Transverse HOM damping in the 200MHz TWC

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Present configuration in the tunnel

- Two 4-section cavities
- Two 5-section cavities
- 460MHz **transverse** HOM couplers (4 per cavity)
- 628MHz **longitudinal** HOM coupler (4 per section)
- 938MHz **transverse** HOM coupler (0-3 per section)
628MHz impedance

- Considered most deteriorating HOM regarding beam stability
  - Further significant damping required for LS2
- Existing 628MHz HOM couplers damp already very well
- Further improvements are difficult to achieve
- **Possible option:** Couple to the magnetic field in the positions of the 938MHz transverse couplers (via it’s coupling loops)

Test measurements in the lab on a single-section cavity
Improvements in 600MHz range 1

High impedance mode

Damped with probes and loops

Damped with probes only (no loads on loops)

Undamped (no loads on probes and loops)

*courtesy T. Roggen
Improvements in 600MHz range

- Damped with original configuration (= loops with original filters)
- Damped with probes
- Damped with probes and loops with 630 MHz config.

*courtesy T. Roggen
Effects in the 900MHz range

Damped with original configuration (= loops with original filters)

Damped with probes and loops with 630 MHz config.

High impedance mode

Should we worry about this?

*courtesy T. Roggen
Transverse impedance

• Which values of transverse impedance are acceptable in the SPS?
• Which values of transverse impedance are acceptable in the 200MHz TWC?
  • What are the critical transverse resonances in the ranges 460 & 940MHz
• How much less damping of 938MHz mode is acceptable?
  • E.g. when replacing with a combined coupler for both 628&938MHz modes
Transverse coupler at 938 MHz acts on longitudinal impedance:

- Damp the longitudinal HOM at 914 MHz ($\sim \times 0.15$)
- Enhance the longitudinal HOM at 628 MHz ($\sim \times 1.4$)
Longitudinal stability – Transverse coupler off

- 628 MHz HOM critical for long. stability.
- Changing the filter on transverse 938 MHz coupler:
  - 628 MHz longitudinal HOM multiplied by 0.68.
  - 914 MHz longitudinal HOM multiplied 6.6.

- Simulations on SPS FT, 72 bunches, double RF: 10 MV + 1 MV and LIU baseline longitudinal impedance model.
Impedance model

PRESENT

FUTURE
Longitudinal stability – Transverse coupler off

- 628 MHz HOM critical for long. stability.
- Changing the filter on transverse 938 MHz coupler:
  - 628 MHz longitudinal HOM multiplied by 0.68.
  - 914 MHz longitudinal HOM multiplied 6.6.
- Simulations on SPS FT, 72 bunches, double RF: 10 MV + 1 MV and LIU baseline longitudinal impedance model.
- Longitudinal stability threshold increased by 10%.
- What about transverse stability?

![Nominal bunch length graph](image-url)
Thank you for your attention.

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1section SP-measurements

-Single section in workshop
-On **ALL** couplers (loop & probe) a 630-filter unit was mounted (!)
-Measured: $S_{21}$

* slide by T. Roggen
References