Calculation of cavity voltage

Pf=Pdiss+Pr+dU/dt

Pdiss=ωU/Q0 and Pe=ωU/Qext with Qext external Q for FPC

Er=Ef-Ee => =>

So

with 1/QL=1/Q0+1/Qext, one get:

And since => , with R/Q in accelerator definition, we have

So

Beam cavity energy exchange

Refer to page 333 of [[1](#_ENREF_1)] and [[2](#_ENREF_2)] for the details of the fundamental theorem of beam loading.

, with R/Q in accelerator definition

Beam energy change: q(Vc-Vb)

Cavity voltage changes from Vc to Vc-2Vb

Cavity energy change:

Energy conserved.

[1] Padamsee H, Knobloch J and Hays T 1998 *RF Superconductivity for Accelerators* (Weinheim, Germany: Wiley-VCH)

[2] Wilson P B 1978 *Physics of High Energy Particle Accelerators,* ed R A Carrigan (Fermilab Summer School