

# Intrabeam Scattering Studies in FELs with RF-Track

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# Introduction



**Intrabeam Scattering (IBS) → Important source of Slice Energy Spread (SES) growth in FELs, high brightness injectors and linacs, affecting their performance.**

Investigated across multiple facilities: SwissFEL, European XFEL, FERMI, DESY Zeuthen (PITZ), SHINE.

## **Novel IBS MonteCarlo model**

- Implemented in RF-Track [1].
- Benchmarked with FEL simulations [2].
- Already applied to FEL studies [3].
- Not relying on Gaussian assumptions.

## **RF-Track – Tracking code**

**Optimized for FEL simulations and high- brightness linacs.**

- Photocathode emission.
- Space Charge.
- Intrabeam Scattering.
- Wakefields.
- Beam loading.
- Coherent Synchrotron Radiation 1D.



[1] P. Desiré, A. Gerbershagen, A. Latina, “Intrabeam scattering simulation with a novel hybrid-kinetic Monte Carlo method,” LINAC’24 (2024)

[2] P. Desiré, A. Latina, S. Di Mitri, A. Gerbershagen, “Benchmarking Intrabeam Scattering with RF-Track,” J. Phys.: Conf. Ser. (2025).

[3] W. C. Cheng, D. Gu, M. Zhang, H. X. Deng, “Analysis of Slice Energy Spread Increased by Intra-Beam Scattering at the SHINE Injector and Linac” IPAC’26 (2026)

# SwissFEL Injector / Benchmark

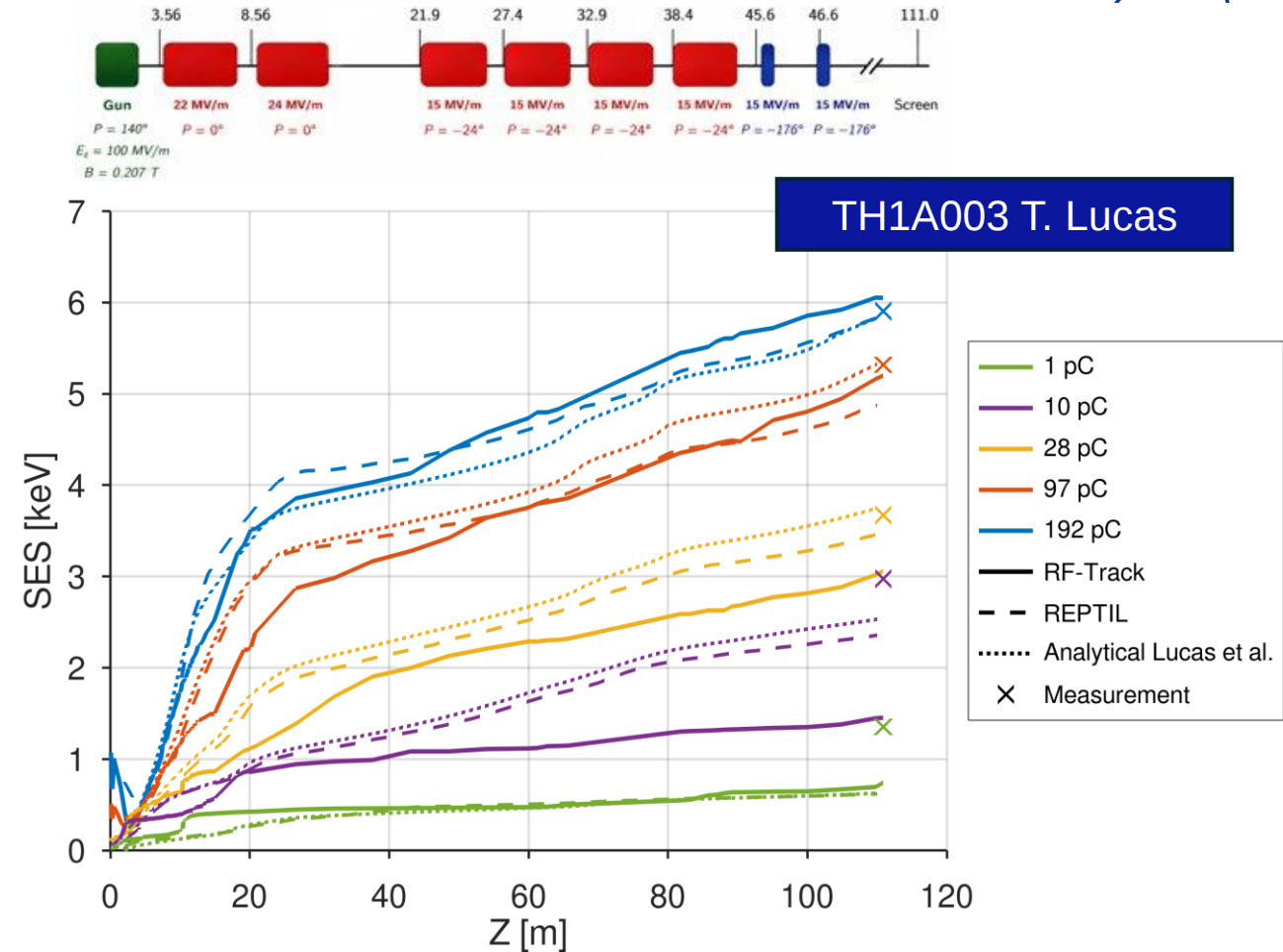
## Effect of IBS and SC RF-Track vs simulations, measurements [4]

**High charges: Excellent agreement.**  
Validation of IBS implementation.

**Lower charges: Largest differences.**  
Smaller IBS effect. Reference predictions also deviate more from the measurements.

Possible discrepancies:

- Differences in SES calculation methods
- Transv. emitt. - 10% different in 192 pC case.

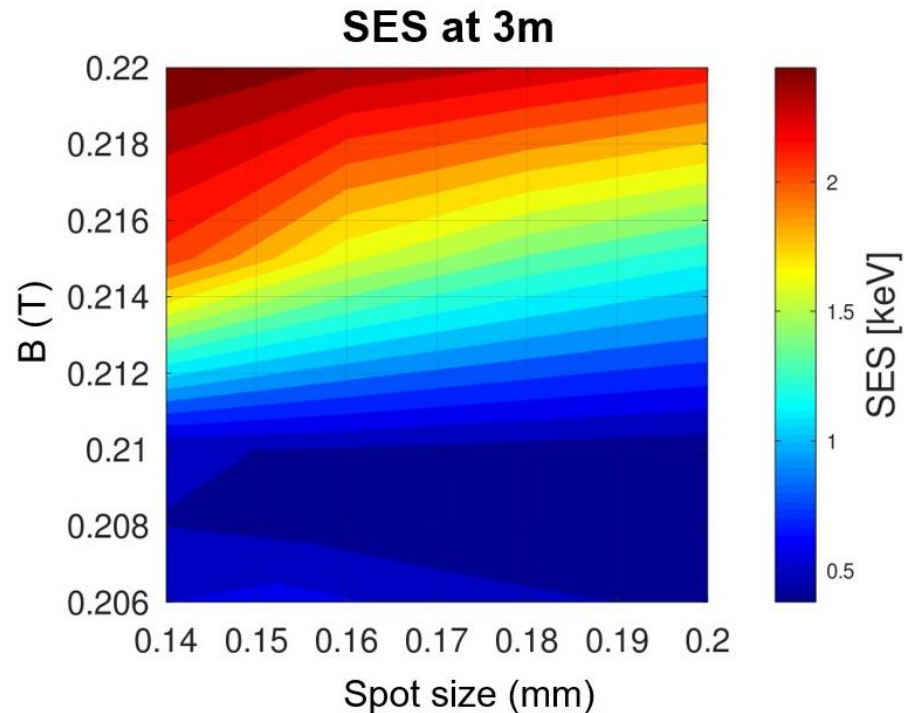


[4] T. G. Lucas et al., "Accurate modelling of intrabeam scattering" Sci. Rep. (2026).

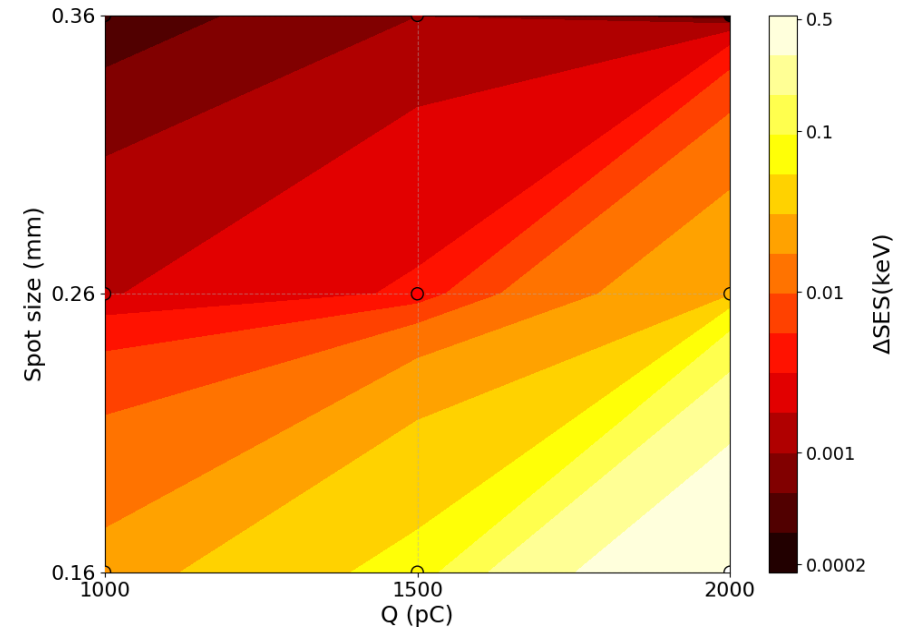
# Other Studies – Towards Optimization



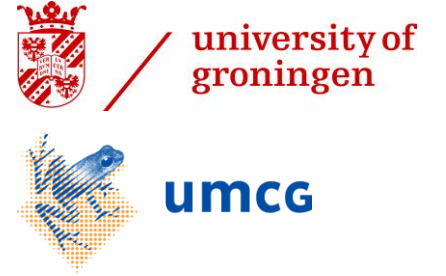
## SwissFEL gun – Parameter Sensitivity



## FERMI photogun: IBS effect at 0.6m



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# Thank you for your time

*See you at the poster!*  
*TUPO005 - MC2.A04: FELs*