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cea

iSAS TA2

Energy savings from the cryogenics

High-Temp SRF

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Scientific Context

·The final goal is energy saving from the cryogenics **developing a high performance SRF cavity operating at 4.2 K.** *Very challenging*.

·State of the art is Nb_3Sn on Nb → **limitations:**

- *Nb is expensive;*
- *low thermal conductivity may affect max gradient;*
- *no facilities ready in Europe (All R&D programs are in USA).*

·The **Nb_3Sn on Cu** technology is the **most promising alternative** and is **currently develop in iFAST** H2020 project. (by CEA, HZB, INFN, STFC, RTU, IEE, UniSiegen)

·Nb_3Sn on Cu has the advantage that it can also be **attractive for industrial partners**

→ conduction-cooled, turn-key SRF for smaller accelerators.

·The **world's first prototype Nb_3Sn cavity on Cu** is planned to be built in **iFAST** (expected $Q_0 > 10^9$ @ 4K)

·Independent on this topic is also conducted at CERN in the framework of FCC R&D

·**Further optimizations to the process are expected to be needed to implement the cavities in a cryomodule.**

Scope

- **Optimization of the results obtained in iFAST (and ARIES) for «High T» SC thin-film cavities on Cu**
- It will go to study and **develop fundamental properties for cryomodules that have not been explored in iFAST:**
  - **RF cavity tunability** (studying stability/resiliance against mechanical deformation and thermal stress)
  - **Flux trapping** (studying flux trapping and thermal current induction aiming at reducing the Surface Resistance)
- The **R&D** will be conducted **on small samples, QPR and 1.3 GHz cavities.**
  - *Coatings will be done at INFN, STFC (Nb_3Sn via PVD) and CEA (ALD coatings)*
  - *Tunability will be studied with mechanical strength measurements on small samples at CEA, tuning system for 1.3 GHz cavity to be implemented at HZB.*
  - *Flux trapping will be studied on samples and choke at STFC, on planar samples, QPR and 1.3 GHz cavities at HZB, 1.3 GHz cav. at CEA.*
- **Main coating will be Nb_3Sn,** but results obtained in iFAST with other materials will be take into account.
- **Final deliverable will be one tunable 1.3 GHz cavity operating at 4.2 K fully characterized in terms of flux trapping**

Team

CEA

- Mechanical test on coupons + characterizations, ALD coatings on coupons and cavities + 1.3 GHz cavities RF test

HZB

- Mechanical test on cavities, Magnetometry on coupons, QPR RF test +MG, 1.3 GHz cavities RF test + MG
- Consumable (LHe)

INFN

- Nb_3Sn coatings on coupons and QPR and 1.3 GHz cavities, morphological characterization, polishing

STFC

- Nb_3Sn coatings on coupons and QPR and 1.3 GHz cavities, morphological characterization, choke cavities and penetrations characterizations + MG