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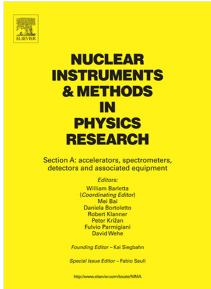

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David Longuevergne

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Geometrical corrections for accurate fitting of the field dependent surface resistance for superconducting accelerating cavities

DAVID LONGUEVERGNE*, INSTITUT DE PHYSIQUE NUCLEAIRE, CNRS-IN2P3, UNIVERSITE PARIS-SUD, UNIVERSITE PARIS-SACLAY, 91406 ORSAY, FRANCE

*longuevergn@ipno.in2p3.fr

Abstract

The different processes at the origin of the dependence of the surface resistance with the RF magnetic field are still not fully understood. Several models have emerged since many years to explain the drop of the quality factor Q_0 (commonly called Q-drop) of a superconducting cavity versus the accelerating gradient. Experimental data are commonly fitted by applying a coarse approximation to convert the Q_0 (a global property) into a surface resistance (local property). Extracting accurately the surface resistance from experimental data requires to take into account the RF field distribution over the accelerating structure contrary to what is commonly done in the community. Assuming a field dependent surface resistance does not allow anymore to use the well-known formula Q_0=G/R_s. This paper gives a procedure to perform an accurate conversion of the quality factor measured during a cavity test into a surface resistance to avoid any error in the evaluation of fitting parameters due to the geometry.

1 Introduction

The evaluation of the surface resistance of superconducting cavities from experimental data is essential for their optimization and for the understanding of all the dissipation processes occurring while subject to very intense radiofrequency (RF) electromagnetic fields (typically 100 mT and 50 MV/m). The SRF (Superconducting RF) community has developed several models like Thermal Feedback Model (TFM) [1, 2], Interface Tunnel Exchange (ITE) [3], Magnetic Field Enhancement (MFE) [4], Magnetic field dependence of the energy gap [5, 6], Percolation Model [7], or Non-Equilibrium theory [8] in an effort to explain and fit the field dependence of the surface resistance. The changes observed in the fitting parameters allow optimizing the surface preparation process and more specifically the different thermal treatments (hydrogen degassing, low temperature baking, nitrogen doping [9]) or surface treatments (Buffered Chemical Polishing, Electropolishing or Mechanical Polishing).

The quality factor of a superconducting cavity is defined as