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Superconducting Radiofrequency research and development at TRIUMF and UVic

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Superconducting radiofrequency (SRF) cavities are an enabling technology for modern high power accelerators enabling material science (e.g. Canadian Light Source), nuclear physics (e.g TRIUMF), and particle physics (e.g. LHC, Electron ion collider) experiments. The behaviour of superconductors under radiofrequency is distinctively different from the DC case being intrinsically dissipative at temperatures above 0K and strongly dissipative above the lower critical field Hc1. This requires dedicated research and development for reliable operation and advancing the technology beyond state of the art. One particular technical challenges is efficient recovery and mitigation of performance degradation during operation to maximize availability for experiments. Under ideal conditions, state of the art SRF cavities reach fundamental limitations in terms of accelerating gradient (energy gain per unit length) and power dissipation. Further performance increases require specialized chemical and surface treatments, tailored to specific cavity types (optimized in shape for different charged particles from electrons to heavy ions) and exploring heterostructure nanomaterials. I will highlight recent research highlights from TRIUMF and UVic including results from testing new surface treatments on unique multimode coaxial resonators and material science investigations using beta detected nuclear magnetic resonance (beta-NMR) and muon spin rotation and relaxation (muSR) combined with the state of the art material analytic techniques (Transmission electron microscopy, secondary ion mass spectroscopy). The very low dissipation of SRF technology is also of interest to applications in quantum technology. Based on SRF cavity data we have developed a model for two level system losses.

Keyword-1

Superconductivity

Keyword-2

Particle Accelerators

Keyword-3

Radiofrequency Superconductiv

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