



This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

Task 9.2 Prototype 1.3 GHz

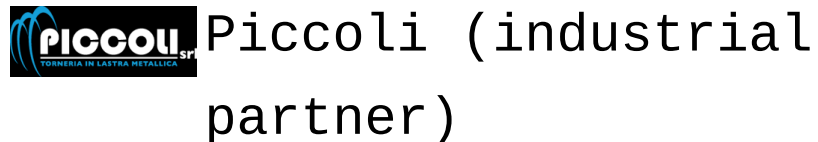
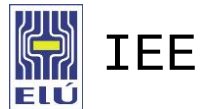
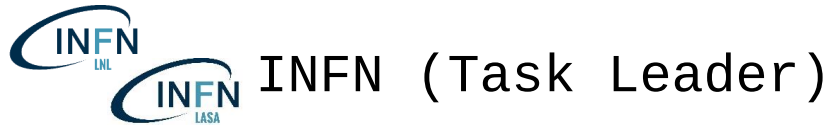
iFAST WP9 kick-off meeting 5th
May 2021

Cristian Pirin 

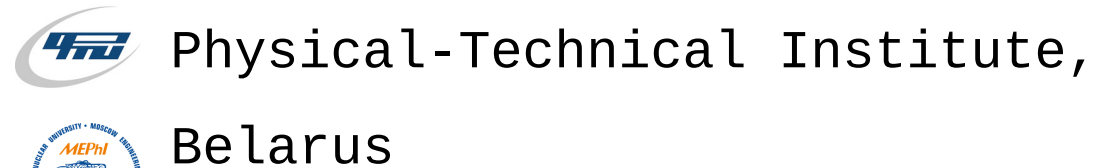
iFAST



Partners



Associated Partners



- Moscow Engineering Physics Institute



Task 9.2 description

Objectives

- **Optimize and industrialize the manufacturing of seamless elliptical copper cavities**
- **Demonstrate the possibility to replace the current Nb bulk technology with an innovative SRF cavity coated with a superconducting film**

Description of work

This Task will demonstrate the possibility to replace the current Niobium bulk technology with an innovative SRF cavity coated with a SC film. The goal is to realize a thin film cavity prototype at 1.3 GHz (TRL 5) with a surface resistance at 4.2 K close to Nb bulk surface resistance at 2 K ($Q_0 \sim 10^{10}$ at 1.3 GHz). Different materials with T_c higher than Niobium will be explored for the deposition of the final prototype, as for example Nb₃Sn and SIS multilayer, building on the results obtained by the ARIES project and other I.FAST Tasks. The prototype will consist of a single-cell elliptical Cu cavity coated with a SC film and tested in a vertical cryostat. Different aspects of the cavity production will be addressed, in particular, cavity manufacturing and preparation, film deposition and cavity testing. A pre-prototype cavity at 6 GHz will allow the complete exploration of all deposition parameters at lower cost before upscaling to the larger 1.3 GHz cavity.

INFN and PICCOLI will optimize the seamless production of the elliptical cavities; PICCOLI will provide EB welded elliptical cavities to test the substrate effect on SC coating. INFN will be in charge of preparing the internal copper surface of the cavities prior to the coating with Centrifugal Barrel Polishing (CBP) and chemical/electrochemical polishing. The coating and morphological characterization of SC films involve four institutes (INFN, UKRI, USIT and CEA) that will develop different coating set-ups. CEA, IEE and UKRI will be in charge of the SC characterization (HC1, T_c , Tunneling Spectroscopy). Cross-checked SRF tests will be done at HZB, INFN and STFC.



Task 9.2 description milestone and deliverable

MS38: First seamless copper 1.3 GHz cavity produced as substrate for the coating of the SC film (Report)	M12	D9.2: RF test on coated resonant cavity. <i>Resonant cavity coated and tested with an alternative material to Niobium with a $Q_0 > 10^9$ at 4.2 K and 1.3 GHz.</i>	M46
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EASY to achieve

Real Challenge!

Sub tasks

- Cavity substrate production   
- Cavity substrate preparation   
- SC film coating   
- Morphological characterization    
- SC characterization   
- RF TEST   

Cavity substrate production

SEAMLESS



- Developing of CNC process
- 4 cavities
- EBW of flanges not provided →



EBW



- 4 cavities

8 cavities in total



can be more → limitation from EBW welding,
polishing, RF test

Cavity substrate preparation

Mechanical polishing

- Grinding 
- Centrifugal Barrel Polishing 
(PIT needs media)

Chemical polishing

- EP  
- SUBU  

Schedule

- Design and building/adapting of 1.3 GHz coating system
- Coatings on coupons (dielectrics?, Cu)
- Coating of a 1.3 GHz cavity

Materials

- Nb_3Sn
- NbTiN?
- NbN?
- Other?



Morphological characterization



- XRD
- SEM
- EDS
- AFM
- EBSD?
- TEM?



SC characterization

- Magnetometry 
- Field penetration 
- HW cavity 
- Tunneling 
- AC Magnetometry 

**Provide samples
dimension**

- RF Test @ 4.2 K
- RF Test @ 2 K
- Temperature Mapping?
- Flux trapping?

How many cavity in total can be tested?

Possible Task Schedule

12 months

- First substrate ready (milestone)
- Deposition system ready

24 months

- All substrates ready
- First coupons characterized

36 months

- First cavity coated and tested

46 months

- A good cavity measured! (deliverable)



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Thanks for your attention

Time for discussion



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