# Power Dissipated by Trapped Vortices under a Strong RF Field and Campbell Penetration Depth in Superconducting Resonant Cavities

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***Abstract*** – **Vortices trapped in superconducting resonant cavities during their cooldown through the critical temperature can produce significant losses at radio frequencies (RF), even though a nearly full magnetic screening of the cavities has been used to reduce the negative effect of trapped flux. Sparse trapped vortices with areal densities corresponding to only few percent of the earth field result in a temperature-independent residual surface resistance which can account for 10-50% of the total surface resistance at 1-2GHz and 2K. In this talk I give an overview of RF losses of sparse trapped vortices perpendicular to the cavity surface as functions of the RF field amplitude and frequency. The main contribution to the RF losses comes from bending vibrations along vortices over the Campbell penetration depth which can be much larger than the London penetration depth of the driving Rf current. I will also discuss new effects at high RF fields at which the nonlinear Larkin-Ovchinnikov decrease of the viscous drag with the vortex velocity at strong RF current densities can significantly increase the Campbell ripple length, resulting in an anomalous decrease of the surface resistance with the RF field amplitude.**

**Main issues —**

- Trapped vortices can produce significant losses which can be much higher than the BCS losses in SRF resonator cavities.
- Vortex losses are determined by an effective Campbell penetration depth.
- New physics of superfast vortices driven by strong RF Meissner screening currents at the depairing limit.
- How fast can vortices move? How long does it take for a vortex to penetrate a superconductor?
- Nonlinear dynamics of supersonic vortices: field-dependent RF vortex losses, Larkin-Ovchinnikov instability, decrease of the surface resistance with the RF amplitude, …
- How much vortex dissipation in SRF resonator cavities can be tolerated? Can vortex losses be mitigated by strong pinning?

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