Contribution ID: **57** Type: **not specified**

HTS coated conductor coatings in haloscopes for dark matter search

Tuesday 25 November 2025 16:15 (15 minutes)

High temperature superconducting YBa2Cu3O7-x (YBCO) is an enabling material that have recently entered the field of microwave cavities that must operate at very high magnetic fields; an example is the axion haloscope for dark matter search. The reason is the ability to significantly improve cavity efficiency by increasing the quality factor due to the low surface resistance values of YBCO at high magnetic fields, which cannot be achieved with any other material. Under the operating conditions of haloscopes, the surface resistance of YBCO is entirely governed by the penetration of superconducting vortices (quantized magnetic flux lines) and the ability to immobilise them. The lack of data at these conditions prompted us to study the high-field microwave response of YBCO, realising the enormous opportunities that these materials bring to this field [1,2]. However, the high anisotropy of YBCO makes it virtually impossible to deposit them directly on the geometrically complex surfaces required by these cavities, imposing the use of complicated YBCO growth methods that require epitaxial templates, Coated Conductors (CCs). For this reason, we have developed a coating technique to cover the curved surfaces of the cavities with CCs [3]. In this contribution, we will present our knowledge and research achievements towards the use of CCs materials for high-field haloscopes in the search for dark matter. In particular, we will show the results obtained for 9 GHz haloscope cavities operating up to 11 T and 4.2 K, searching dark matter axions in a mass range of 36 ⍰eV within the RADES experiment [4,5]. Importantly, this approach started from our contribution on other HEP applications requiring materials with low surface resistance values at very high magnetic fields, such as the FCC hadron collider beam screen, where our findings have positioned CCs as a strong candidate to replace Cu as a low surface impedance coating [6].

[1] T. Puig et al, Supercond. Sci. Technol. 32 (2019)
[2] A. Romanov et al. Scientific reports 10 (2020)
[3] G. Telles et al, Supercond. Sci. Technol 36 (2023)
[4] J. Golm et al. IEEE Trans. Appl. Supercond. 32 (2022)
[5] S. Ahyoune et al, submitted to JHEP
[6] A. Abada et al, European Physical Journal- Special topics 228 (2019)

Authors: GUTIERREZ ROYO, JOFFRE (ICMAB - CSIC); Dr TELLES, Guilherme (ICMAB - CSIC); Prof. PUIG, Teresa (ICMAB - CSIC); Mr IRFAN, Ahmed (ICMAB - CSIC); Dr LAMAS, Neil (ICMAB - CSIC); Mr BENEDETTI, Luca (ICMAB - CSIC); Dr GRANADOS, Xavier (ICMAB - CSIC); Mr GARCIA, Rafael (IFAE); Mr MUNDET, Julia (IFAE); Ms GOLM, Jessica (CERN); Dr WUENSCH, Walter (CERN); Dr CALATRONI, Sergio (CERN); Prof. DÍAZ MORCILLO, Alejandro Benedicto (UPCT); Prof. MIRALDA ESCUDÉ, Jordi (UB - ICCUB); Dr DOBRICH, Babette (Max Plank); Prof. IRASTORZA, Igor (Universidad de Zaragoza)

Presenter: GUTIERREZ ROYO, JOFFRE (ICMAB - CSIC)

Session Classification: Parallel HEP