RCS chain parameters discussion

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Inputs for transverse impedance/stability simulation in RCS and Collider

- Impedance/Wake simulations
  - Vacuum chamber geometry, material and length? (See slide on current assumptions)
  - Average beta function (and/or transverse tune)?
  - First RF cavities number and properties (Shunt impedance, quality factor, frequency)?
  - Effect of eddy currents in the beam pipe?
- Stability simulations
  - Transverse and longitudinal beam emittances in RCS chain : ~25 um rad (transverse) / 7 mm rad (longitudinal)? (from https://muoncollider.web.cern.ch/design/general-parameters)
  - Number and position of RF stations, energy gain per RF station?
  - Collider: RF and beam parameters (RF voltage, harmonic, tune…)?
  - Longitudinal/transverse stability cross-effects?

Investigations for next meeting

- PyHEADTAIL/Xsuite/BLOND longitudinal and transverse tracking with multiple RF stations
- Parameters for the Collider ring

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Additional content

Key inputs for RCS chain transverse impedance/stability

- Beam chamber geometry, size, and materials
- RF cavities properties (shunt impedance, quality factor, main frequency), number of cavities
  - Not yet included in impedance model
- Twiss beta values
  - Can use average beta function approximation for now
- Beam parameters (number of bunches, intensity, emittances...)

Current assumptions for impedance/stability

- Vacuum chamber
  - circular 30mm radius, copper at room temperature (300K, RRR=70, B=7T → rho=18 nΩ m)
  - infinite thickness
  - 5990m (complete ring length)
- Average beta = 50m in x and y
- Beam parameters (transverse and longitudinal) → from Fabian's parameters table
  - Single bunch, intensity 2.0e12 p.p.b
  - Momentum compaction factor : 2.4e-3
  - Synchrotron tune Qs=1.5/0.5/0.5 (at injection in RCS-LE/ME/HE)

Current work and next steps

- Transverse (and longitudinal) resistive wall impedance and wakefield with PyWIT and ImpedanceWake2D
  - PyWIT: toolbox to easily construct impedance and wake models
  - ImpedanceWake2D : for circular or flat axisymetric structures, uses field matching technique
- Transverse stability simulations with PyHEADTAIL
  - In RCS: Large energy change per turn → longitudinal stability issue if the RF cavities are lumped in one element (see IK and HD presentations at https://indico.cern.ch/event/1049297/)
  - Should be possible in PyHEADTAIL to split the RF systems in several substations (join separate Drift and Kick elements to form the longitudinal map)