

Technologies available at CERN to support new experiments/ideas: outcome of TECH workshops

Sergio Calatroni (CERN), on behalf of the PBC Technology WG



9.11.2022

Outline

- Introduction to Technology WG
- Rationale of workshops
- Outcome and selected examples



The PBC Technology Working Group

Mandate (highlights):

- ...explore and evaluate possible **technological contributions of CERN** primarily to non-accelerator-related experimental physics initiatives and projects that may also be hosted elsewhere
- ...survey technologies that could become relevant to CERN accelerator and non-accelerator projects
- ...favour the **exchange of experience and expertise** in technological domains such as superconducting and normal conducting magnet and RF technology, cryogenics, optics, vacuum and surface technology
- ...support the development of new physics experiments and detection methods like quantum sensing and new (accelerator and non-accelerator) experiment proposals

Objectives:

- Contribution to advancing conceptual designs where appropriate (see next talks)
- Identification and promotion of synergies with Quantum Sensing Initiative at CERN and with other PBC Working Groups
- Documentation of identified and undertaken initiatives and benefits for the experimental community



Experiments & proposals linked with Tech WG (reviewed at PBC annual workshop 2021)

- Grenoble Haloscope (GrAHal) → will apply to Recognized Experiments Committee
- VMB@CERN → will apply to SPSC and talk this morning
- ALPS-II / Jura
- DarkSide
- Ptolemy- Carbon NanoTubes → talk last week at QTI
- STAX
- Advanced-KWISP
- AION-100 @ CERN \rightarrow talk this morning
- RADES/HTS \rightarrow talk this morning
- Axion Heterodyne Detection \rightarrow talk this morning
- babyIAXO → Experiment at DESY, collaboration agreement with CERN



Rationale of workshops

- Favour the exchange of experience and expertise in various technological domains
- Support the development of new physics experiments and detection methods at and outside CERN
- Promoting the exchange of information between physicists and technology experts at CERN and in relevant institutions
- Aimed at a mixed audience of physicists and engineers



List of (mini-)workshops

- 1. Superconducting RF (co-chair: Chloé Malbrunot)
- 2. Lasers & optics (co-chair: Guido Zavattini and Giovanni Cantatore)
- 3. Vacuum, coating and surface technologies (WG chairs)
- 4. Cryogenics technologies (co-chair: Antonio Perin, Herman Ten Kate)



First mini-workshop: superconducting RF technologies

- September 21st, 2021 (afternoon). Online workshop (Zoom)
- 84 registered participants, about 40 concurrently online. 8 talks in two sessions.
- <u>Google Doc</u> for offline Q&A (very successful)
- Indico link (public access)



SRF mini-workshop: agenda

14:00 → 14:10	Introduction: format & Idea Speaker: Babette Dobrich (CERN)	15:40 → 15:55	A proposal for a first HTS accelerating cavity. Speaker: Walter Wuensch (CERN) MTS accel proposal HTS accel proposal
14:10 → 14:25	Superconducting RF at CERN: overview Speaker: Walter Venturini Delsolaro (CERN) Image: SRFatCERNovervie SRFatCERNovervie	15:55 → 16:10	SRF for axion haloscopes Speaker: Sergio Calatroni (CERN) SRF_Talk_Sergio_v7 SRF_Talk_Sergio_v7
14:25 → 14:40	HTS coatings for FCC and beyond Speakers: Joffre Gutierrez Royo (ICMAB - CSIC), teresa Puig (CSIC) PBC2021_JGR_v5.p PBC2021_JGR_v5.p	16:10 → 16:25	Heterodyne Detection of Axion Dark Matter in SRF Cavities Speakers: Raffaele D'Agnolo, Raffaele Tito Dagnolo (Univ. of California San Diego (US)) C dagnolo_axion_shor
14:40 → 14:55	SRF coatings at CERN Speaker: Guillaume Jonathan Rosaz (CERN) PBC_Workshop_202 PBC_Workshop_202	16:25 → 16:40	SRF at BASE and BASE haloscope Speaker: Stefan Ulmer (RIKEN (JP)) 2021_RF_in_BASE 2021_RF_in_BASE
14:55 → 15:10	Characterisation of (high temperature) SRF cavities for axion search in ARIES at CERN Speakers: Jessica Golm (Friedrich-Schiller-Universitaet Jena (DE)), Jessica Golm (Friedrich-Schiller-Universitaet Jena (DE)) Jena) PBC_workshop_202	16:40 → 16:55	discussion axions/experiments block over a coffee Please consider using the google doc: https://docs.google.com/document/d/1wvvuL_QI4mwQfT_nx-RpedcW0ghzZL3nFyr-TfNy9ug/edit?usp=sharing
15:10 → 15:25	Discussion technology + accelerator block over a coffee Please consider using the google doc:	16:55 → 17:00	closeout



https://docs.google.com/document/d/1wvvuL_QI4mwQfT_nx-RpedcW0ghzZL3nFyr-TfNy9ug/edit?usp=sharing



- First workshop, very motivated participants
- Was it successful at establishing links?
 - Most presenters had already connections, workshop helped defining and focusing future activities (HTS superconductors)
 - Spreading knowledge of the different experiments, perhaps connections may happen in future



Axion Heterodyne Detection proposal





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Second mini-workshop: laser & optics technologies

- December 10th, 2021 (full day). Online workshop (Zoom)
- 73 registered participants, about 40 concurrently online. 16 talks in three sessions.
- <u>Google Doc</u> for offline Q&A (very successful)
- Indico link (public access)



Laser & optics mini-workshop: agenda



9.11.2022



Lunch break

Highlights

- Large number of presenters from very different backgrounds
- Exchanges and connections?
 - Experts in laser technologies from different origins and backgrounds have established links
 - Thin films experts from CERN and outside could get information on their different expertise
 - And first connections to the quantum sensing community



Photos (50 people)





Third mini-workshop: vacuum, coatings and surface technologies

- April 6th, 2022 (full day). Online workshop (Zoom)
- 108 registered participants, about 70 concurrently online. 13 talks in three sessions.
- Google Doc for offline Q&A
- Indico link (public access)



Vacuum, surfaces and coatings: agenda

09:00 -	→ 09:10→ 09:30	Introduction Speakere: Andrzej Siemko (CERN), Babette Dobrich (CERN), Paolo Chiggiato (CERN), Sergio Calatroni (CERN) Image: PBC miniworkshop Image: PBC miniworkshop <th>11:40 → 12 12:00 → 12</th> <th>2:00</th> <th>Requirements, challenges and past experience with polarized H/D internal targets Speaker: Paolo Lenisa (Universita e INFN, Ferrara (IT)) CERN_lenisa_22_04 CERN_lenisa_22_04</th>	11:40 → 12 12:00 → 12	2:00	Requirements, challenges and past experience with polarized H/D internal targets Speaker: Paolo Lenisa (Universita e INFN, Ferrara (IT)) CERN_lenisa_22_04 CERN_lenisa_22_04
09:30 -	→ 09:50	Model based extreme vacuum pressure measurements at BASE	12:20 → 13	3:30	Lunch break
		Speaker: Barbara Maria Latacz (Max-Planck-Institut für Kemphysik, Heidelberg, Germany, RiKEN, Ulmer Fundamental Symmetries Laboratory, Japan)	13:30 → 13	3:50	Talloring mechanical properties of optomechanical detectors Speaker: Marin Karuza (Universita e INFN Trieste (IT))
09:50	→ 10:10	Vacuum simulation tools (molflow)			PBC_2021_apr.pdf
10.10	+ 10 [.] 30	Speaker: Marton Ady (CERN) 20220406 pbc mini 20220406 pbc mini Vacuum characterization canabilities (outgassing permeation atc.) at CEPN	13:50 → 14	l:10	Surface analysis facilities at CERN Speaker: Marcel Himmerlich (CERN) PBC_Technology_W PBC_Technology_W
		Speaker: Ivo Wevers (CERN)			
		PBC_miniWorkshop	14:10 → 14	1:30	Speaker: Laurent Pinard
10:30	→ 11:00	Get yourself a coffee			
11:00 -	→ 11:20	Speaker: Pedro Costa Pinto (CERN) Pacer Cern-Te thin films CERN-TE thin films	14:30 → 14	1:50	Porous nanomaterials exposed to proton beams Speaker: Thierry Stora (CERN) Porous materials_P Porous materials_P
11:20 -	→ 11:40	Thin film coating facilities at CERN/EP Speaker: Thomas Schneider (CERN) P_DT_TFG_PBC_m	14:50 → 15	5:10	Surface treatments and electrodeposition at CERN Speaker: Leonel Marques Antunes Ferreira (CERN)
•			15:10 → 15	5:40	Final discussion and close up



Highlights

- Largest participation in terms of audience
- Links and synergies?
 - People involved in CNTs, graphene, established links
 - Catalogue of CERN facilities made available to outside users
 - Link between different branches of the PBC tree



Photos (75 people)







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Fourth mini-workshop: cryogenic technologies

- September 28th, 2022 (full day). Hybrid workshop (CERN bldg. 40 + Zoom)
- 64 registered participants, about 15 on-site and 20 concurrently online. 9 talks in three sessions.
- Google Doc for offline Q&A (not used)
- Indico link



Cryogenic technologies mini-workshop: agenda

09:00 → 09:10	Introduction and scope of the workshop	13:45 → 14:10	An overview of sub-Kelvin cooling technologies
	Speaker: Antonio Perin (CERN)		Speaker: Gerard VERMEULEN (Institut Neel (CNRS))
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09:10 → 09:45	CERN Cryolab range of technologies	14:10 → 14:35	Effective passive thermal heat pipes for cryocooling
	Speaker: Dr Torsten Koettig (CERN)		Speakers: Bertrand BAUDOUY (CEA - SACLAY), Bertrand Baudouy
	PBC workshop Sept BC workshop Sept		2022_PBC Technolo
09:45 → 10:10	Cryogenic technologies for the AMS 100 SC magnet	14:35 → 15:00	Overview of cryocooler technologies enabling accelerator science
	Speaker: Prof. Stefan Schael (Rheinisch Westfaelische Tech. Hoch. (DE))		Speaker: Prof. dr Srinivas Vanapalli (University of Twente)
	AMS-100_Cryo_202		Pbc_cern_2022092
10:10 → 10:35	Ultralight cryogenic structures	15:00 → 15:25	Cryogenic instruments for microscopy and nano-precise sample positioning
	Speaker: Maria Soledad Molina Gonzalez (CERN)		Speaker: Dr Philipp Leubner (Attocube)
	20220928_Soledad		D1 Cryogenic instru 01 Cryogenic instru
10:35 → 11:05	Coffee break	15:25 → 15:55	Final discussion and close up
11:05 → 11:30	Liquid Argon cryogenics for the Neutrino platform		
	Speaker: Caroline Fabre (CERN)		
	2022_PBC_worksho		
11:30 → 11:55	Remote ultralow vibration cooling for the Einstein telescope		
	Speaker: Stefan Hild (University of Maastricht)		
	2021_09_28_cryo.pdf		





- First workshop with presentation from an industrial company
- Connexions established?
 - Between accelerator and experiment cryogenic applications
 - Between high temperature and low temperature cryogenic experts



Mini-workshops: feedback

- Workshops well received, lively discussions online + separated google doc for written offline Q/A.
- Interaction between technology specialists and experiment proponents at early stage can be very fruitful
- Important to spread information on breadth of technologies and expertise available at CERN, and on technologies developed in partner Institutes
- Format (0.5-1 day) was adequate, participation was from diverse backgrounds
- Diversity not optimal, worse for presenters (8:1) than for audience (4.8:1)
- Hybrid formal not ideal for having good exchanges, will reconsider for the future
- Nevertheless mini-workshops fill a need and should continue



Future mini-workshops

- SC technology (magnets, shielding and other)
- Fabrication technologies, mechanical engineering
- Cryogenic EM / atomic detection technologies link with QTI
- Other suggestions? Please contact the WG conveners



Thank you! Questions?

The PBC Technology working group conveners

Sergio Calatroni, Babette Döbrich, Andrzej Siemko

The PBC Technology working group members

Giovanni Cantatore (aKWISP, INFN & Univ. Trieste), Gianluca Cavoto (Ptolemy, INFN & Univ. Roma I), Raffaele-Tito D'Agnolo (Heterodyne, IPHT France), Jessica Golm (HTS/RADES, Friedrich-Schiller-Univ. Jena, CERN), Richard Hobson (AION100, Imperial UK), Livio Mapelli (DarkSide, INFN and Univ. Cagliari), Antonio Perin (CERN), Pierre Pugnat (GrAHal, CNRS-LNCMI Grenoble), Joern Schaffran (JURA – ALPS-II, DESY), Paolo Spagnolo (STAX, INFN & Univ. Pisa), Herman Ten Kate (BabyIAXO, Twente Univ.), Guido Zavattini (VMB, INFN & Univ. Ferrara).





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