training courses:** 2 French courses



2. Context

Radiation created during the LHC operation impacts the properties of the insulation materials of superconducting coils.

Polymeric resins are used in the superconducting coils in the LHC as part of the insulation system. During the operation of the LHC, radiation is created which degrades the properties of the insulation material. Since polymeric resins are organic materials, they suffer the most damage when exposed to ionizing radiation. Therefore we need to understand which **resins and composites** are radiation resistant to employ them in coils.



2. Context



Before VI

When coils are fabricated, they are impregnated with polymeric resin through **vacuum impregnation (VI)**, a process that uses vacuum and pressure to fill the coil with resin, creating a solid block.

The objective of this project is to characterize various types of resins through mechanical and chemical test to find the best option for the insulation.



After VI



3. Material Tested

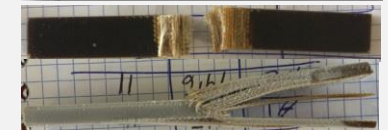
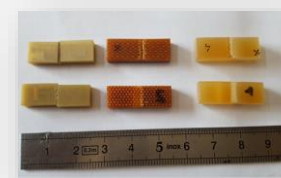
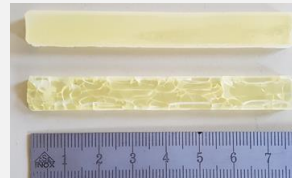
Resin	Hardener	Brand name	Supplier
Bisphenol A epoxy	Methyl nadic anhydride	CTD 101K	CTD
DGEBA epoxy	Polyetheramine (Jeffamine D-400)	Araldite F	Huntsman
DGEBA epoxy	-	Damisol 3418	Von Roll
DCBE cyanate ester/Bisphenol F-Bisphenol A epoxy 40:60	-	CTD 425	CTD
Polyesterimide	-	Damisol 3630	Von Roll



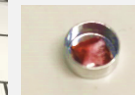
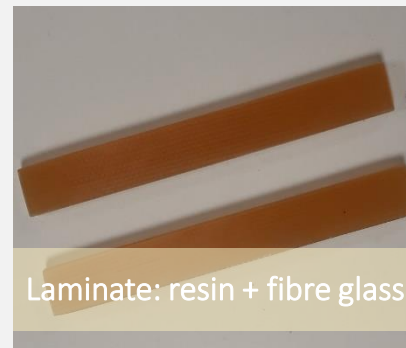
Composites	Brand name	Supplier
Bismaleimide triazine & S2 glass fibres	BTS2	Arisawa
Bismaleimide triazine & S2 glass fibres	Rikalite	Nippon Rika
Polyetherimide & E glass fibres	Duratron	Quadrant

4. Characterisation Tests

Mechanical properties studied	Characterization test
Flexural Strength	Three Point Bending
Interlaminar Shear Strength	Short Beam Shear
Toughness	Charpy Impact
Chemical properties	Characterization test
Glass Transition Temperature	Differential Scanning Calorimetry (DSC)



Samples produced in-house:

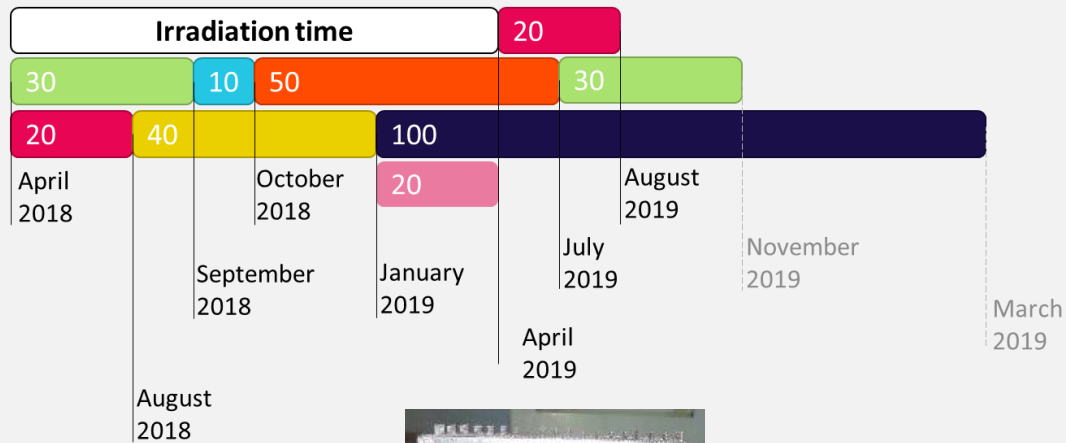


Tests were performed at room temperature and 77K in liquid azote



5. Radiation Hardness Campaign

Levels of irradiation tested:



<p>Dose rate</p> <p>~ 10 kGy/h</p>	<p>Radiation type</p> <p>Gamma ray</p>	<p>Radiation conditions</p> <p>Air</p> <p>RT</p>
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5 samples are being tested per resin per irradiation level and per temperature test



Irradiation is being held in Japan: CERN/KEK collaboration

6. Experience at CERN



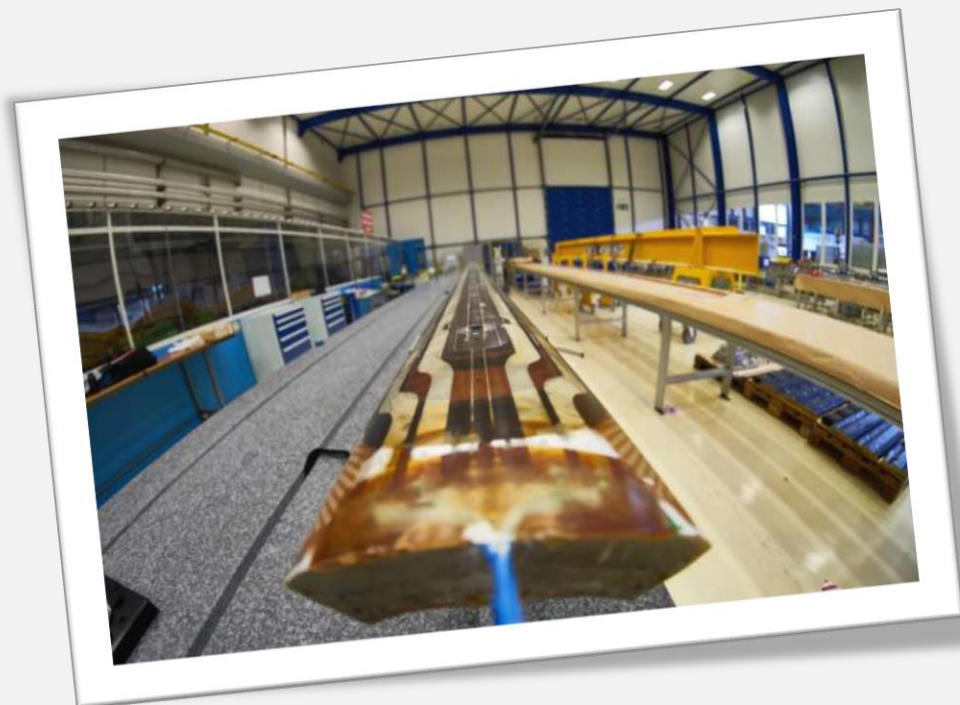
My contribution to the irradiation campaign started in November 2018 with the production and characterization of samples for our study. During my experience I:

- Acquired knowledge in **coil fabrication process**.
- Increased my knowledge on polymer behavior, specially **epoxy's**.
- Acquired experience in **mechanical testing** and treatment of data.



At the moment we are writing a **paper** with the results we have (up to 40 MGy).

Obrigada!



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