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Experimental investigation of multipactor in mixed-mode RF regimes for particle accelerators

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We report on how RF propagation modes affect the onset of multipactor in particle accelerators. In these systems, RF sources drive fields through couplers into accelerating cavities. While couplers typically operate in standing wave mode, the passage of particle bunches perturbs this regime, introducing a mix of standing and traveling waves. This change can strongly influence multipactor, a resonant electron multiplication phenomenon.

To investigate this, we developed a dedicated test bench at LPSC Grenoble using a 1.8 m, 1⁵/₈ inch copper coaxial line with ceramic vacuum windows, UHV seals, and multiple diagnostic ports. The setup includes a variable stub to control reflected power and diagnostics to monitor electron flux and electric field amplitude.

We measured multipactor thresholds as a function of reflected power at different RF frequencies. Results confirm that thresholds scale with wave mode composition, following predictions from literature [1, 2, 3]. We also discuss limitations of our measurements, which are affected by RF conditioning processes during operation.

- 1 Somersalo et al., Particle Accelerators, 1998.
- 2 Pérez et al., IEEE Trans. Plasma Sci., 2009.
- 3 Sleiman et al., IEEE Trans. Plasma Sci., 2024

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