GINGER Simulations of Sequential HXR -> SXR Layout

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LCLS II PHYSICS MEETING

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Approach to Simulation of HXR // SXR Simultaneous Operation

- Time-steady (monochromatic runs) & SASE runs with GINGER code; e-beam: 3 kA, 12 GeV, 0.6 mm-mrad
- Geometry is HXR undulator #1: 29-mm period, 84 m of active undulator + breaks -> 103 m (4.15-m module length)
- Following HXR undulator is a strong chicane (0.5 mm); e-beam longitudinal phase space “requietized”; shot noise added for SASE runs; time-steady runs use equiv. shot noise input of 10 kW
- SXR undulator: 60-mm period; 74-m total length; module = 3.42 m of undulator magnets + 0.73-m break
- External beta function is 15-m in both undulators (applied by artificial harmonic “ion focusing”)
- “Fresh Bunch” Geloni et al. scheme (e-beam delayed by 0.5 bunch length by a chicane at HXR undulator midpoint) also modeled
Time-Steady 8 keV HXR + 800 eV SXR Sim. Results

- **HXR 8-keV**
  - 20 GW
  - Radiation Power vs. Z
  - Harmonic Bunching vs. Z
  - Rms Sigma-E vs. Z

- **SXR 800 eV**
  - 100 GW
  - Radiation Power vs. Z
  - Harmonic Bunching vs. Z
  - Rms Sigma-E vs. Z
*SASE* 8 keV HXR + 800 eV SXR Sim. Results
“Fresh bunch” scheme suggested by Geloni et al.; use delay chicane in HXR undulator to keep energy spread growth small in e-beam tail
*SASE* 8 keV HXR with delay chicane at 44m

Bunch Head

100 GW

Avg. Radiation Power vs. Z

Avg. Fundamental Bunching vs. Z

Avg. Sigma E vs. Z

Bunch Tail

10 GW

Avg. Radiation Power vs. Z

Avg. Fundamental Bunching vs. Z

Avg. Sigma E vs. Z
**SASE** SXR: tail region following HXR with delay chicane at

- 800 eV
- 2 KeV
Summary

- Time-steady runs agree with H-D Nuhn’s analysis for sequential HXR -> SXR approach with single bunch
- SASE runs are much more pessimistic due to continuing growth of sigma_E beyond initial saturation
  (SASE == “the gift that keeps on giving...”)
- HXR deep saturation desire in conflict with desire for high power, deep saturation at keV SXR energies
- “Fresh bunch” scheme may alleviate dilemma; space requirements small compared to total hall length