ACCELERATOR SEMINAR

High Quality Factors and large Gradients in Superconducting Niobium Resonators

Mattia Checchin,
Illinois Institute of Technology,
Chicago, IL

Very high quality factors in superconducting niobium resonators can be successfully achieved by implementing the nitrogen-doping technique. Many studies proved that such a treatment decreases tremendously the temperature-dependent part of the surface resistance, but, on the other hand, it increases the surface resistance per amount of trapped magnetic field. Such a contribution to the surface resistance as a function of the mean-free-path can be described as the interplay of two different regimes: pinning and flux-flow regimes, for low and large values of mean-free-path respectively. The experimental data acquisition and the model to describe the trapped flux surface resistance as a function of the mean-free-path will be presented.

A new thermal treatment—nitrogen-infusion—suggests that low temperature nitrogen-doping can provide both high gradients and high quality factors, allowing low dissipation at gradients larger than 35 MV/m. Such high accelerating gradients can be reached because the nitrogen-infusion generates a dirty/doped layer at the rf surface, with thickness lower than the penetration depth. By means of numerical solutions of the Ginzburg-Landau equations, the energetics of the vortex penetration for a superconductor with a dirty layer at the surface is studied in detail. Such a calculation suggests that the dirty layer at the rf surface promotes a higher energy barrier to the vortex penetration, and an enhanced lower critical field that delays the vortex penetration increasing the accelerating gradient. By cleverly tuning the superficial layer dirtiness, the beneficial effect of nitrogen-doping on the quality factor can also be exploited, allowing for low dissipation at high accelerating gradients.

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11:00 a.m.
ARC, Room 231

Coffee before seminar beginning at 10:45 a.m.

Jefferson Lab

For further info, please contact Carlos Hernandez-Garcia at x6862.