HW-1

- Some answers for Pb. 4 "Understanding figures of merit for beamlines."

The overall performance, which considers the signal-to-noise ratio of the experiments within the "resolution window" set by the optical setup of the beamline should be the brilliance OR brightness in 6D.

However, usually tranverse phase space may be decoupled from the longitudinal one, so may consider 4D Brightness (B_{4D}) and longitudinal one separately. Here are what matter in each category of applications:

(i) Diffraction: The spatial resolution is defined by coherent superposition of electron waves. Hence coherence length is most important. SO given the ~~[illegible]~~ brightness, the optimization should be for $L_\perp$ [same given] and may achieve short Δt independently.

(ii) Scanning microscopy: signal obtained from inelastic scattering over focused beam ~~area~~ footprint, rastered along the surface. Hence, the spatial resolution is accomplished by minimizing Δr, despite of increasing $\Delta\alpha$. short at possible within space-charge limit.

(iii) Imaging: in coherent imaging mode, resolution is limited by the contrast ~~of~~ modulation transfer function, which is diffraction-limited. Hence high Coherence length $L_\perp$ is the objective. But avoid the space-charge effect, by bunching moderately.

(iv) Spectroscopy: This mainly involves longitudinal dimension. The optimization is small ΔE while compromising Δt.

(v) For X-FEL generation at undulator sector, coherent electrons with high bunch charges N_e (ΔE, Δt small) are of high importance.