PBC technology WG

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March 2021
Initiatives/Experiments (possibly outside CERN) with technological challenge/expertise

(old?) PBC Technology WG

Facilitate connection, Discussion forum identify mutual benefit
Initiatives/Experiments (possibly outside CERN) with technological challenge/expertise

List of technologies (past mandate/ new mandate):
- High field magnets
- Cryo
- RadioFrequency (RF)
- optics/photon detection
- Vacuum (large-scale/UHV)
- new: high-T superconductors (HTS)
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PHYSICS :-)
- New particles (Dark Matter etc)
- Low-energy fundamental physics (vacuum magnetic birefringence)
From past WG report (2018: https://cds.cern.ch/record/2652165)
Two highlights of the past mandate:
- VMB@CERN proposed and presented to SPSC
- babyIAXO magnet design finalized

Described in dedicated talks!
-> will flash through news of all initiatives now
DarkSide (input from Livio Mapelli)

-> purify UAr from Ar39, leaving only Ar40 by exploiting slightly different volatility
-> 350m Aria high column
-> excellent results on prototype column (26m)
-> first Aria paper. Leak checks carried out at CERN

Acknowledgements

The second phase of the leak checks, carried out at CERN, was performed under service agreement KN3155/TE. We

Separating $^{39}$Ar from $^{40}$Ar by cryogenic distillation with Aria for dark matter searches

Fig. 7 Installation of the first support structure in the shaft of the Car
bosuolcis mine, 3Brush site.
CNTs for DarkPMTs (input by G. Cavoto)

Prototype INFN Roma, coupled to UV source

Relevant techno: (hv in) vacuum, secondary e^- emission in vacuum
JURA (input by Jörn Schaffran)

- JURA could be the "ultimate" optical LSW experiment on a long time-scale, combining forces of ALPS-II and OSQAR using current/future accelerator magnets.
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- JURA could be the ultimate optical LSW experiment on a long time-scale, combining forces of ALPS-II and OSQAR
- ALPS-II: first light expected in 2021, cryogenic magnet operation planned for fall 2021

Relevant techno: MAGNET/optics
STAX (input py P. Spagnolo)

-> idea to exploit higher photon flux from Gyrotrons (10s of GHz). To detect:

TES Nanowire


A (Red) TiAu
B (Blue) Al electrode
IP (Yellow) Al-O tunnel probe

Relevant techno:
MAGNET/optics, photon detection/MW
babyLAXO (input by H. ten Kate)

Tendering design complete - next step: manufacturing, assembly & installation design

Relevant techno: magnet, cryo
GrAHal (input by P. Pugnat)

-> hybrid magnet in Grenoble:
43T/34mm, steps to 9T/800mm

Relevant techno: RF, magnet, vacuum

RF Cavity developments at Neel Institute

Detection at 77 K of a simulated axion signal of $4 \times 10^{-19}$ Watt at 5.76 GHz; Sensitivity at $3\sigma = 5 \times 10^{-20}$ Watt

$P \propto g_{\alpha\gamma}^2 B_0^2 V < 10^{-21}$ W

$\Rightarrow$ RF cavities (0.3-30 GHz) at 20 mK & quantum amplifiers SQUID & JPA (IN) in strong magnetic field (LNCMI)

First data taking in 2021 at 2 K & 16 T in 55 mm dia. sc coil

RADES-HTS (Input by J.Golm)

-> synergy with groups studying e.g. FCC beamscreen

-> measurements slot via ARIES in May 2021

Coating material/methods:

- Nb$_3$Sn coating
- ReBCO coating
- ReBCO tape

ReBCO tape \(\rightarrow\) scalable
ICMAB technology to strip of Cu and Ag layers
ReBCO layer is exposed to the RF fields

Relevant techno: RF, magnet, vacuum
**aKWISP** (input by G. Cantatore)

Detection of membrane displacements by novel particles, wish to upgrade to 4K

Relevant techno: optics/cryo
VMB@CERN (input by G. Zavattini)

- measure vacuum magnetic birefringence using
  A macroscopic external magnetic field

The PVLAS experiment was limited by the intrinsic noise coming from the Fabry-Perot mirrors.
That was … a lot! What to take away?

Nota bene: Our exact mandate for the `new PBC’ to be sharpened: All the following statements potentially subject to update (e.g. experiments followed up in SPSC vs PBC, interplay with CERN quantum initiative? etc...)

-> In principle this was/is an open working group, contact the PBC coordinators if you think you fit (we wish to cross-fertilize communities)

-> work to establish contacts to CERN technological expertise for initiatives where appropriate

-> work to connect experiments with common/complementary expertise

-> enjoy discussing some physics

-> ~ monthly to bi-monthly meetings [https://indico.cern.ch/category/8816/](https://indico.cern.ch/category/8816/) (need to request mailing-list membership)