Probing Transverse Impedances in the High Frequency Range at the CERN-SPS

HB conference, 9-13 Oct. 2023, *Flash presentation*

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HB 2023

THAFP01

POLITÉCNICA

About me

2 years at CERN with graduate program

Working at CERN-
BE-ABP-CEI section

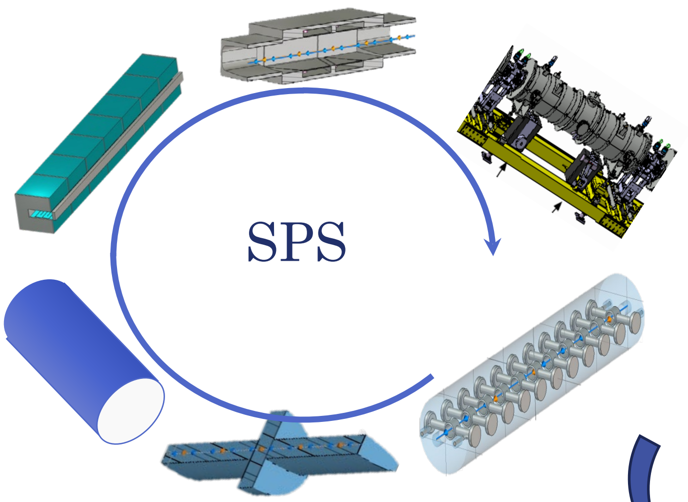
Now started PhD at CERN
in Jul 23' ☺
In collab with UPM, Madrid, Spain

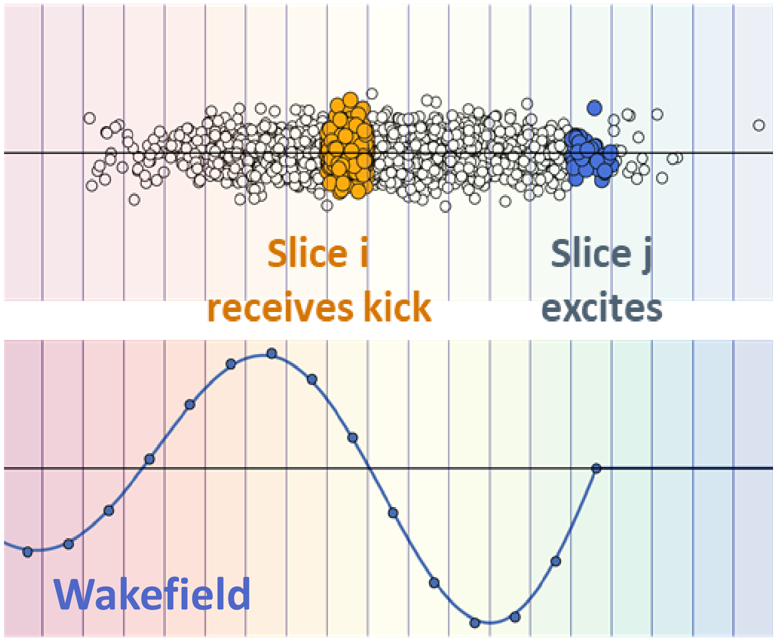
PhD topic: "3D Time domain wake solver for impedance calculations"

Motivation of the studies

We construct the SPS impedance model from simulations and/or bench measurements

We use the impedance model in PyHEADTAIL simulations to predict beam behavior

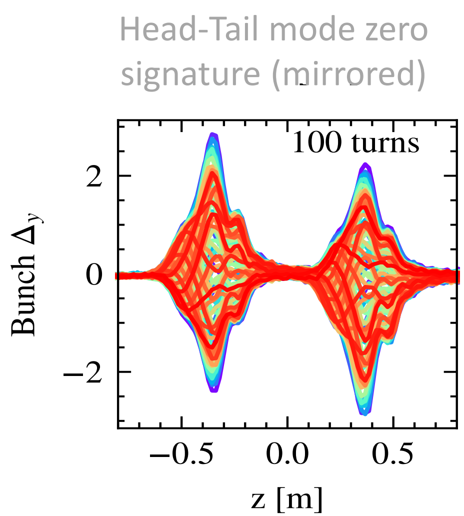


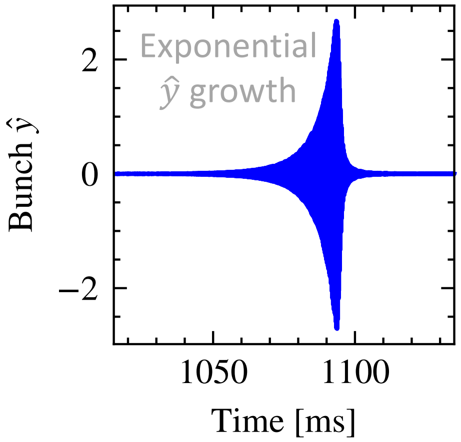


*Images from K. Li and G. Rumolo "Beam Instabilities III", CAS 2022, Sevrier, France [link]

Need to benchmark the model!

Growth rate measurements





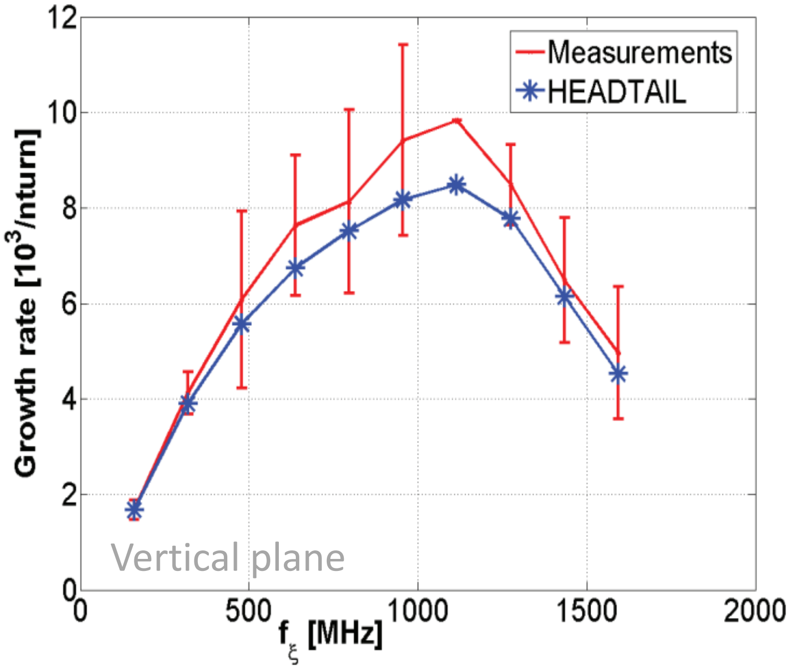
Beam-based measurements benchmark:

Measure Head-Tail mode zero instability growth rate vs chromaticity to benchmark the transverse impedance model

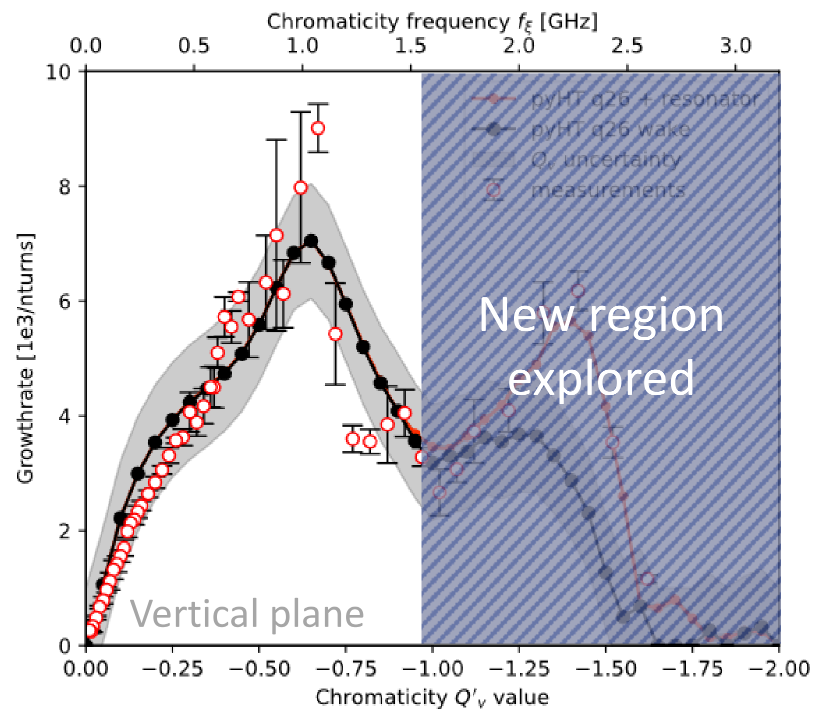
$$\tau^{-1}(\xi) = \Gamma\left(\frac{1}{2}\right)\frac{\mathrm{Re}\left[Z_{\perp,dip}^{eff}(\xi)\right] N r_0 c^2}{8\pi^2 \gamma Q_\perp \sigma_z}$$

Previous findings

2013 measurements*
Pre-LS2



2022 measurements**



Uncertainty of the second peak:

- Lack of chromaticity Q' measurements
  - Scarcity of points

*C. Zannini, MOPJE049, IPAC 15

**E. de la Fuente, WEPL155, IPAC 23

Chromaticity measurements

2023 measurements: Measuring Q’ from Head-Tail phase shift data using 2D Fourier Transform

Chromaticity measurements

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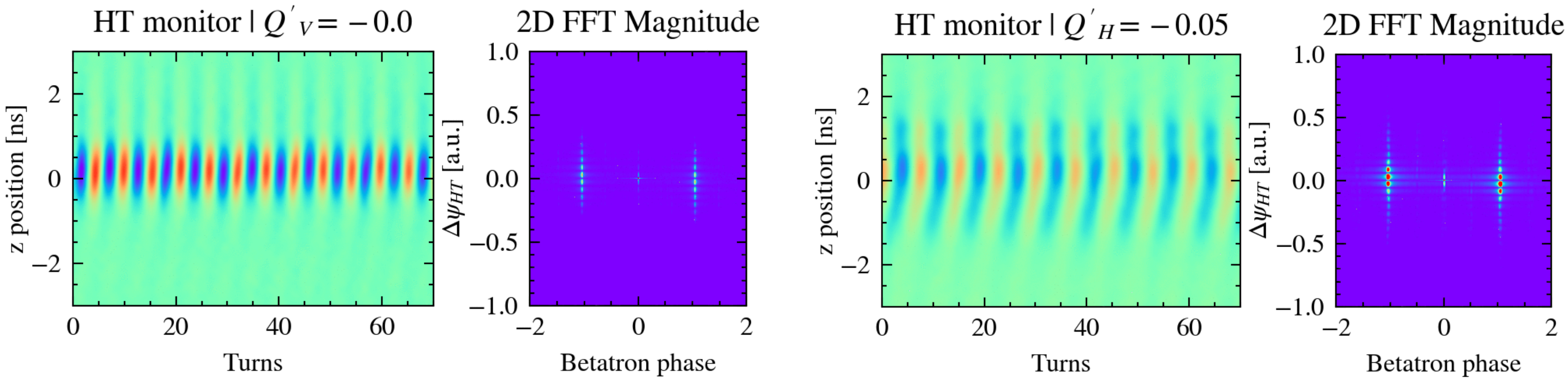
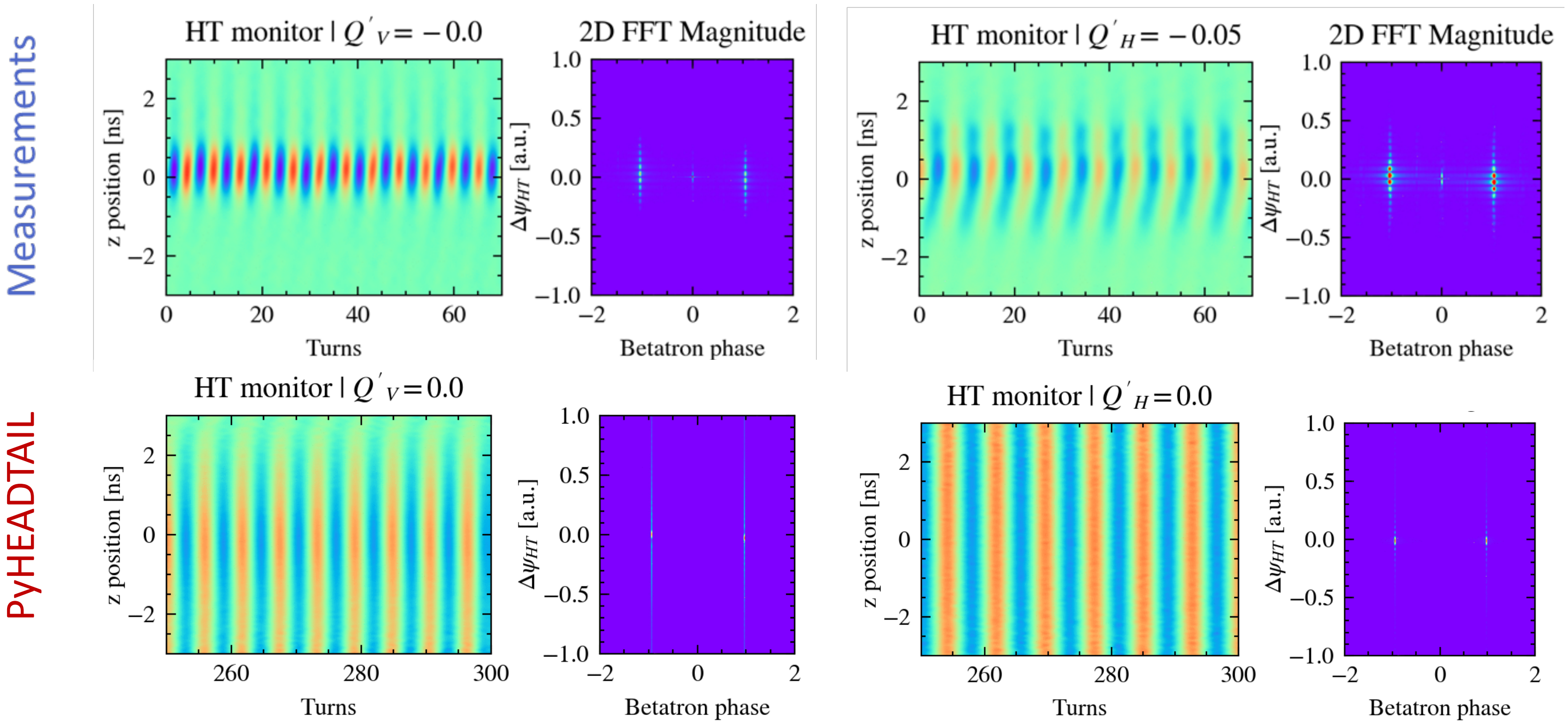
Measurements



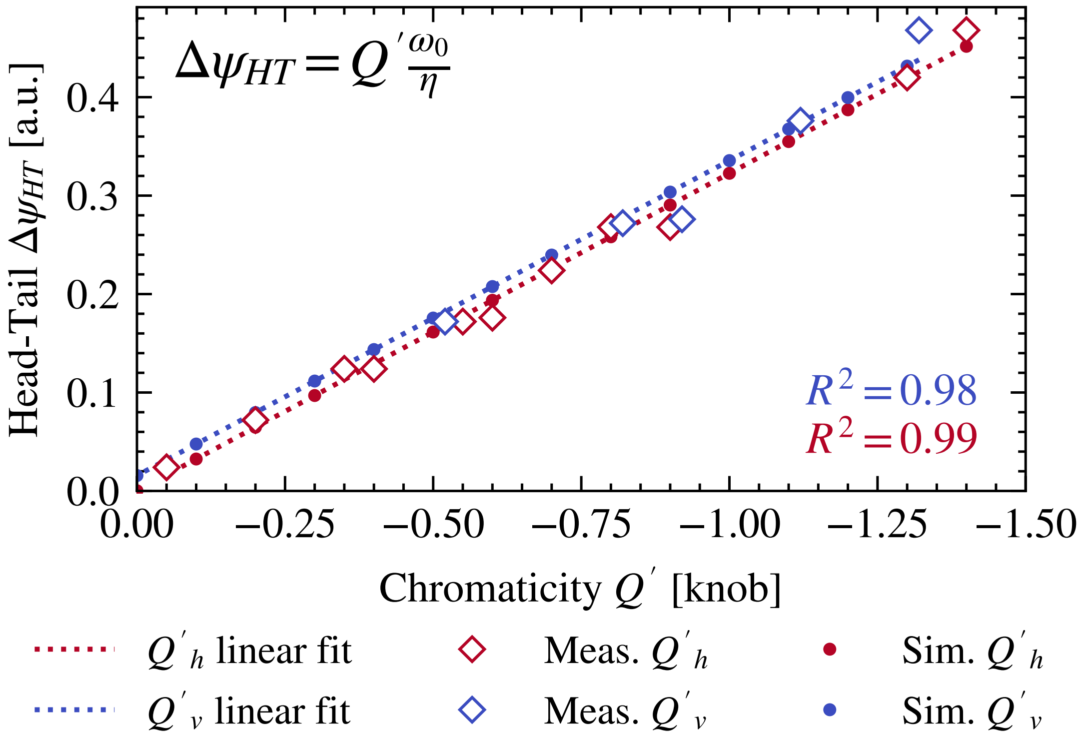
Chromaticity measurements

2023 measurements: Measuring Q' from Head-Tail phase shift data using 2D Fourier Transform



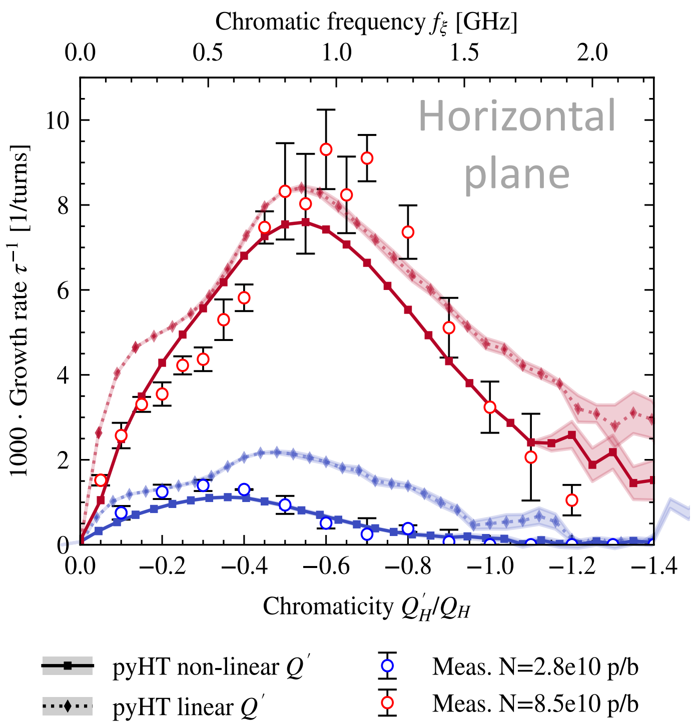
Chromaticity measurements

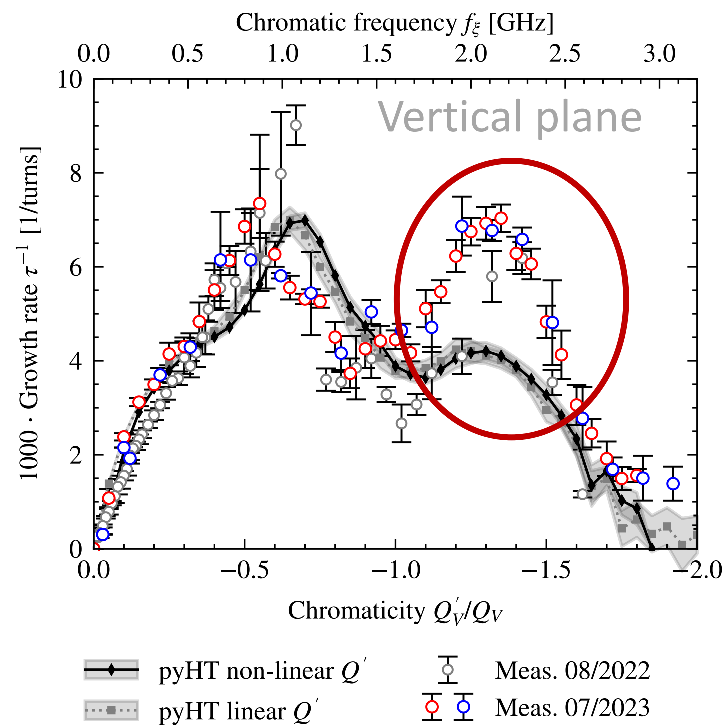
2023 measurements: Linearity of phase shift $\Delta\psi_{HT}$ with Q' probed



Key results

2023 measurements





Future work aims to clarify the origin of this impedance contribution

Thank you

& see you at the poster session ☺ !!!

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