Flux Trapping in Coaxial Superconducting Radiofrequency Cavities

R. Gregory[1], T. Junginger[1], P. Kolb, R. Laxdal[1], M. McMullin[1], Z. Yao
TRIUMF, Vancouver, Canada
[1]Also at University of Victoria, Victoria, Canada

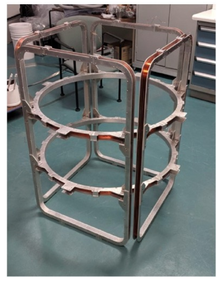
Coaxial Cavities

TRIUMF has a Half Wave Resonator (HWR) and Quarter wave Resonator (QWR). Multiple resonant modes can be tested after one cool-down

Coaxial Cavities

Helmholtz Coils

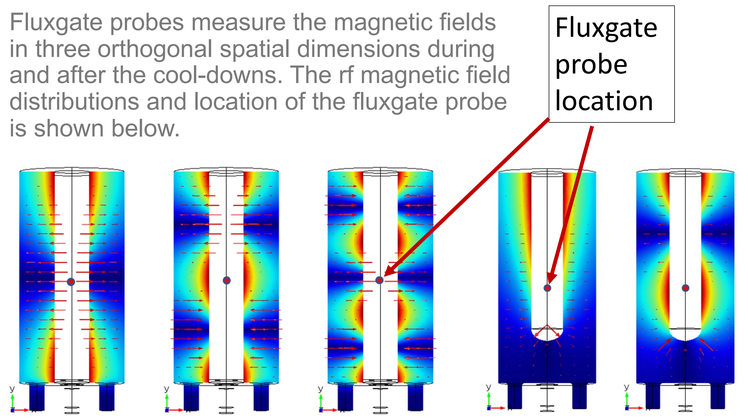
The Helmholtz coils produce a very uniform magnetic fields in all three spatial dimensions that surrounds a cavity during a cool-down.



Helmholtz Coils

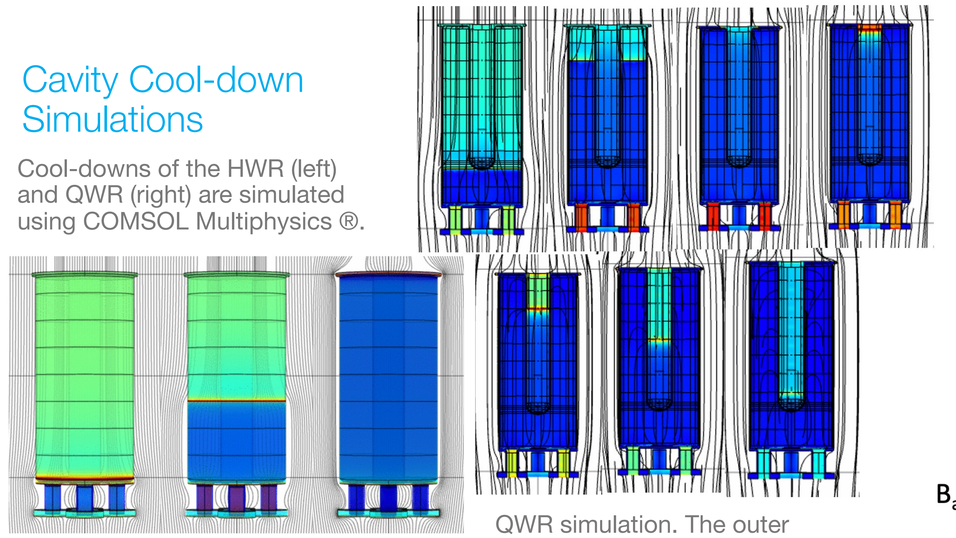
RF Magnetic Field

Fluxgate probes measure the magnetic fields in three orthogonal spatial dimensions during and after the cool-downs. The rf magnetic field distributions and location of the fluxgate probe is shown below.



Cavity Cool-down Simulations

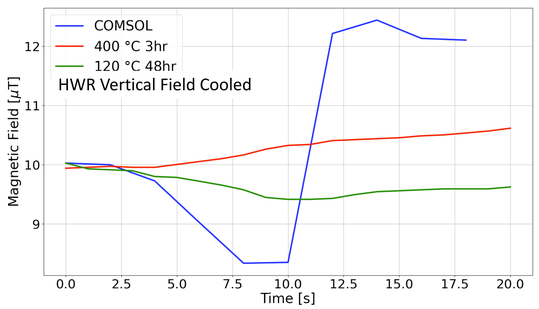
Cool-downs of the HWR (left) and QWR (right) are simulated using COMSOL Multiphysics ®.



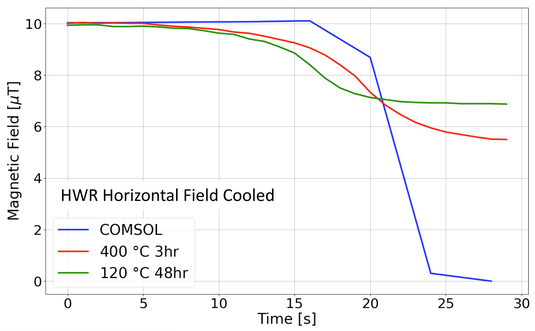
HWR simulation. The cavity is cooled from bottom to top.

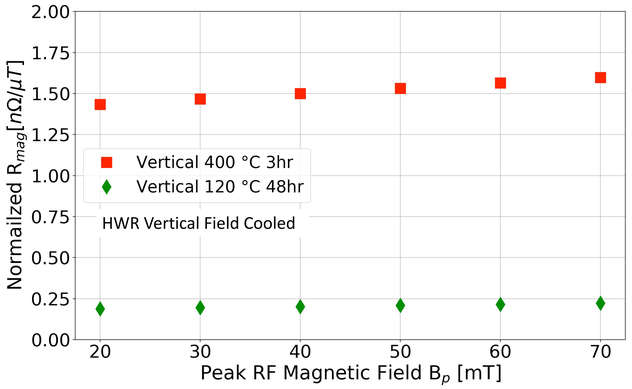
QWR simulation. The outer conductor is cooled from bottom to top, followed by the inner conductor which is cooled from top to bottom.

HWR Results

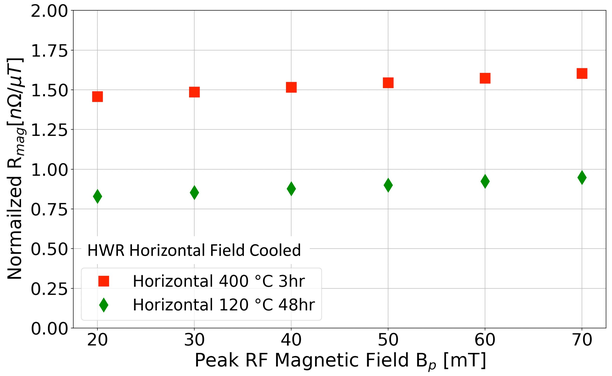


Simulated and measured magnetic field measurements during cavity cool-downs.

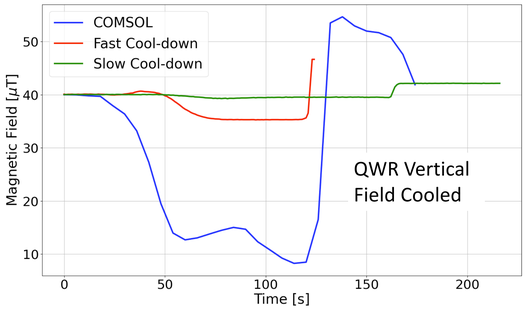


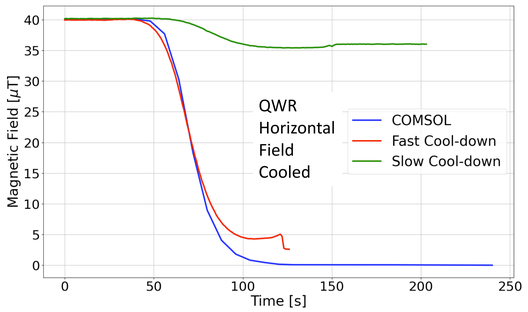


Corresponding R_{mag} divided by applied field values



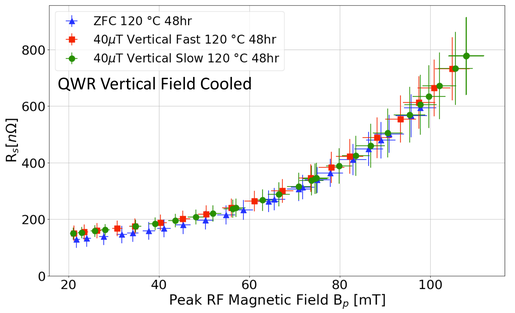
QWR Results



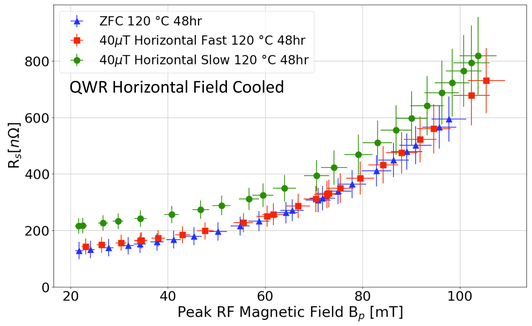


The fast cool-down with a horizontal applied field yields near complete flux expulsion.

The fast and slow cool-downs with a vertical applied field lead to similar levels of surface resistance.



For the horizontal field cooled results the fast cool-down leads to lower surface resistance and higher Q values.



Discovery, accelerated