Measurements at HoBiCaT:
Heating HOM loop couplers in CW mode

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BERLInPro approved on 10/08/2010!!

BERLInPro, a 100 MeV ERL to demonstrate high currents and low emittance for future light source applications.

Heating HOM loop couplers in CW mode

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Measurements on TESLA HOM loops in CW operation at HoBiCaT

Horizontal tests at the HoBiCaT testfacility operating TESLA cavities in CW mode

Test of thermal behavior of TESLA type HOM loop couplers
Heating HOM loop couplers in CW mode

Wolfgang Anders, HZB
HOM pickups have been problematic for CW

- Pick-up „sees“ a small part of the accelerating field
  → The tip heats up a little (<< 1 W)

- But: The tip is cooled only via the ceramic of the feed-through
  → A thermal bottleneck may cause thermal runaway
Mesurement setup

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Braid to 2-phase line

Cooling of sapphire feed-through

CERNOX temperature sensors

Cooling of housing

HOM pot
Improved HOM pickups

Improved cooling through

– Sapphire feed-throughs to cool the inner conductor
– Good thermal anchoring to 1.8 K (2-phase line)

Developed by Jefferson Lab

Tests in collaboration with DESY and JLAB
Measurement of Q v. E, DESY S33

- 20 MV/m reached
- Limited by quench caused by liquid helium instability (boiling, chimney to 2phase line to small)
- HOM pick-ups did not quench
- However, it still takes roughly an hour or more to reach thermal equilibrium
- Relatively high „zero field“ temperature

Question:
- Effect of pick-up cables (RG223 ca. 3 meters long)
- Do we need the thermal anchor?
Disconnected HOM Pick-up cables

- Zero-field temperatures drop significantly (nearly 4 K)
- Temperature rise on tuner side negligible & time constant short
- Higher time constant and temperature rise on coupler side.
Effect of cables

Temperatures of feed-throughs
Pickup cables attached

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Effect of cables

Temperatures of feed-throughs
Pick-up cables disconnected

Heating HOM loop couplers in CW mode

Temperature (K)

$E_{\text{acc}}$ (MV/m)

Coupler side
Tuner side

No cooling straps attached to 2PL

4 K !!
Effect of the cooling straps

Cut connection to 2-phase line of the cooling straps to feed-through (no pick-up cables attached)

- Still cooling to HOM „pot“
- Behavior essentially unchanged
- External cooling not required
- However, should repeat without any straps altogether

- What causes heating on the coupler side? (vacuum pump port?)
Asymmetry due to heat from pumping line?

Temperatures beam tubes

Heating HOM loop couplers in CW mode  
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No difference in performance observed between 16 and 8 mbar
HOM cooling in the distant past….

HERA cavity (SRF1987), HOM coupler LHe cooled …
Loop coupler with double filter

TESLA HOM

KEK HOM

with double filter

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Conclusions

- Saphire feed-throughs are essential for CW mode
- Bath temperature plays no role
- Cooling by straps to 2PL is not required (up to 20 MV/m CW). Remains to be investigated if cooling can be removed altogether.
- Pick-up cables are a significant source of heat! These need a thermal anchor and/or low conductivity cables must be employed
- 20 MV/m (and higher) CW operation should be easily realisable with saphire feed-throughs!

Courtesy C. Reece, JLAB

Thermal anchoring of cables, CEBAF