

# The Impact of Microbunching on the **Synchrotron Radiation Spectrum at bERLinPro**

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### Motivation

• bERLinPro is a high current energy recovery linac prototype [1] being built at Helmholtz-Zentrum Berlin



a)



b)



## Helmholtz **Zentrum Berlin UberlinPro**

### **Simulation Parameters**

Several bunches are tracked through a dipole magnet of the bERLinPro recirculator section.

beam parameters	
energy	50 MeV
tracked particles	200000
charge (standard bunches)	77 pC
charge (short bunches)	7.7 pC
dipole parameters	

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bending radius	0.765 m
bend angle	$45^{\circ}$
length	0.585 m





• phase space and bunch form factor of a) nominal bERLinPro bunch and lattice b), c) nominal bunch with FODO section d), e) academic short bunches f) bunch form factor of e)

## **Gaussian Beams**

• Gaussian beams were simulated to test the merit of WAVE spectrum calculations









• left to right: single particle, Gaussian beam with 1000 particles and 40 points of spectral resolution, same beam with 400 points of spectral resolution • 1000 particles are not sufficient to reproduce the smooth single particle curve

### **bERLinPro Beams**



- dipole radiation spectra of a) nominal bERLinPro bunch and lattice b) nominal bunch with FODO section c), d) academic short bunches
- a) and b) have a bunch charge of 77 pC, c) and d) of 7.7 pC
- comparing a) and b) shows the effect of microbunching driven by the FODO section
- at low energies b) shows an increase in brilliance where the bunching form factor approaches 2%
- the longitudinal dispersion  $R_{56}$  of the dipole quickly smothes out microbunching, thus suppressing its effect on the radiation spectrum
- bunches c) and d) are much shorter so that the bunch length approaches the wavelength of the low energy end of the spectrum
- coherent synchrotron radiation (CSR) can be observed in d) starting at a photon energy of 0.2 eV

## Summary and Outlook

- microbunching driving FODO-structure has no negative impact on bERLinPro operation in either bunch mode
- [2] shows that a small chicane in front of the dipole can further drive the microbunching
- a planned master's thesis will investigate the benefits of microbunching for a light source based on Compton backscattering

### Acknowledgement

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### **Related references**

- [1] M. Abo-Bakr et al., "Conceptual Design Report BERLinPro", Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany, 2012.
- [2] S. D. Rädel, "On space charge driven microbunching instability in bERLinPro", Humboldt-Universität zu Berlin, Mathematisch-Naturwissenschaftliche Fakultät, 2017, DOI: 10.18452/ 17714
- M. Scheer, "WAVE A Computer Code for the Tracking of Electrons through Magnetic Fields and the Calculation of Spontaneous Synchrotron Radiation", Proceedings of ICAP2012, Rostock-Warnemünde, Germany