



1st St Com meeting, 25/06/2021

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WP9 coordinators

WP9 objectives

- Define a strategy for innovative superconducting RF (SRF) cavities coated with a superconducting film.
 - Deposition techniques: PVD and ALD
 - Superconducting films: Nb, NbN, Nb₃Sn, V₃Si (and others) and SIS
 - Optimization of flat SRF thin films production procedure
- **Optimise and industrialise the production**
 - of seamless copper cavities and
 - of the deposition techniques.
- Produce and test prototypes of SRF (single-cell elliptical) cavities:
 - Initially with pre-prototypes with $f = 6$ and 3 GHz
 - Scaling up for $f = 1.3$ GHz.
- Test a new laser treatment of Nb coated cavity.

➤ Main goal:

- Improving the performance and reducing the cost of acceleration systems
 - both production and operation

WP9 tasks

- **Task 9.1:** Coordination and strategy for innovative superconducting accelerating cavities
 - CEA, INFN, HZB, UKRI, USI, JLab MEPHI, PTI.
 - *Task Leaders: C. Antoine (CEA), O. Malyshev (UKRI)*
- **Task 9.2:** Innovative SC accelerating cavity prototype
 - INFN-LNL, INFN-LASA, PICCOLI, UKRI, USI, CEA, IEE, HZB, PTI, MEPHI
 - *Task Leader: C. Pira (INFN)*
- **Task 9.3 :** Optimisation of process parameters and target development for SRF cavity coating with A15 material
 - UKRI, INFN, IEE, USI, HZB, MEPHI, HZDR
 - *Task Leader: R. Valizadeh (UKRI)*
- **Task 9.4:** Surface engineering by atomic layer deposition (ALD)
 - CEA, CNRS
 - *Task Leader: T. Proslie (CEA)*
- **Task 9.5:** Improvement of mechanical and superconducting properties of RF resonator by laser radiation
 - RTU, UKRI, INFN, IEE, HZB
 - *Task Leader: A. Medvids (RTU)*
- **Task 9.6:** Optimization of flat SRF thin films production procedure
 - HZB, INFN, UKRI, USI, CEA
 - *Task Leader: O. Kugeler (HZB)*

Task 9.1: Coordination and strategy for innovative superconducting accelerating cavities
(CEA, INFN, HZB, UKRI, USI, JLab MEPHI, PTI). *Task Leaders: C. Antoine (CEA), O. Malyshev (UKRI)*

- The Virtual IFAST WP9 kick-off meeting took place on 4th May 2021:
 - Indico link to the meeting <https://indico.cern.ch/event/1024185/> .
- Started with an introduction of each partners (i.e. institute, laboratory or university).
 - In 3-5-min (2-3 slides) one of representative of each institution told others about
 - main interest of his team in this collaboration and
 - what expertise, equipment and samples (cavities) they bring to the IFAST WP9 collaboration.
- Then each Task leader reported a vision on the Task followed by a discussion on
 - Task, milestones and deliverables,
 - A role of each partner,
 - Communication with other tasks,
 - A provisional plan for 1st year.
- The next IFAST WP9 meeting is scheduled for September 2021



Task 9.2: Innovative SC accelerating cavity prototype (*INFN-LNL, INFN-LASA, PICCOLI, UKRI, USI, CEA, IEE, HZB, PTI, MEPHI*) *Task Leader: C. Pira (INFN)*

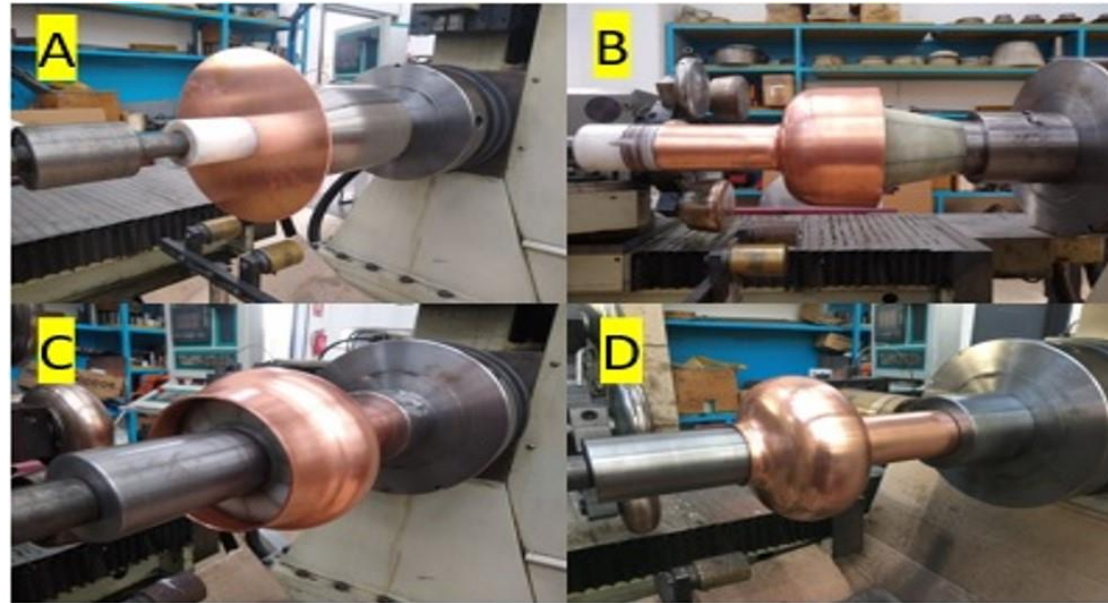
Task 9.3: Optimisation of process parameters and target development for SRF cavity coating with A15 material (*UKRI, INFN, IEE, USI, HZB, MEPHI, HZDR*) *Task Leader: R. Valizadeh (UKRI)*

At the moment each group is setting up the transition from ARIES to iFAST focusing on the design of the new deposition systems for cavities coating.

The first joint Task 9.2/9.3 meeting is planned for the second half of July 2012.

Ongoing activities:

1. Study of the seamless production of 1.3 GHz by spinning (LNL and Piccoli, poster presentation at SRF2021 conference next week)



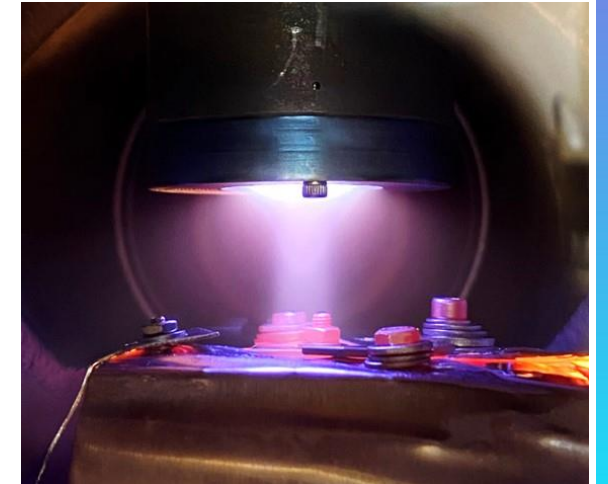
Tasks 9.2 and 9.3 (continued)

Ongoing activities:

2. Design of 3 cylindrical cathodes with permanent magnets, to test different coating parameters of Nb films on Cu substrates at STFC
3. Sharing of 1.3 GHz Cu substrate from LNL to Uni Siegen
4. CAD designing of the deposition system at Uni Siegen
5. Developing of Nb₃Sn target at LNL by dipping for 6 GHz (LNL, poster presentation at SRF2021) [common activity between Tasks 9.2 and 9.3]

Plans in near future?

- 1) Continue the ongoing activities
- 2) Set-up teams tools
- 3) Market search for copper purchase
 - for production of flanges, pipes and cavities at PTI
- 4) Task meeting (hopefully in person, if possible)



Task 9.4: Surface engineering by atomic layer deposition (ALD)

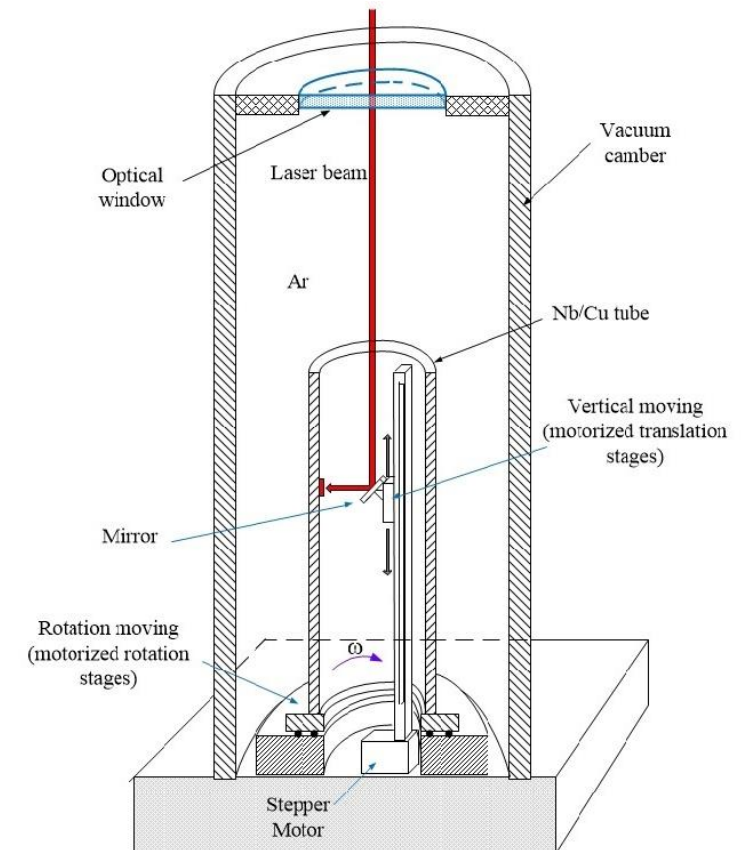
(CEA, CNRS) *Task Leader: T. Proslie* (CEA)

- The budget line has been created on the 16/06/2021 so orders can be placed.
- Orders for ALD system parts have been submitted: RGA, Tubing, Pumps/oil. These are for the interconnection from the ALD system to the Vacuum Oven.
- The ALD system is ready.
- The control program in LabVIEW is under construction by the Informatics Department at CEA.
- The Oven is scheduled for delivery end of July.
- Construction work for gas, water, power supplies and extraction for the Oven+ALD system will start in 2-3 weeks.

Task 9.5: Improvement of mechanical and superconducting properties of RF resonator by laser radiation

(RTU, UKRI, INFN, IEE, HZB) *Task Leader: A. Medvids (RTU)*

- The design of new laser treatment facility for treatment of Nb film on tubes with diam. from 80 to 250 mm is completed:
 - A laser and a mirror head are already available
 - Motors – tender advertised
 - All other parts: a vertical moving assembly, a tube rotation assembly and a vacuum chamber will be produced at RTU by Sep., then assembled by Oct. 2021
- Other activities:
 - Small sample treatment facility is available for new sample for optimising laser parameters for Nb film



Task 9.6: Optimization of flat SRF thin films production procedure

(HZB, INFN, UKRI, USI, CEA) *Task Leader: O. Kugeler (HZB)*

- Collaboration with PTI (Minsk) on QPR sample preparation:
 - HZB provides suitable Cu and Nb samples,
 - PTI EB weld them, then does pull tests on a weld
 - Also send one sample back to HZB for inspection
 - These welds will be characterized at HZB with stress tests and laser scanning microscopy
- Collaboration with INFN/LNL on further optimizing the cleaning procedure on Cu QPR sample
- Collaboration with CEA (Saclay) on EP of existing Nb QPR sample, one baseline measurement performed
 - Indium contamination on RF surface identified redo cleaning procedure
 - Perform another QPR baseline test
 - Make ALD SIS multilayer at Saclay, test it with QPR
- Active use of WP9 SharePoint at espace.cern.ch for coordination of work in information exchange

Milestones and Deliverables

Tasks Description	Year 1												Year 2												Year 3												Year 4																																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50																																	
WP9 Innovative superconducting thin film coated cavities																																																																																			
9,1 Coordination and Strategy for Innovative Superconducting Accelerating Cavities																									M												D																																														
9,2 Innovative Superconducting (SC) Accelerating Cavity Prototype												M																																				D																																			
9,3 Optimisation of process parameters and target development for SRF cavity coating with A15 material												M																																				D																																			
9,4 Surface engineering by Atomic Layer Deposition (ALD)																								M																																																D											
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9,6 Optimization of flat SRF thin films production procedure						M																																																D																													

IFAST WP9 Milestones		IFAST WP9 Deliverables	
MS37 International thin film workshop organization (web site + eport)	M28	D9.1: Thin-Film SRF roadmap report. <i>Summaries of the results obtained within the workpackage and prospective inspired from WP advances as well as discussions at TF-SRF 2022.</i>	M35
MS38 First seamless copper 1.3 GHz cavity produced as substrate for the coating of the SC film (Report)	M12 (Apr. 2021)	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
M39 Coating facility built and tested at STFC, USI and INFN (Report)	M12	D9.3: First 6 GHz cavity coated and characterised. <i>Results from the morphological and SC characterisation of first coated cavity with an alternative material to Niobium.</i>	M36
MS40 Construction and operation of the cavity dedicated ALD system (Report)	M24	D9.4: Deposition of superconducting multilayers on cavities. <i>1.3 and 3 GHz Nb and Cu cavities coated and tested with multilayers.</i>	M46
MS41 A facility for laser operation for complex 3D treatment is tested on 1.3 GHz cavity (Report)	M36	D9.5: 1.3 GHz Nb-coated cavity irradiated by laser in Ar atmosphere and RF tested. <i>Increasing of the field of magnetic flux entry in Nb coated 1.3 GHz cavity irradiated by laser in argon atmosphere. Standard RF testing.</i>	M45
MS42 ARIES samples prepared for renewed SC film deposition (Report)	M6 (Nov. 2021)	D9.6: Test of thin-film samples. <i>Four thin film samples reprocessed by 4 different techniques and tested with QPR.</i>	M46

	IFAST WP9 Partners		Leading	Participating
1	CEA (Saclay, France)		WP, Tasks 1 and 4	Task 1, 2, 4, 6
3	IEE-SAS (Bratislava, Slovakia)			Tasks 2-6
4	INFN/LNL (Legnaro, Italy)		Task 2	Tasks 1, 2, 3, 5, 6
5	<i>INFN/LASA (Milano, Italy)</i>			Tasks 2, 3
6	<i>Piccoli S.r.l. (Noale (VE), Italy)</i>			Tasks 2, 3
7	Helmholtz-Zentrum Berlin (Berlin, Germany)		Task 6	Tasks 1 and 6
8	RTU (Riga, Latvia)		Task 5	Task 5
9	University Siegen, (Siegen, Germany)			Tasks 2, 3, 6
10	UKRI/STFC/ASTeC (Daresbury, UK)		WP, Tasks 1 and 3	Tasks 1, 2, 3, 5, 6
11	<i>Lancaster University (Lancaster, UK)</i>			Tasks 1 - 3
12	<i>Jlab (Newport News, Virginia, USA)</i>			Tasks 1, 2
13	<i>PTI (Physics-Polytechnic Institute, Minsk, Belarus)</i>			Tasks 1, 2
14	<i>MEPhi (National Research Nuclear University, Moscow, Russia)</i>			Tasks 1 - 3
15	<i>Helmholtz-Zentrum Dresden-Rossendorf (Dresden, Germany)</i>			Tasks 1 – 3, 5