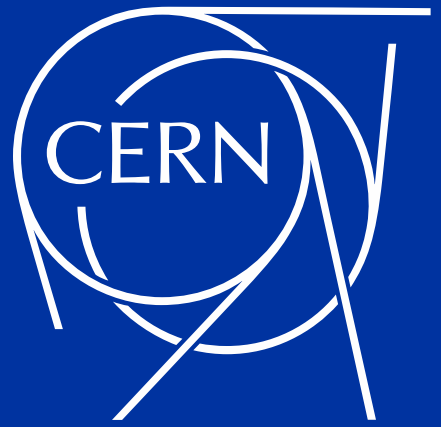

Validation of simulated power distribution in MKP-L

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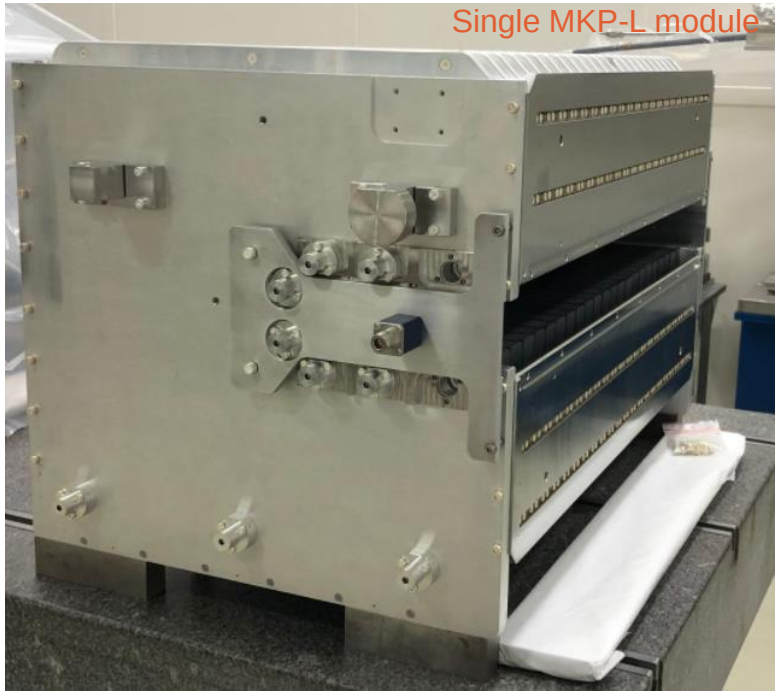
Acknowledgements: Yves Sillanoli, Laurent Ducimetiere, Carlo Zannini, Aaron Farricker
2 November 2020

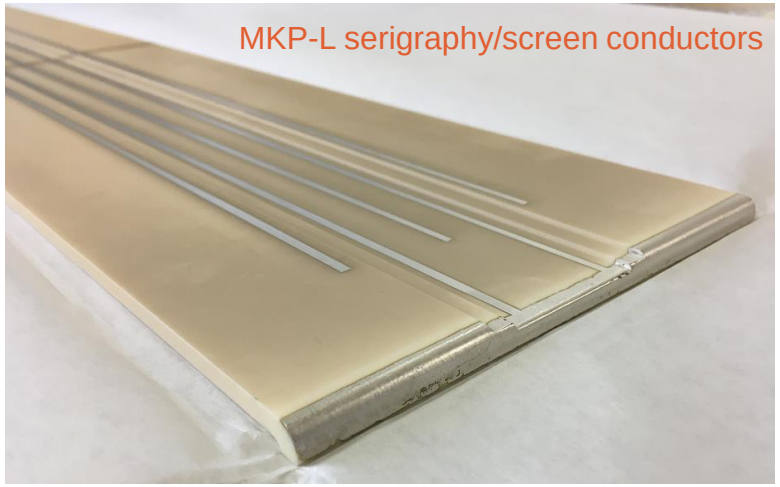
MKP-L overview

- **MKP-L will be subject to significant beam induced heating: Predicted to be an issue as early as 2022**
- **Design for an MKP-L that should mitigate these issues already exists (beam screen/serigraphy)**
- **Until upgrade has been carried through we want to study beam induced heating in more detail. Also relevant for other kicker magnets**
- **New baseline for injector schedule is to stop SPS from week 41 2021 for installation of MKP-L during YETS 2021/2022**

Single MKP-L module

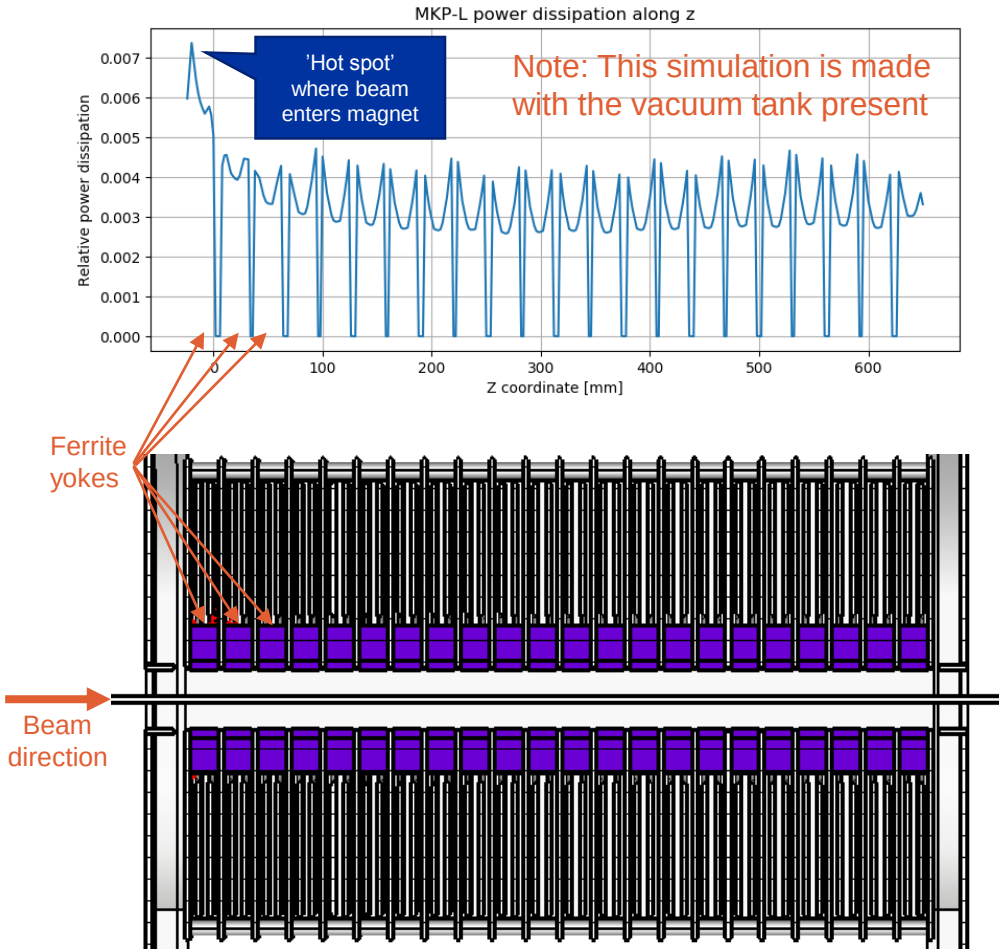


MKP-L serigraphy/screen conductors



MKP-L power distribution

- **Thermal simulations of MKP-L have historically assumed a uniform power distribution throughout the magnet**
- **CST simulations suggest that power dissipation in MKP-L is in fact concentrated to upstream end of magnet**
- **We want to confirm whether this is a real effect as it could impose different limitations on the operation**

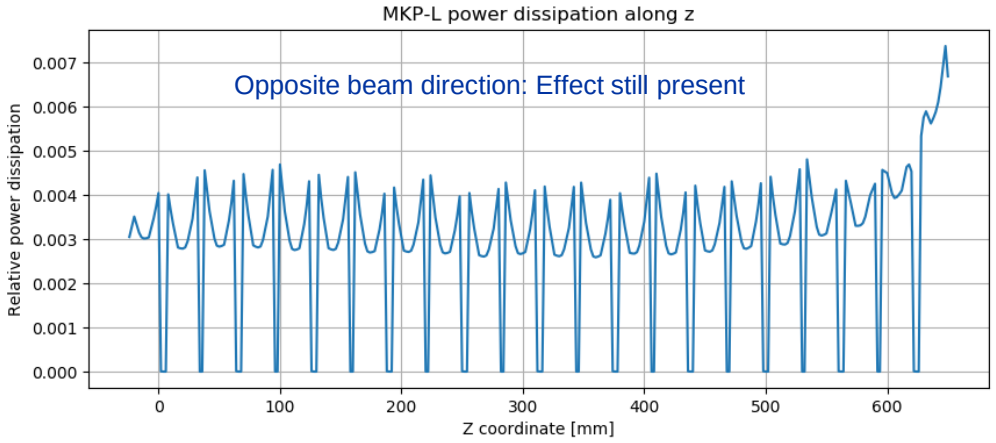


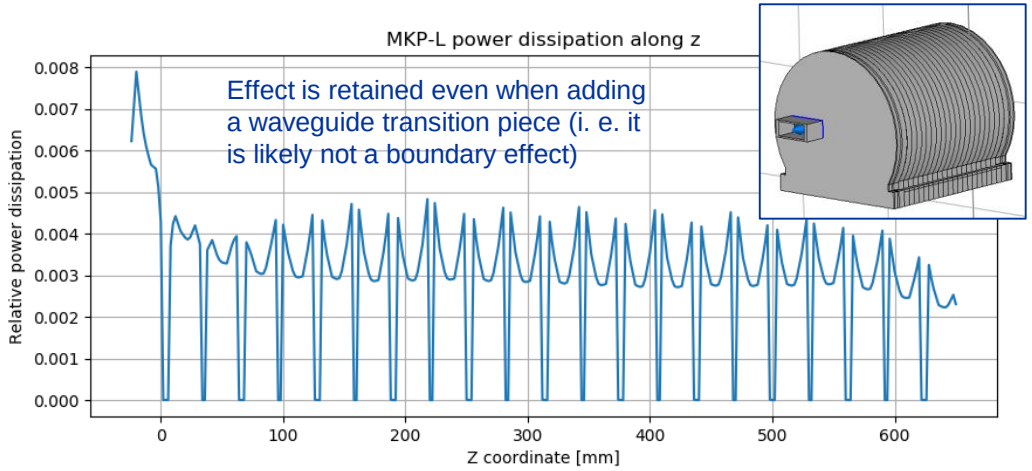
MKP-L power distribution

- **Some checks have been made to see whether it is a simulation model artefact. The effect remains even when:**
  - Running the beam in the opposite direction
  - Adding a waveguide transition piece

- **A similar effect has been observed in simulations of the MKI (and would likely appear in other kicker magnets as well)**

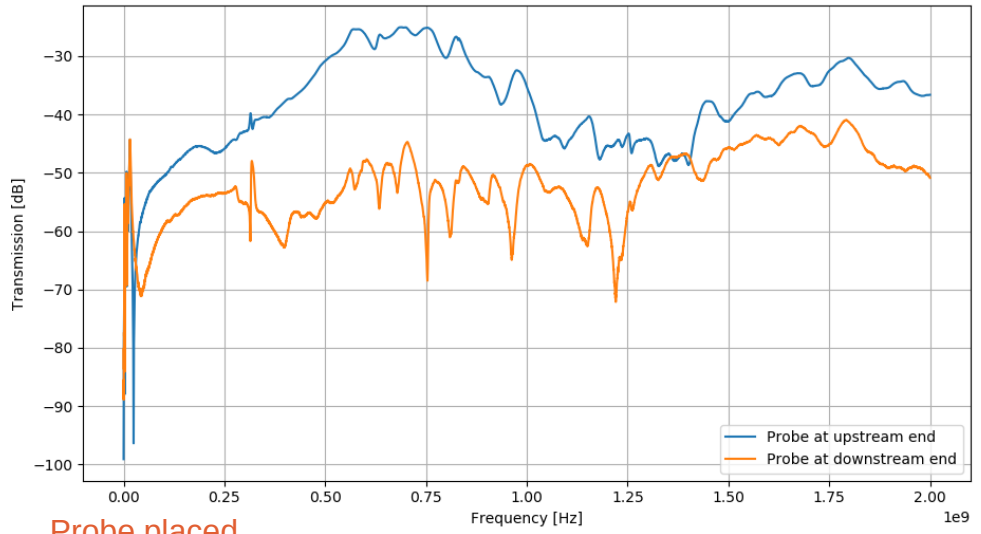
- **Working theory: Caused by field coupling to electrical circuit of magnet**



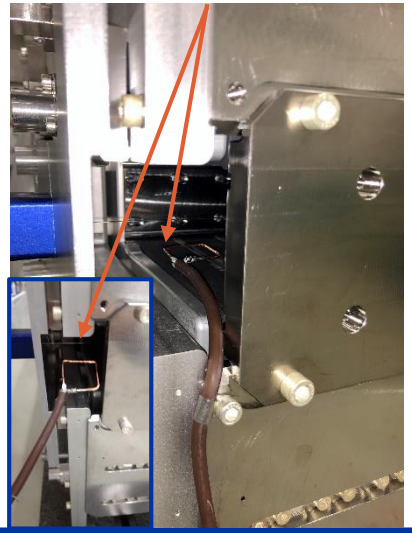


Validation: Probe measurements

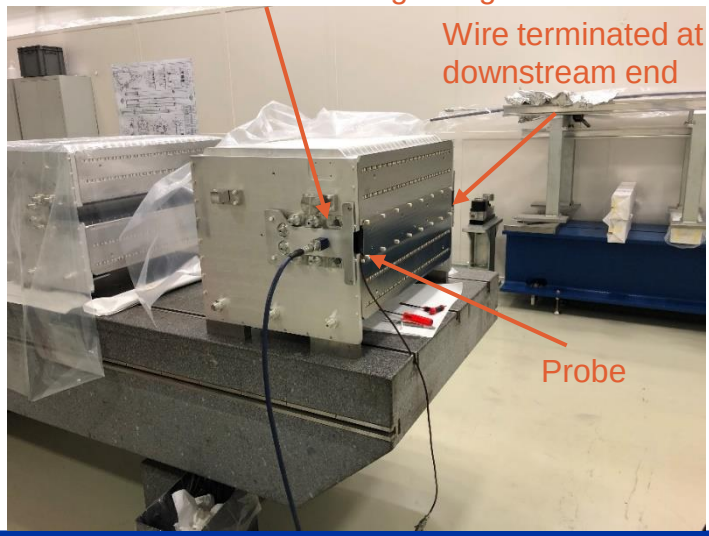
- Measurements made in parallel with impedance measurements: Same wire used for excitation
- In a first approach, we placed a probe above the first and last yoke in the magnet to see the difference in transmission (similar measurement made by Vasilis Vlachodimitropoulos in [1])
- Clear difference in transmission, along the lines with what we are simulating
- Can we get a better idea of how much power is coupled to the electrical circuit of the magnet?



Probe placed underneath wire



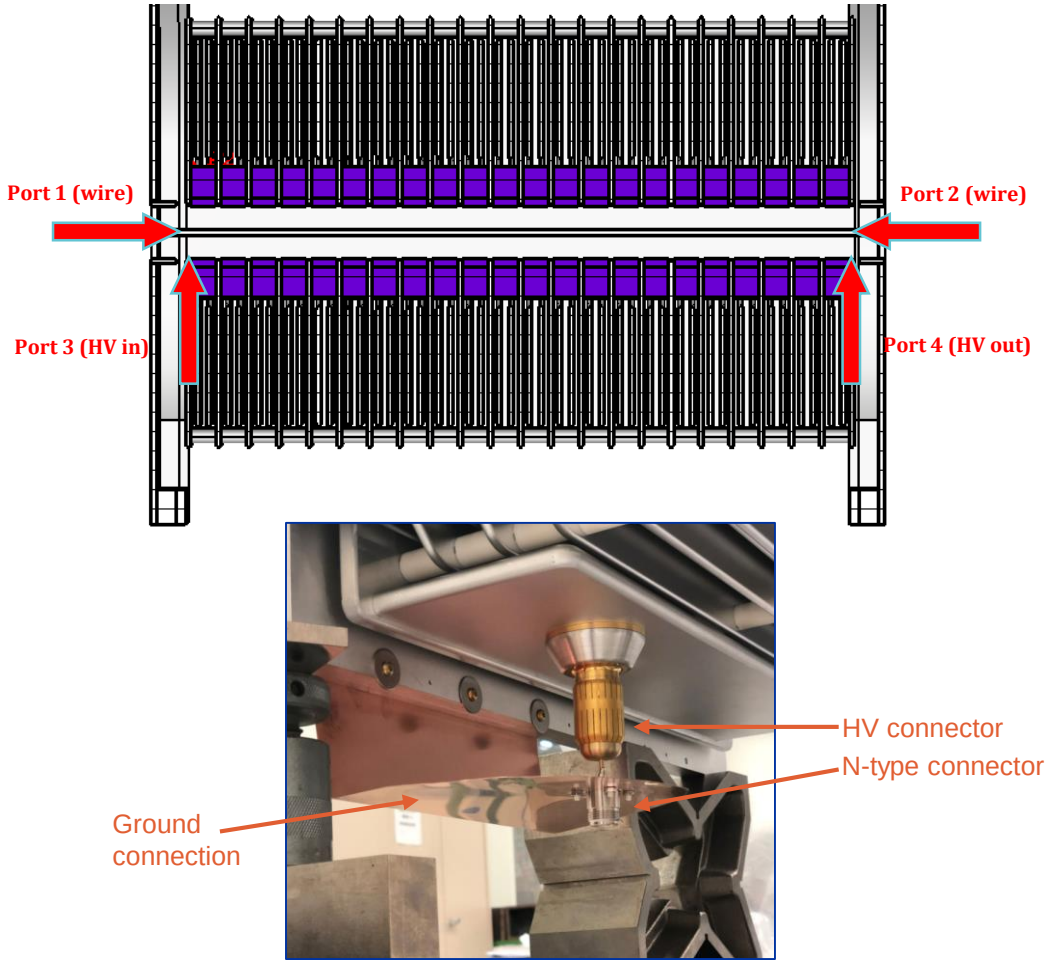
Excitation in wire through magnet



[1]: https://accelconf.web.cern.ch/ipac2018/papers/wepmk005.pdf

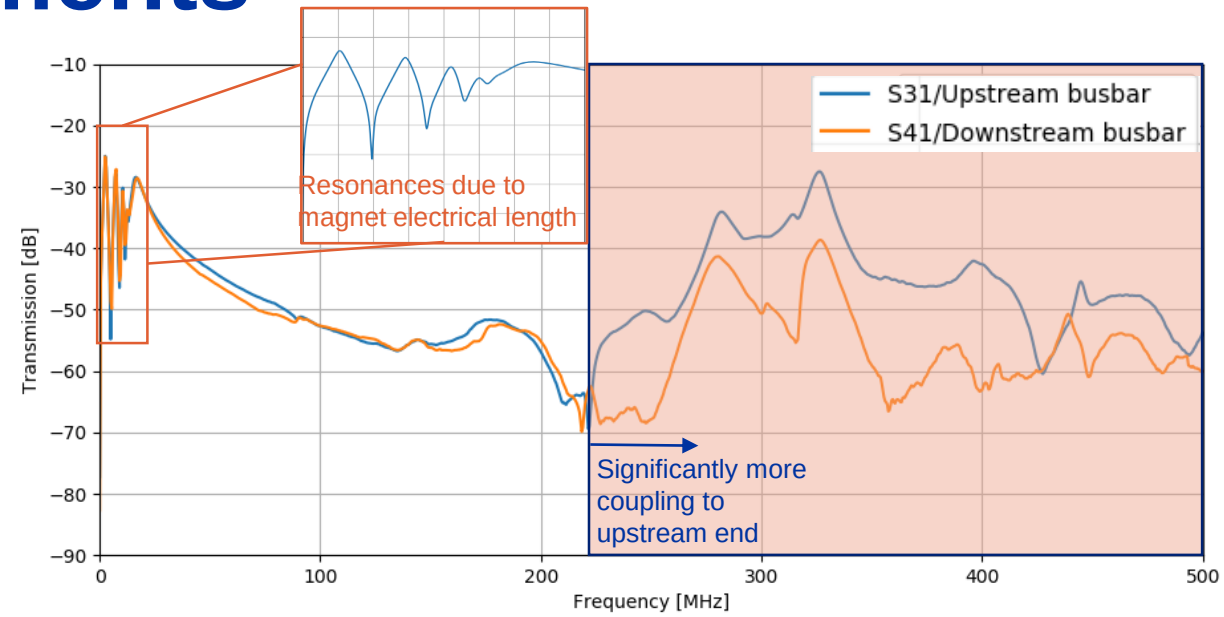
Validation: 4-port measurements

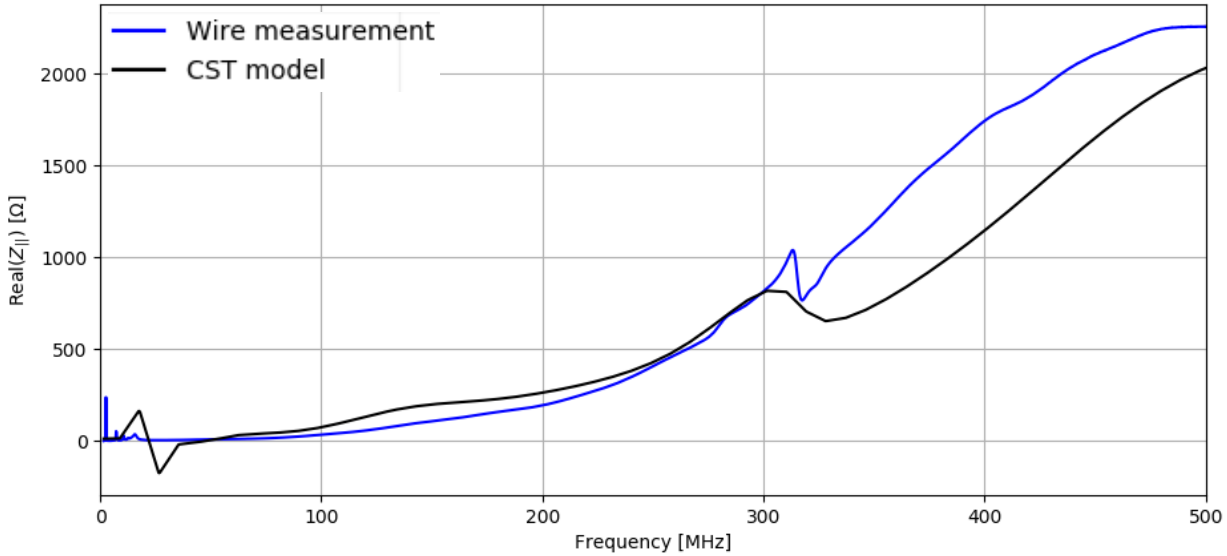
- New type of measurement suggested: Set up magnet as a four port network by connecting the ends of the wire + the HV in/out of the electrical circuit to the VNA
- HV connectors fitted with N-type connectors using special built solution



Validation: 4-port measurements

- **Similarly to probe measurements, transmission is in general higher to upstream end**
- **Still not an absolute measurement of the coupling, but supports our theory since the bigger differences are found in the region where the RF losses are expected to be the highest (true for bunch lengths at both injection and after acceleration)**
- Note: the low frequency resonances also show up on the longitudinal impedance resonances. However, this 4-port measurement allows the magnitude of the coupling between the ‘beam’ and electrical circuit to be evaluated (and can be used to verify CST/Opera simulations of this). This is important for coupling between beam and magnet electrical circuit (e.g. KFA14) and hence studying beam instabilities.





General remarks

- **One tank in reality contains four modules – should we expect each module to heat up in the same way?**
- **If this indeed is a real effect, the power distribution may be affected by the electrical circuit: Would also mean that it could potentially be influenced by the terminations/cable lengths in the electrical circuit of the magnet**