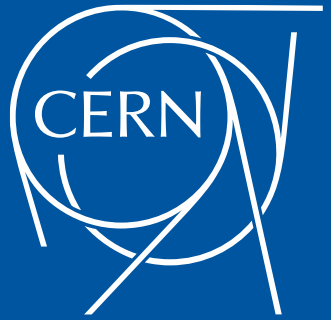



# HTS High Power testing

Presenter: Jessica Golm

05.07.2024

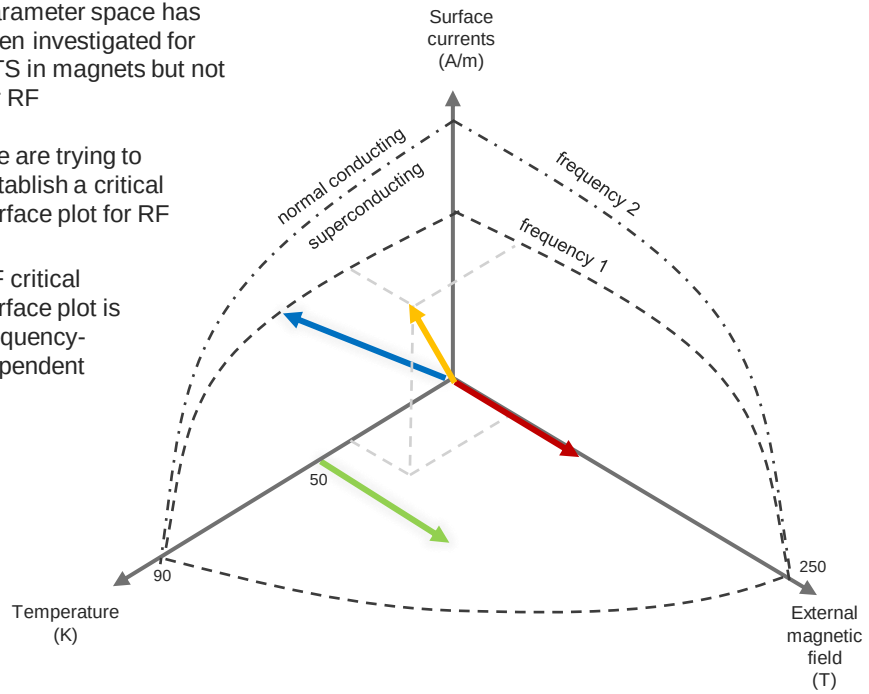
# YBCO critical surface in RF

**Critical surface:**

Parameter space has been investigated for HTS in magnets but not for RF

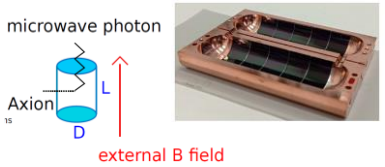
We are trying to establish a critical surface plot for RF

RF critical surface plot is frequency-dependent




**RF Applications:**

Axion experiments:
- High external B-field
- Low temperature (mK – 4 K)
- Low power




FCC beam screen:
- High external B-field
- T ~ 50 K
- Low power

Accelerator applications:

- High temperatures
- High power

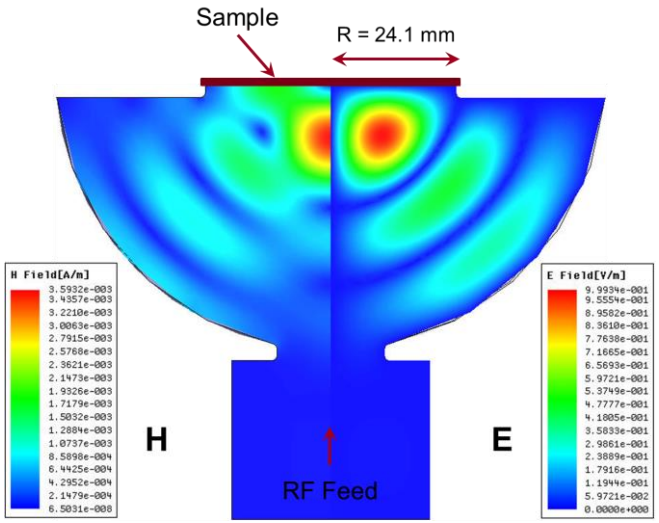
+

external B-field (Muon collider)

# HTS high power characterisation

Test stand:

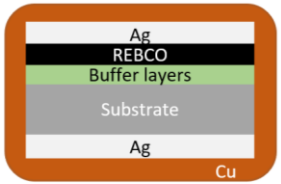
- High-Q X-band hemispheric cavity with a $TE_{032}$-like mode at 11.4 GHz.
- Zero E-field and maximum H-field on the sample
- Sample accounts for ⅓ of total cavity loss
- Can achieve $H_{peak}$ of about 360 mT using 50 MW XL-4 Klystron.

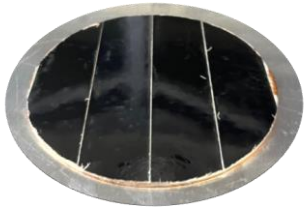



# HTS flat sample discs

## ReBCO tape on Cu disc

Commercially available REBCO tape soldered to the surface by ICMAB



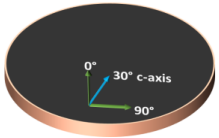
## ReBCO coatings (*sputtered)

Copper disc

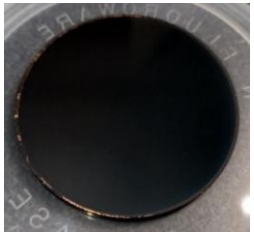
MgO buffer layer + ReBCO coating

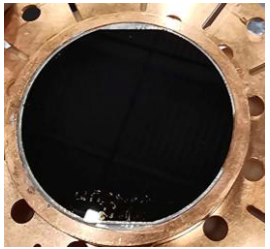
MgO disc

MgO crystal + ReBCO coating




600 nm film





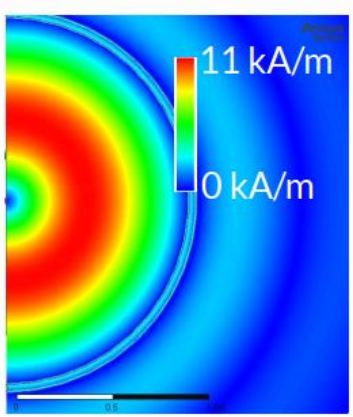
## Bulk HTS

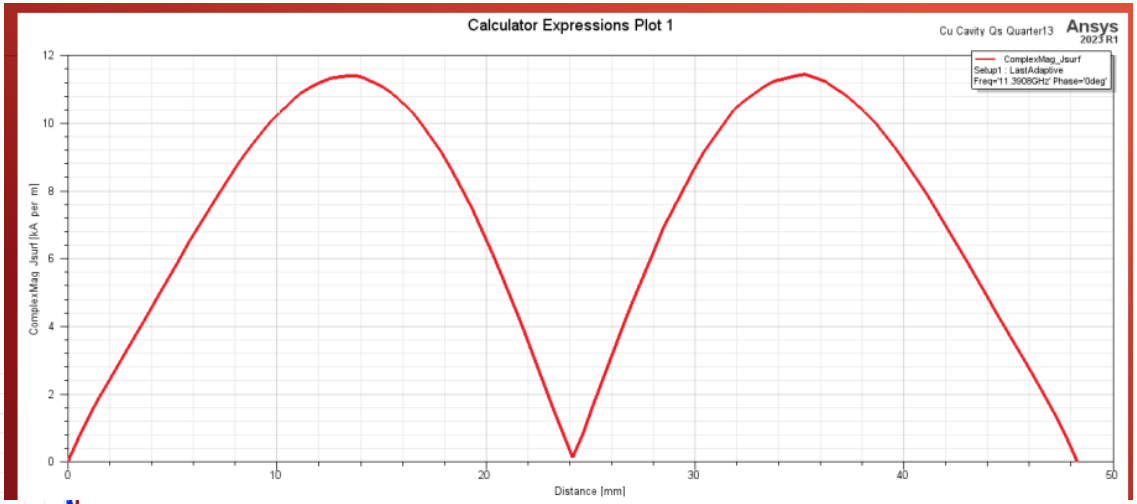
can superconductors

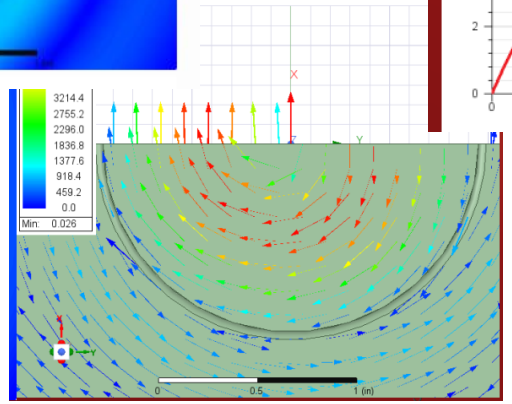


BiSCCO
Tc = 108 K

# Surface currents on the samples

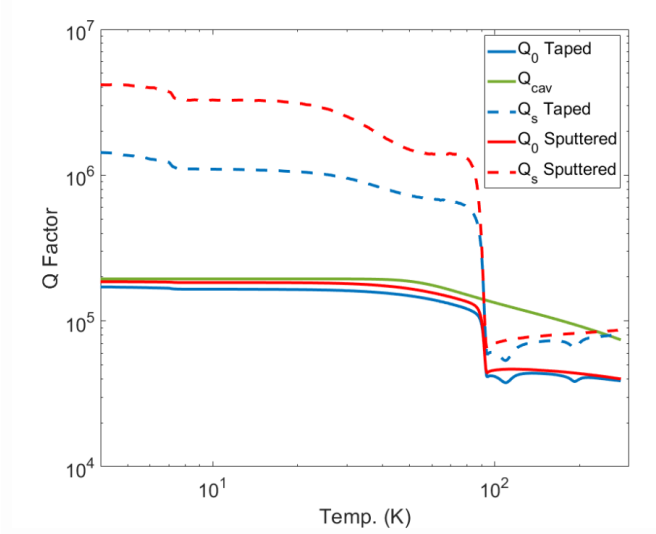


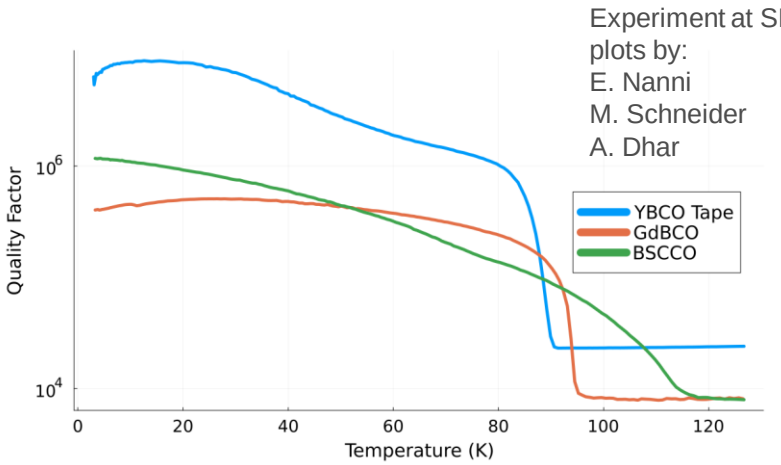



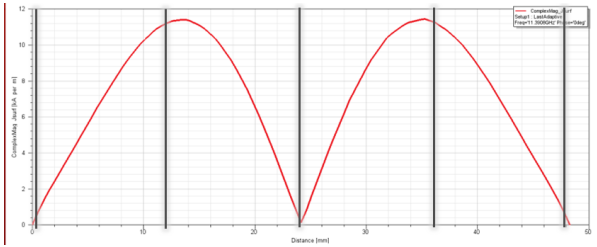

TWT is 1.6 kW @ 11.7 µs pulse
$Q_{tot}$ is 75k
$f_0$=11.43 GHz
=> fill time is 13.4 µs

# HTS low power characterisation of flat samples

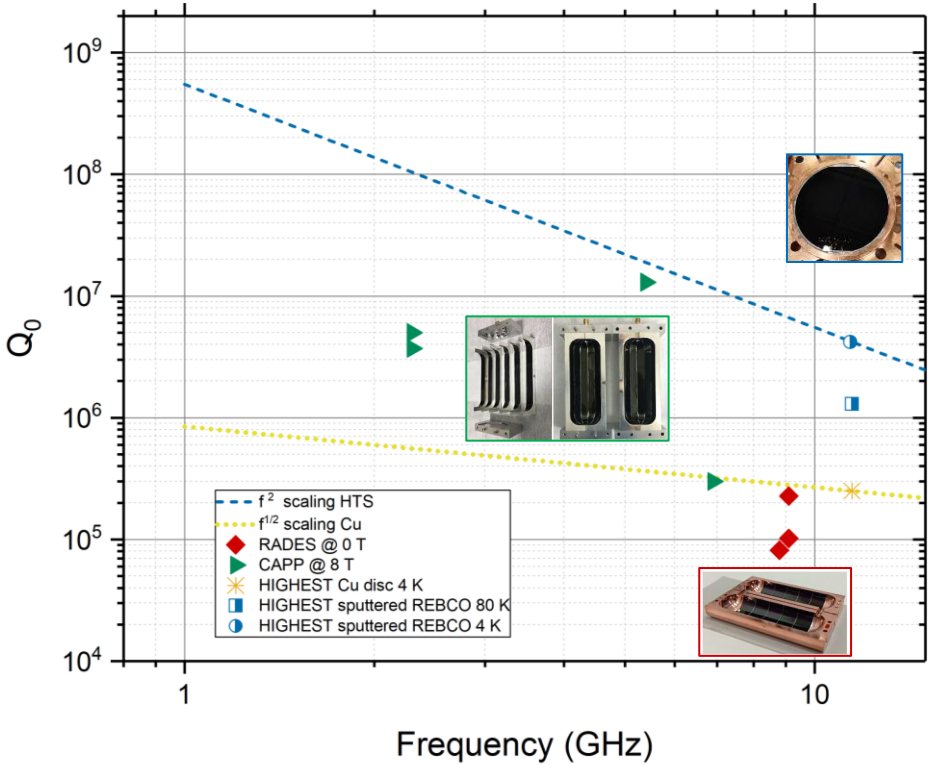



| Improvement compared to | (a) HTS tape | (b) HTS coating |
|---|---|---|
| Cu disc @ 4 K | 10 | 16 |
| Cu disc @ 80 K | 4 | 5 |



# Comparison with low power results from axion experiments




cavities have different geometries

# HTS high power characterisation of flat samples

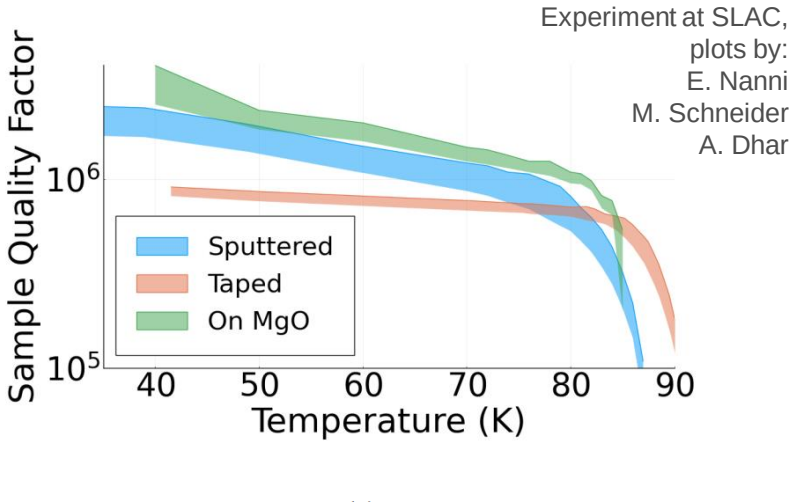



Figure 3: Plots of sample quality factor (a) and conductivity for both REBCO samples, with the shaded regions showing range of values for forward powers between 100 W and 1600 W.

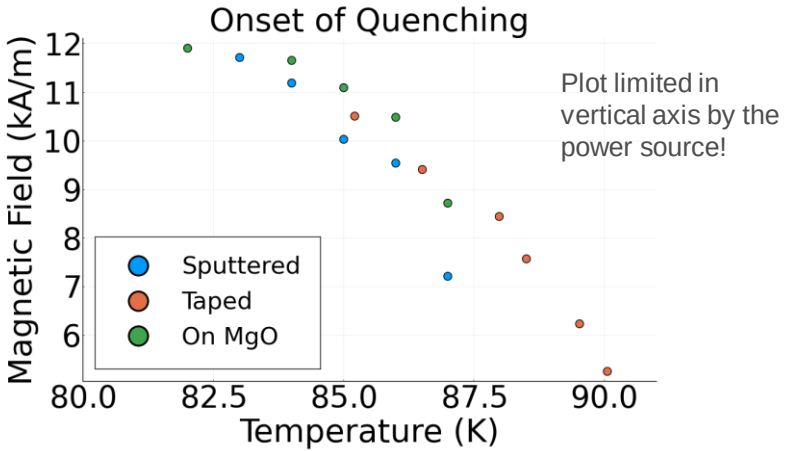



Figure 5: Scatter plot showing the minimum surface magnetic field needed to begin the onset of quenching withing each REBCO sample.

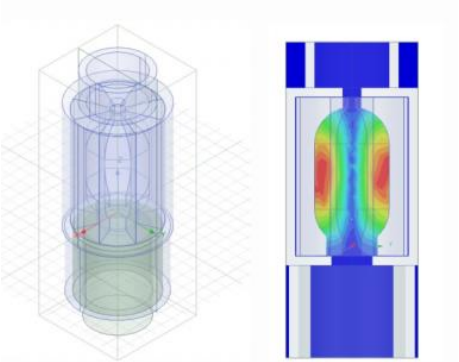
# Conclusion & next steps

## Conclusion

- High power rf use of HTS looks extremely promising
- So far no hints of performance limit in rf current up to the maximum power available in the test

## Next steps

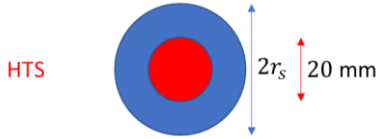
- Test bulk samples with TWT
- Go from TWT to a Klystron to see where the limits are
- Pulse compressor tests with HTS tape
- Shrink sample size with dielectric to test other suppliers and have less joint of tape

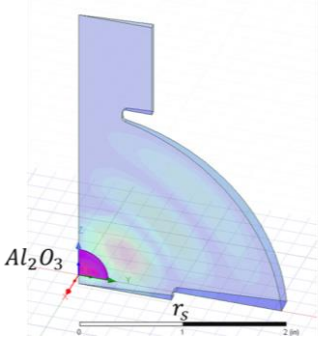


Octagonal cavity exciting the TM010 mode was designed. This allows currents to run longitudinally.

G.Le Sage

❑ Next higher order mode with SLAC cavity using dielectric.




P. Martinez-Reviriego

Thank you for your attention !