Global impact of tapering resistivity on impedance & acceptance criteria for Cu-coating in graphite taperings

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Acknowledgements: C. Accettura, C. Antuono, X. Buffat, B. Salvant, L. Sito, W. Vollenberg.

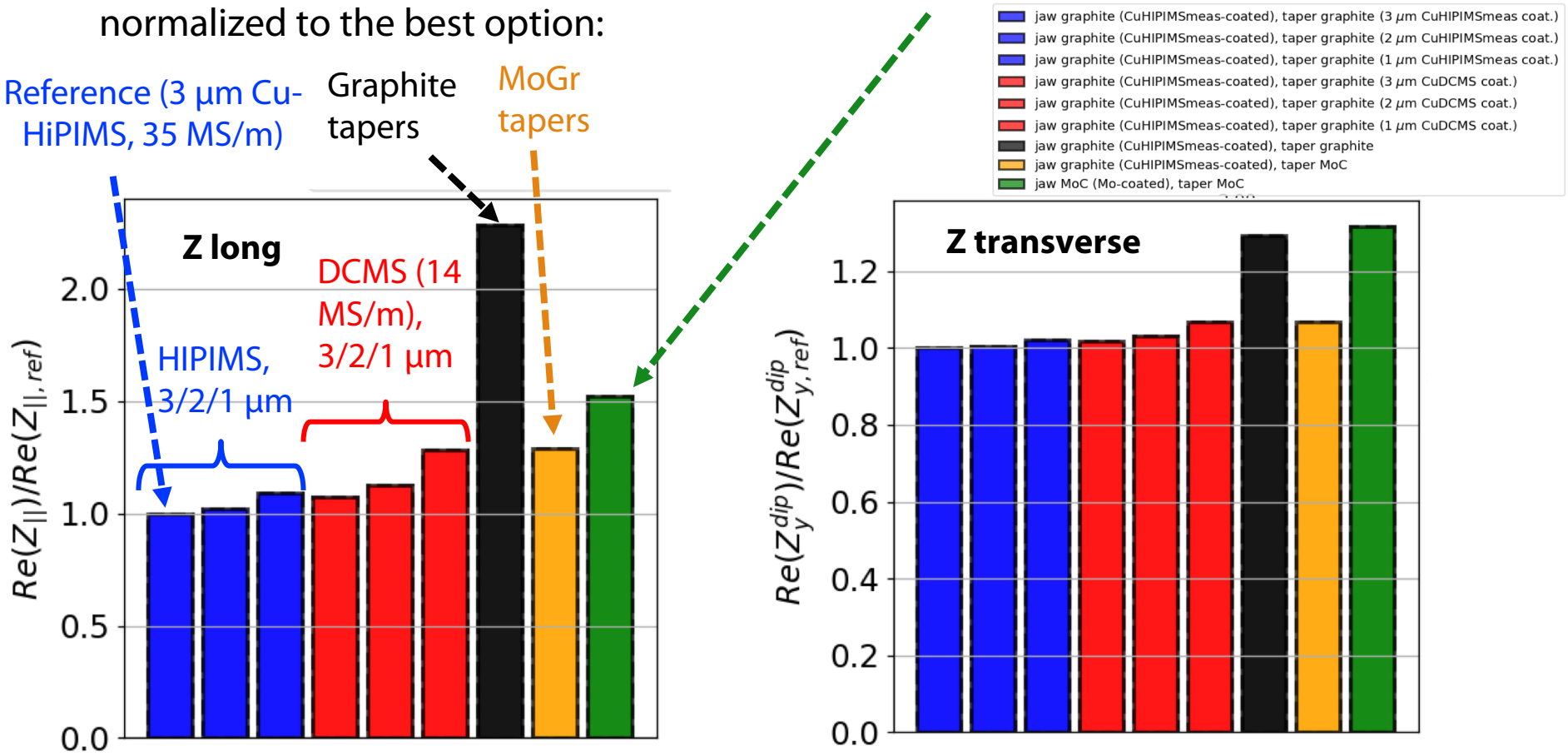
Taperings in Cu-coated graphite TCSPM

- Coating can be applied on graphite tapering, but at a certain angle
  ⟶ reduced conductivity (in tests on platelets) – cf. ***W. Vollenberg***.
- Conductivity cannot be measured with the same procedure as coated blocks (~17 GHz cavity) – cf. ***C. Antuono , L. Sito, L. Giacomel***.
- DC (or low frequency) measurements would be affected by graphite substrate below (skin depth larger than coating thickness).

⟹ What would be a **good qualification criterion** to make sure the Cu coating on taperings is "good enough"?

Impedance of Cu-coated graphite TCSPM

- Impedance at 1 GHz of Cu-graphite TCSPM (jaws coated with Cu-HiPIMS), vs. taper Cu-coating thickness & conductivity, compared to Mo/MoC TCSPM (MoC taper), normalized to the best option:

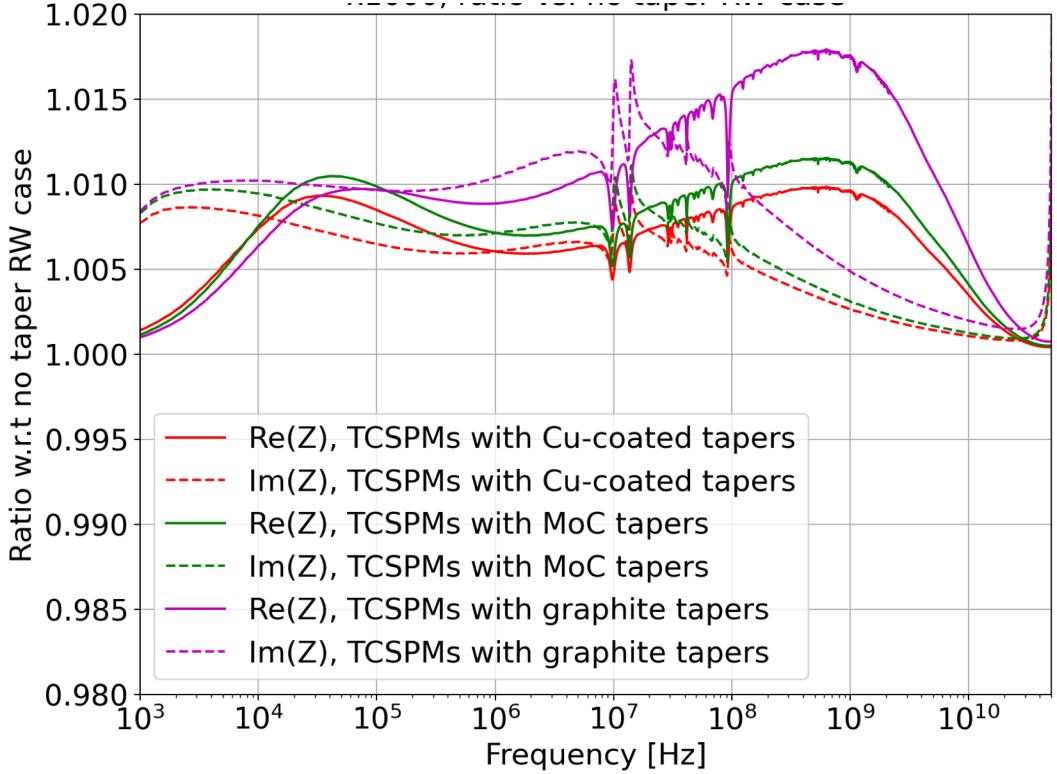


⟹ The essential point is to have at least some coating.

⟹ For impedance, the thicker, the better.

Global impact on transverse impedance

- Comparing 3 different options for the taper material in TCSPM, to the case when tapers resistivity is not at all taken into account in the model:



Zx dipolar

⟹ Impact of taper resistivity is globally close to 1%

⟹ Having MoC tapers for the new TCSPMs would slightly increase this percentage

⟹ Pure graphite tapers (i.e. no coating) would increase it by 1% additional.

Conclusion - acceptance

- In the background of this small study, a huge upgrade of the HL impedance occurred (allowing in particular to include taper RW impedance) – ***many thanks to L. Giacomel***
- Globally, the resistivity of collimator tapers account for ~1% of the total impedance of HL-LHC.
- If the new TCSPM taperings are in pure graphite instead of being coated, this adds **1% additional to the total model**, which is not acceptable.

  ⟹ Hence the taperings should be Cu-coated.

- To some extent, a lower conductivity/thickness, than for the blocks Cu coating, can be tolerated.

⟹ We (with WP5.2) propose to coat witness samples (glass, graphite, and steel) at the same time as the taperings, in a tilted position (as the taperings), and to measure conductivity / adhesion / thickness for them.

⟹ We would like to make sure the thickness is **close to 3 µm** (at least 2 µm) and the conductivity at least that of Cu DCMS (14 MS/m).