Simulations and measurement results of a radially coupled fast faraday cup with increased signal strength

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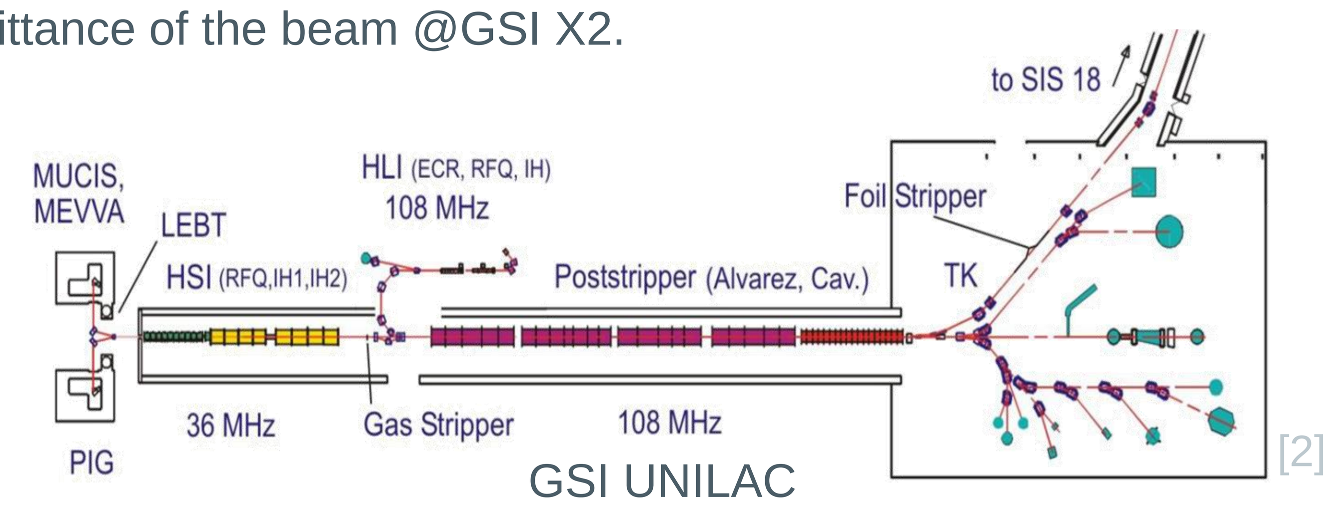
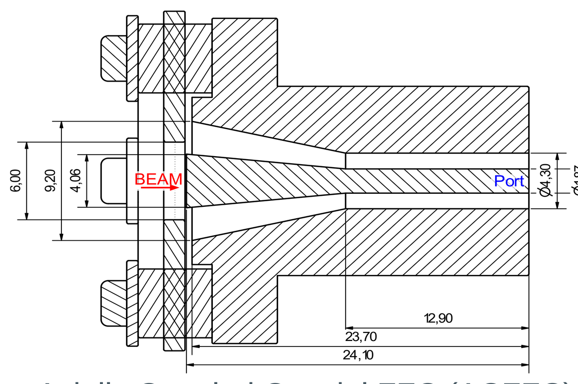
Abstract

Longitudinal bunch shape and mean energy of high-intensity heavy ion beams accelerated at the GSI UNILAC up to 11.4 MeV/u may differ from macro-pulse to macro-pulse and even within a single macro-pulse. Fast Faraday Cups (FFC) are able to measure these changes with high precision. A study on different FFCs has been performed [1] and showed very promising results for a radially coupled FFC (RCFFC). An adapted version of the RCFFC used in the study has been designed to increase the signal strength while still suppressing the secondary electrons as much as possible. We present simulations and measurement results of the FFC study combined with the latest results of the new high-current radially coupled FFC (HC-RCFFC) investigating the bunch shapes and longitudinal emittance of the beam @GSI X2.

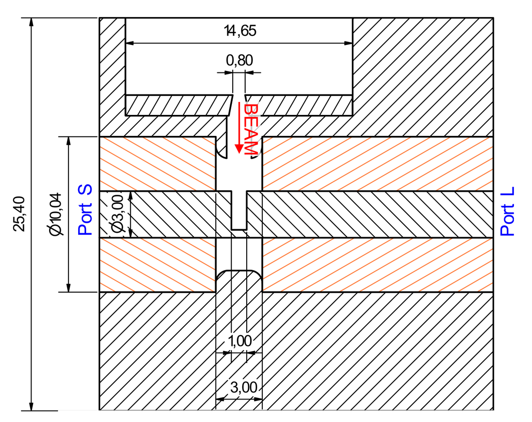


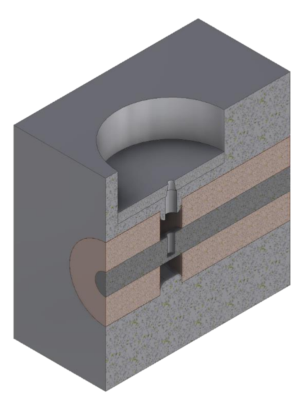
GSI UNILAC

Simulations



Axially Coupled Coaxial FFC (ACFFC)

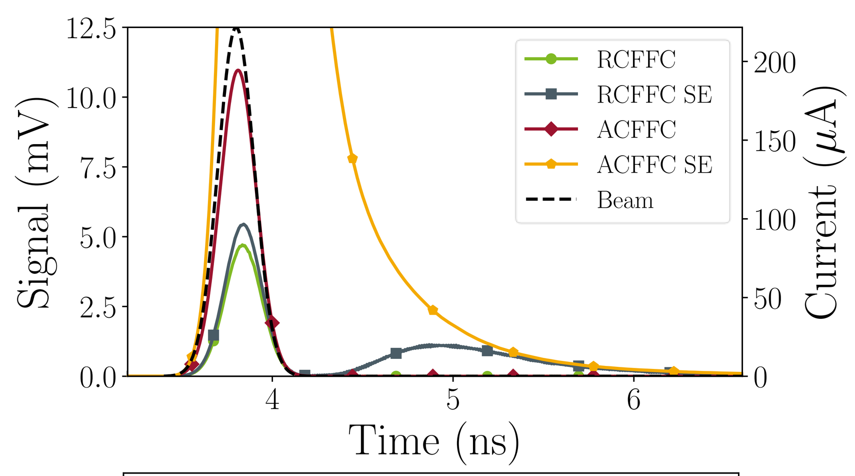


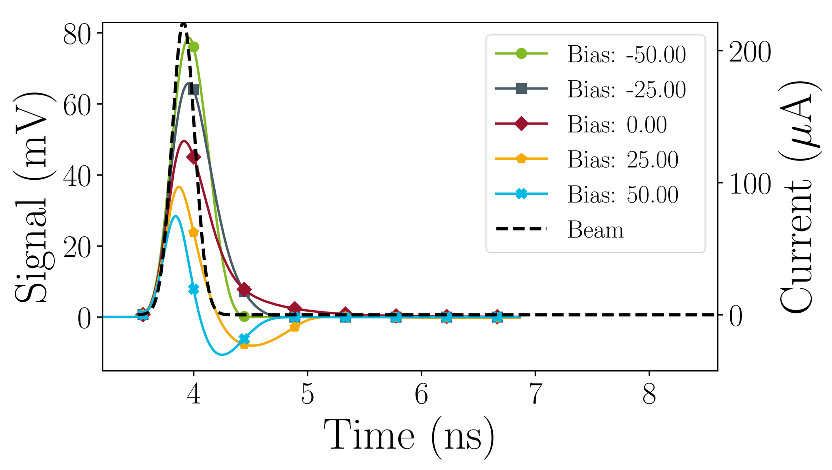


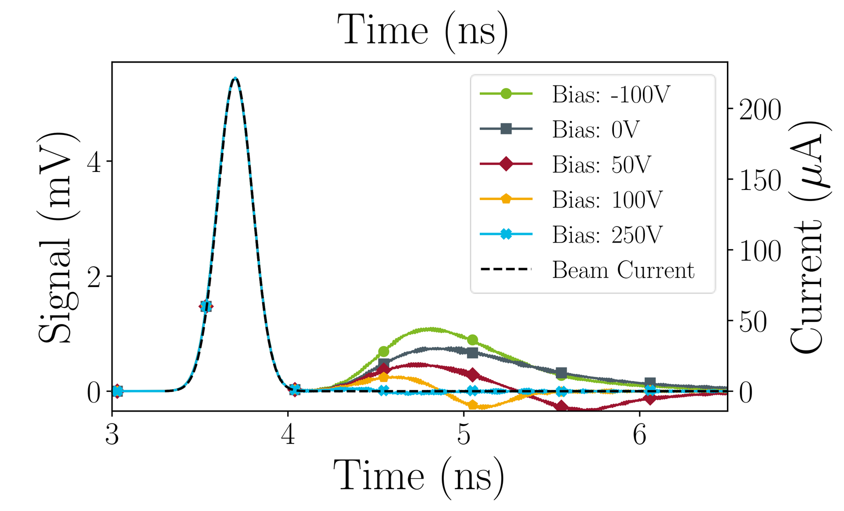
Radially Coupled Coaxial FFC (RCFFC)

Simulation Parameter:

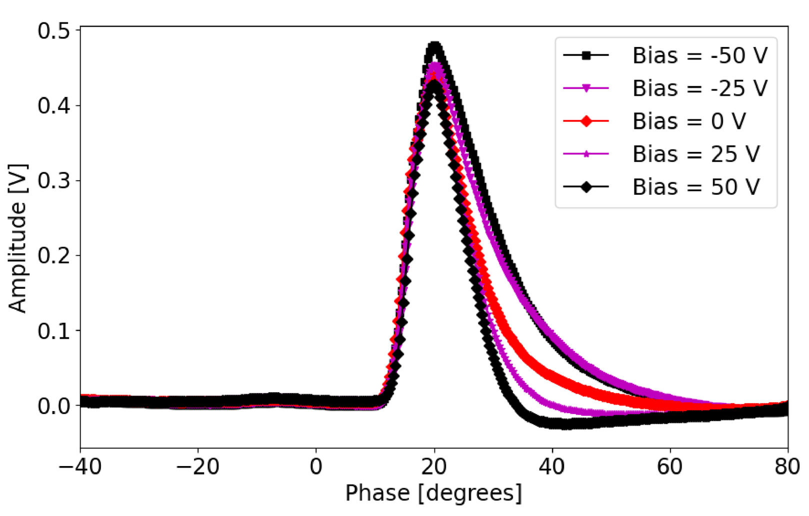
- Ar^{+10}, $N_{ion} = 3.5E4$
- $\sigma_b = 100$ ps, $\beta = 0.15$, $\alpha_{emission} = 0.1^\circ$
- SEE: $50e/ion$, $T_e = 10$eV, no tertiary SE



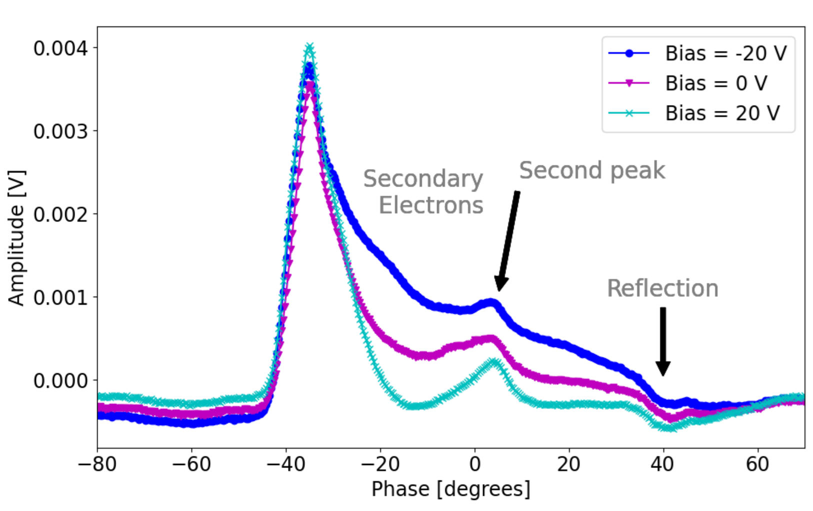




Measurements with ACFFC & RCFFC

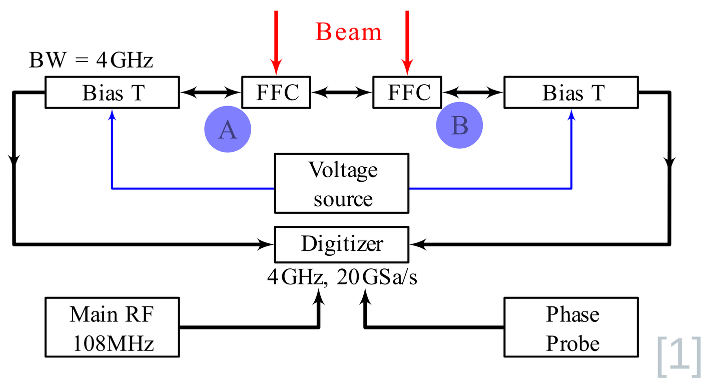


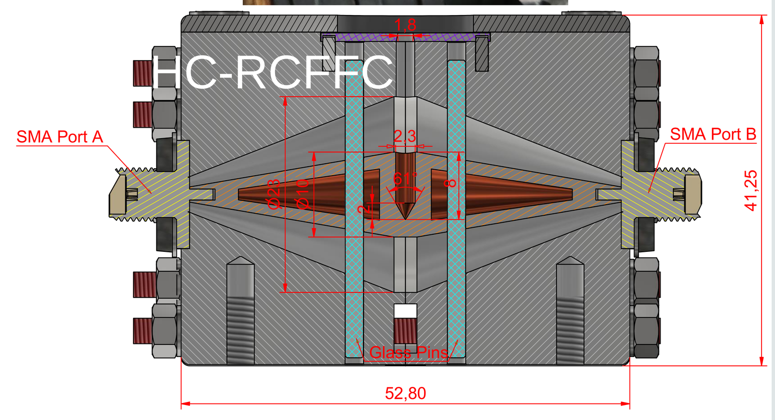
O^{6+}, 8.6 MeV/u, 0.4 mA

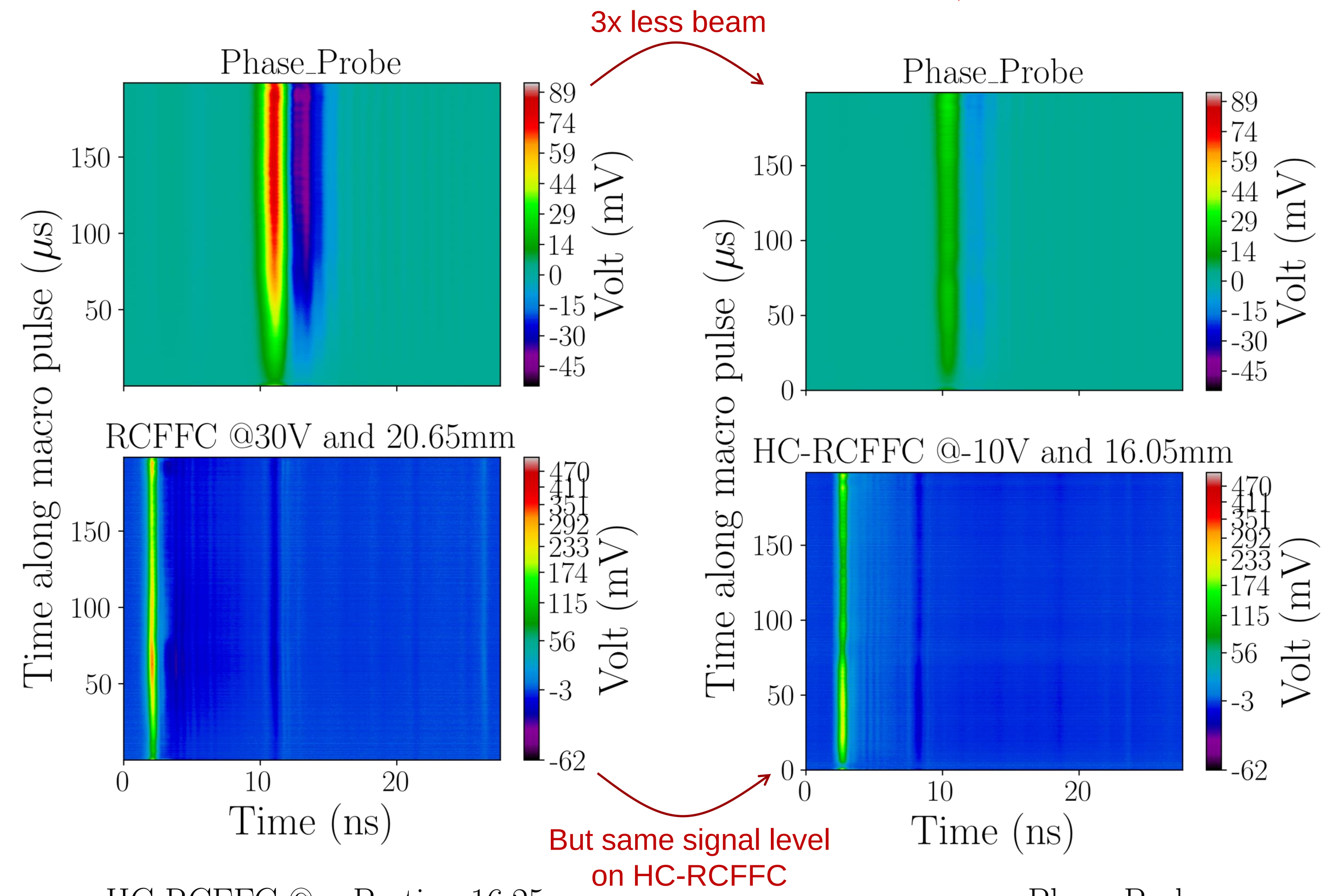


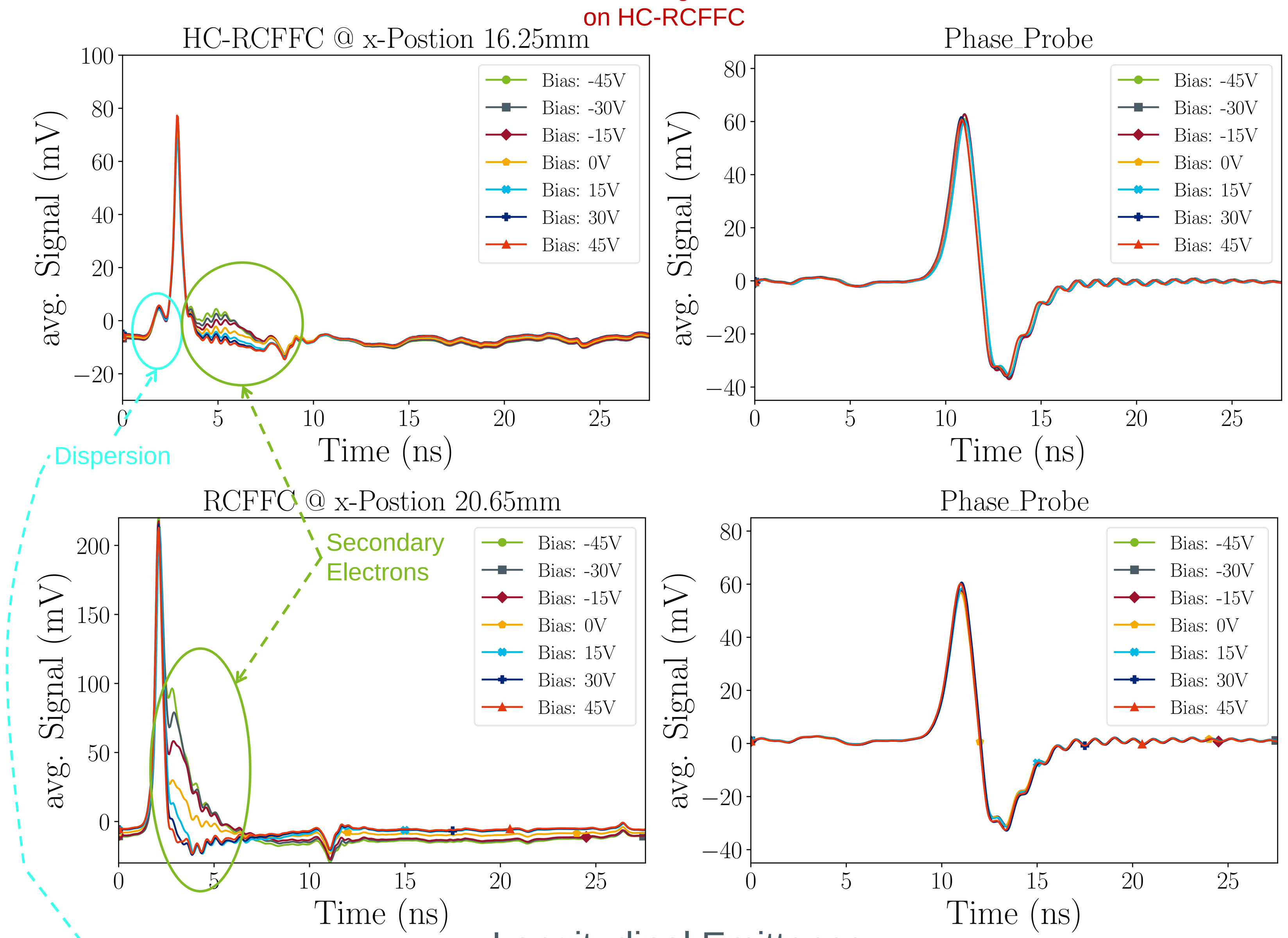
Ar^{10+}, 8.6 MeV/u, 0.4 mA [1]

Experiments with N^{4+} @ 11.4MeV/u

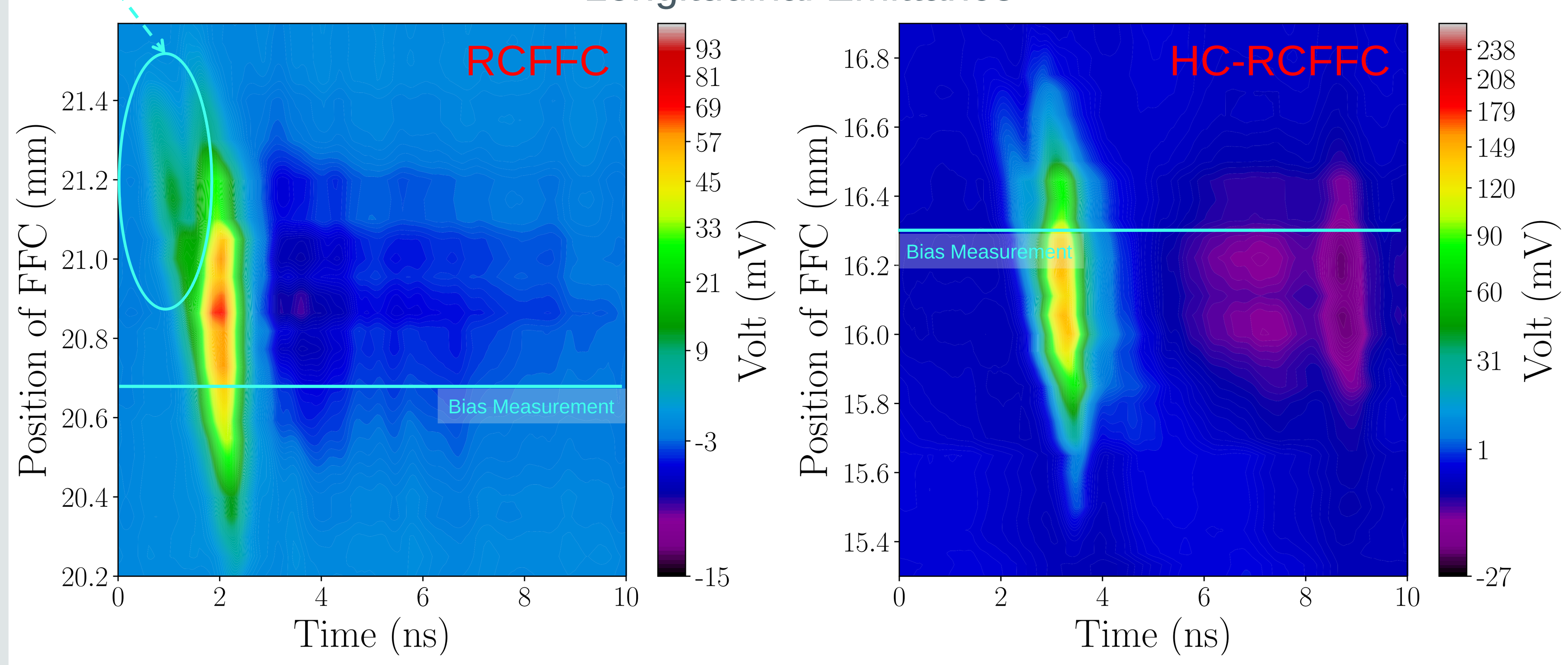








Longitudinal Emittance



Conclusion and Outlook

- RCFFC Designs are less prone to secondaries compared to the ACFFCs
- HCRCFFC can achieve up to 2x the signal strength of the Fermilab-Design
- HCRCFFC supresses the secondary electrons geometrically significantly stronger.
- Longitudinal emittance scans are easily done with RCFFC Designs

References

[1] R. Singh, P. Forck, S. Klaproth, T. Reichert, A. Reiter, and G. O. Rodrigues, “Simulation and Measurements of the Fast Faraday Cups at GSI UNILAC”, in Proc. IBIC’22, Kraków, Poland, Sep. 2022, pp. 286–290. doi:10.18429/JACoW-IBIC2022-TUP
[2] W. Barth et al., High brilliance beam investigations at Universal linear accelerator, PRAB 25, 04101 (2022) UNILAC

Session 2

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