Contribution ID: **1532** Contribution code: **WEPS102** Type: **Poster Presentation**

Reconstructing wake functions using Haissinski distributions from multiple bunch charges

Wednesday 4 June 2025 16:00 (2 hours)

Accurate knowledge of wake functions is crucial in accelerator physics, serving as the cornerstone for understanding intra-bunch interactions and for controlling or mitigating instabilities that limit accelerator performance. Haissinski distributions, which describe the steady-state longitudinal bunch density, are intrinsically determined by the wake function experienced by the bunch. While these distributions are typically computed from a given wake function, we investigate the inverse problem: extracting the wake function directly from measured Haissinski distributions.

In this theoretical work, we introduce a novel method to reconstruct wake functions by utilizing Haissinski distributions obtained at multiple bunch charges. By combining these profiles into an overdetermined system, we address challenges posed by the inverse problem, which is sensitive to noise and discretization errors. Here, our preliminary results suggest that the use of regularization techniques may help achieve more stable reconstructions of the wake function.

Footnotes

Paper preparation format

LaTeX

Region represented

Europe

Funding Agency

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Session Classification: Wednesday Poster Session

Track Classification: MC5: Beam Dynamics and EM Fields: MC5.D04 Beam Coupling Impedance Theory, Simulations, Measurements, Code Development