



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

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

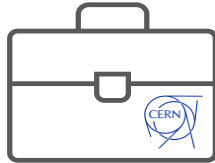
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Elena de la Fuente García, Ingrid Mases Sole, Hannes Bartosik, Giovanni Rumolo, Carlo Zannini



# About me

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2 years at CERN with  
graduate program

Now started PhD at CERN  
in Jul 23' 😊

In collab with UPM, Madrid,  
Spain



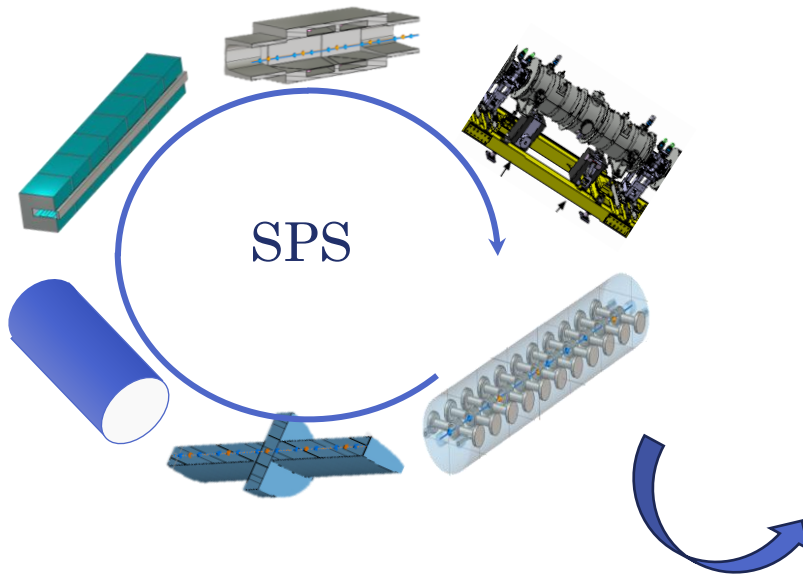
Working at CERN-  
BE-ABP-CEI section

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



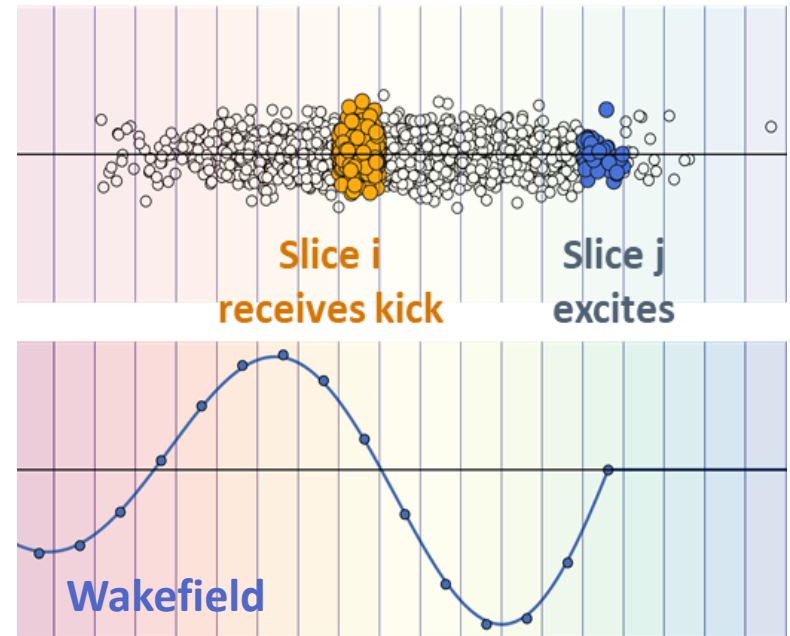
# Motivation of the studies

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



**Need to benchmark the model!**

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

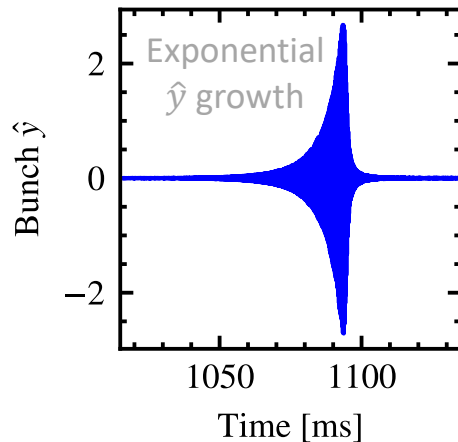
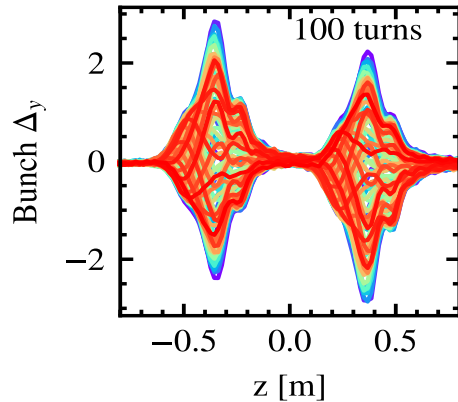


\*Images from K. Li and G. Rumolo "Beam Instabilities III", CAS 2022, Sevrier, France [\[link\]](#)



# Growth rate measurements

Head-Tail mode zero signature (mirrored)



## Beam-based measurements benchmark:

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

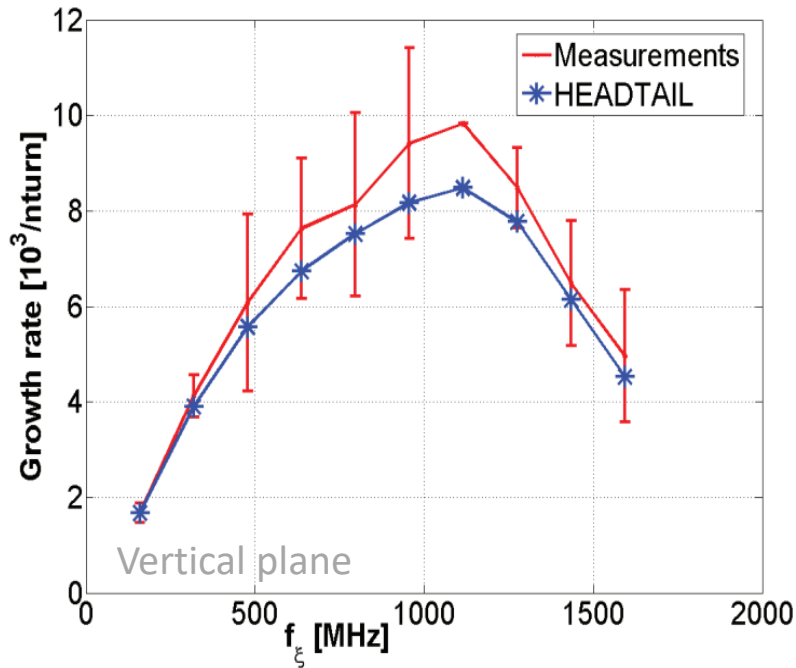
$$\tau^{-1}(\xi) = \Gamma\left(\frac{1}{2}\right) \frac{\text{Re}\left[Z_{\perp,dip}^{eff}(\xi)\right] N r_0 c^2}{8\pi^2 \gamma Q_{\perp} \sigma_z}$$



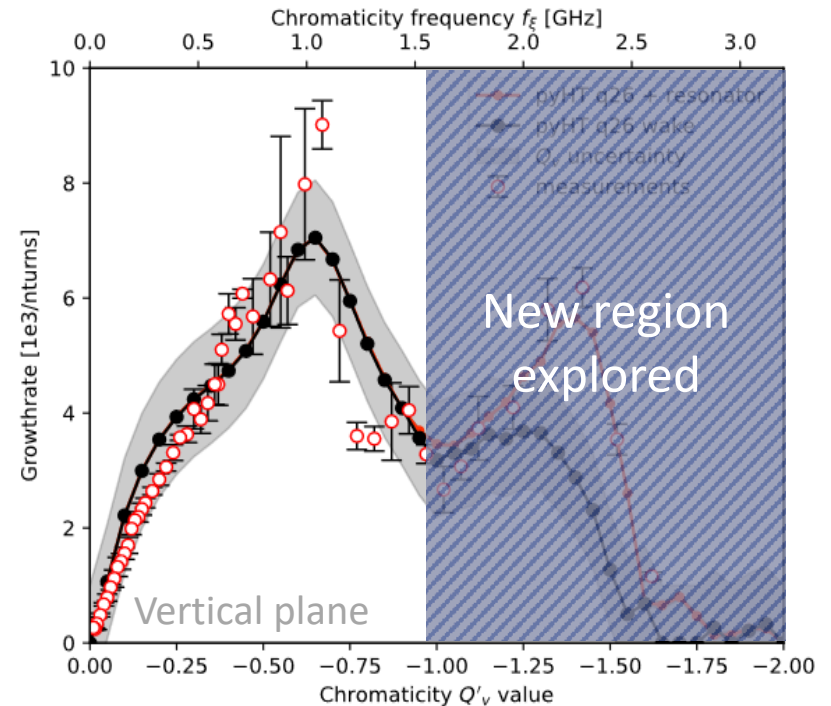
# Previous findings

## 2013 measurements\*

### Pre-LS2



## 2022 measurements\*\*



**Uncertainty** of the second peak:

- Lack of chromaticity  $Q'$  measurements
- Scarcity of points

\*C. Zannini, MOPJE049, IPAC 15

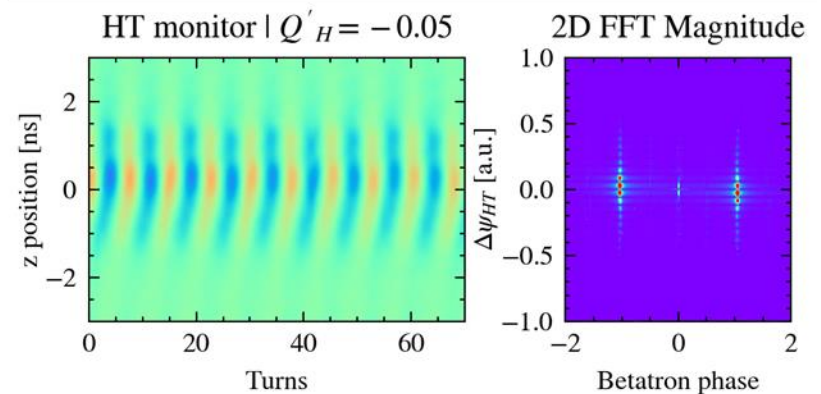
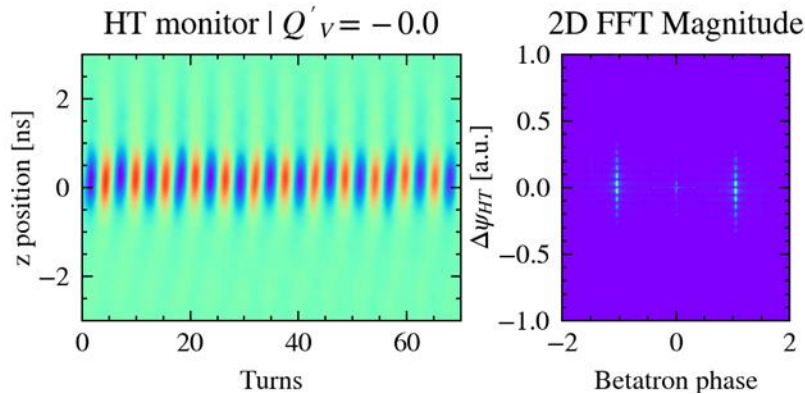
\*\*E. de la Fuente, WEPL155, IPAC 23



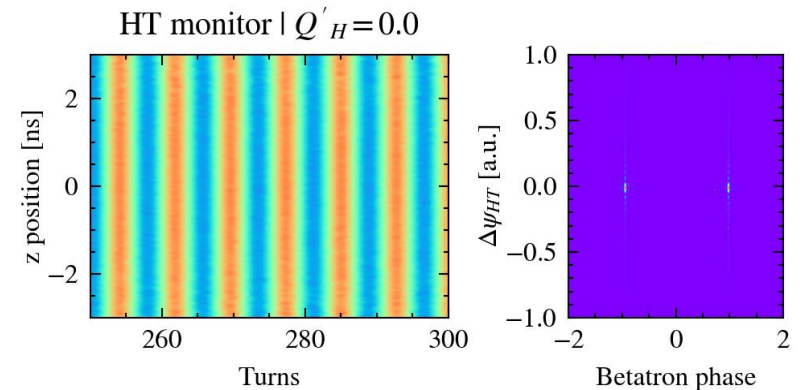
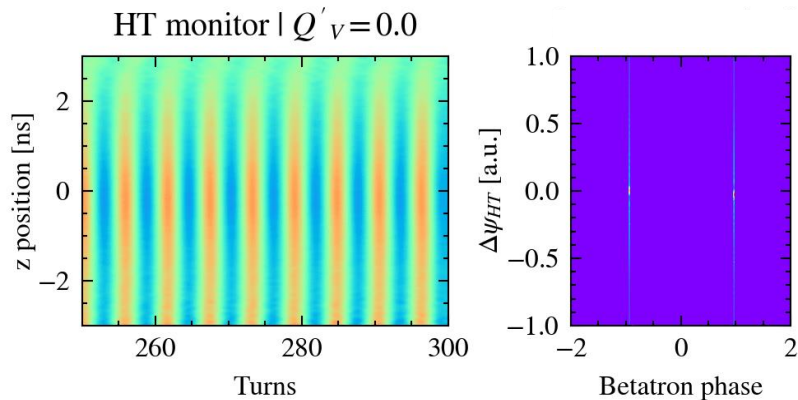
# Chromaticity measurements

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

Measurements



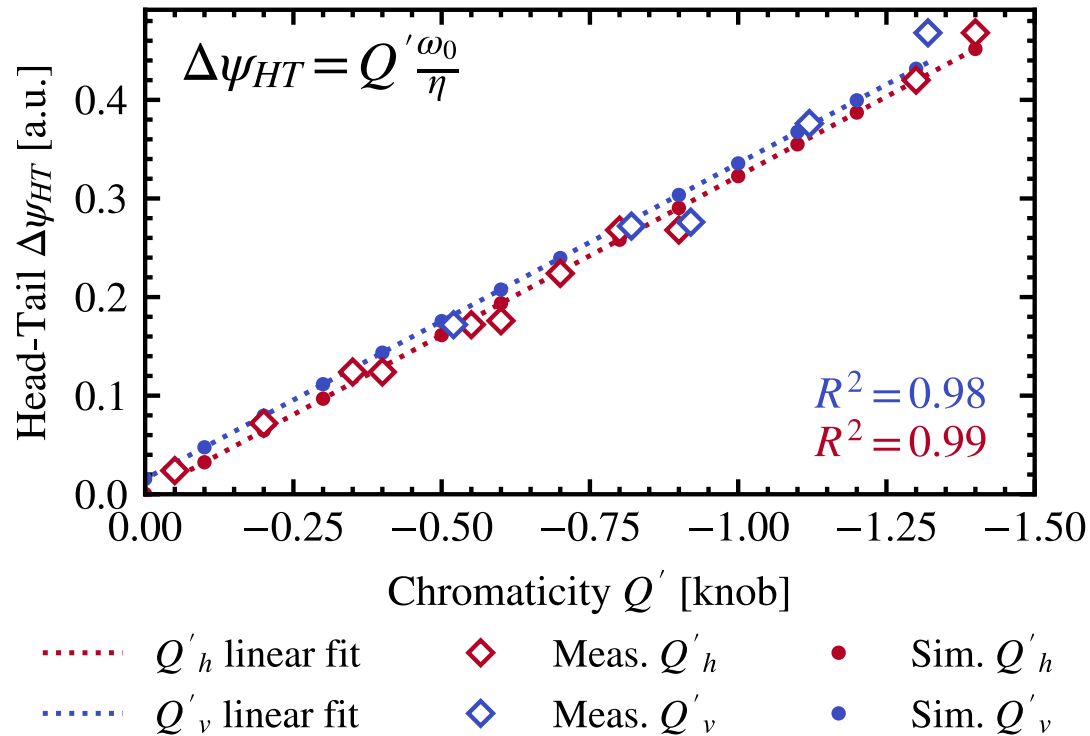
PyHEADTAIL





# Chromaticity measurements

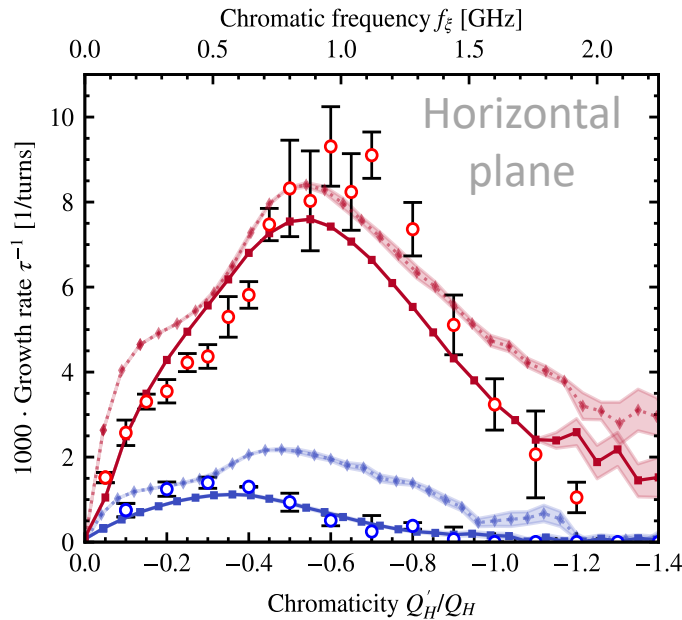
2023 measurements: Linearity of phase shift  $\Delta\psi_{HT}$  with  $Q'$  probed



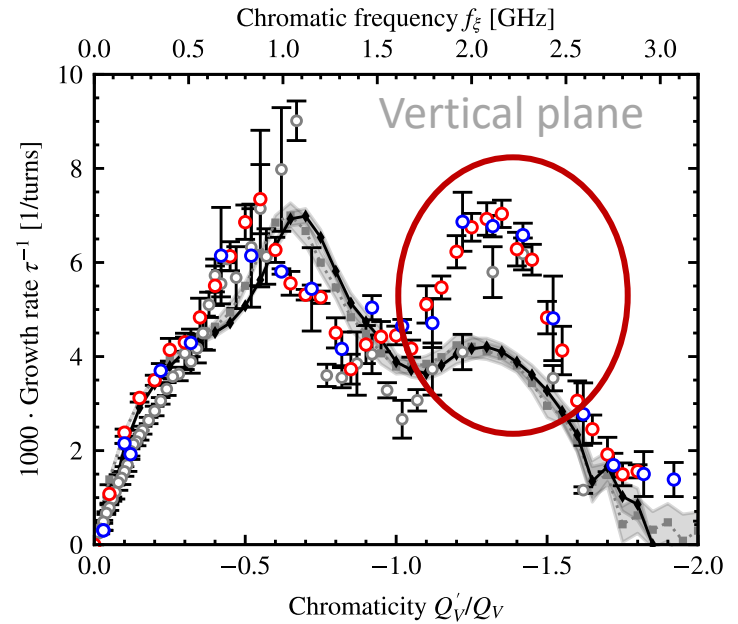


# Key results

## 2023 measurements



—•— pyHT non-linear  $Q'$      $\square$  Meas. N=2.8e10 p/b  
-·-·- pyHT linear  $Q'$      $\circ$  Meas. N=8.5e10 p/b

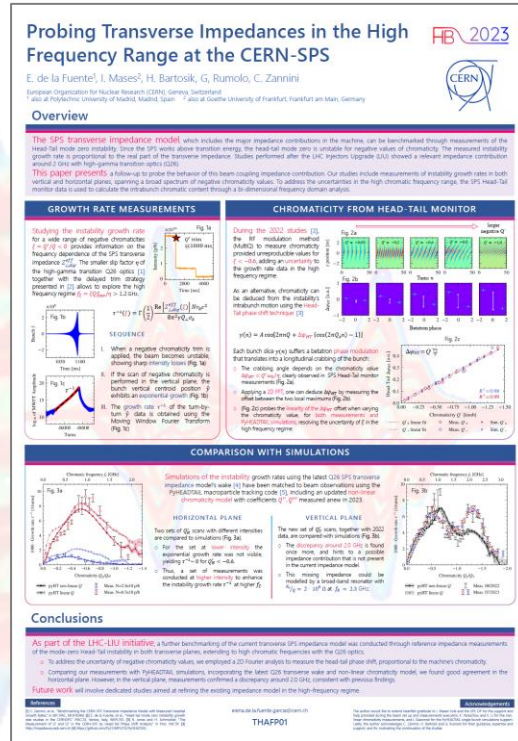


—•— pyHT non-linear  $Q'$      $\square$  Meas. 08/2022  
-·-·- pyHT linear  $Q'$      $\circ$   $\square$  Meas. 07/2023

Future work aims to clarify the origin of this impedance contribution



Thank you  
& see you at the poster session 😊 !!!



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Elena de la Fuente García (BE-ABP-CEI)