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Galactic axions search with a superconducting resonant cavity

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To account for the dark matter content in our Universe, post-inflationary scenarios predict for the QCD axion a mass in the range (10 – 103) μeV. Searches with haloscope experiments in this mass range require the monitoring of resonant cavity modes with frequency above 5 GHz, where several experimental limitations occur due to linear amplifiers, small volumes, and low quality factors of Cu resonant cavities. In this paper we deal with the last issue, presenting the result of a search for galactic axions using a haloscope based on a 35 cm^3 NbTi superconducting cavity, within the QUAX experiment. The cavity worked at T = 4 K in a 2 T magnetic field and exhibited a quality factor $Q_0 = 4.5\times10^5$ for the TM010 mode at 9 GHz. With such values of Q the axion signal is significantly increased with respect to copper cavity haloscopes. Operating this setup we set the limit $g_{a\gamma\gamma} < 1.03 \times 10^{-12}$ GeV^{-1} on the axion photon coupling for a mass of about 37 μeV. A comprehensive study of the NbTi cavity at different magnetic fields, temperatures, and frequencies is also presented.

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