Minutes of RESULTS, PITZ Physics Seminar, 2017-11-09

Project: PITZ
Participants:
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1) Agenda

1. AOB
2. M. Krasilnikov: Beam dynamics simulations for the current setup of the EXFEL Photo injector
3. H. Qian: Emittance improvements of CW photoinjector by ellipsoidal shaping

2) Results:

1. AOB: Please prepare your input for the publication list-2017. Radiation safety teaching for XFEL: check Anne's email. A bERLinPro trip: let's do it between the 6th and the 21st of Dec. The DPG spring meeting deadline is coming: prepare your abstract and send to MK+HQ the beginning of December.
2. MK: The injector parameters are presented. Gun phase is not MMMG (presumably MMMG-6 deg), beam momentum after the gun is unknown, main solenoid current is lower compared to our setup, the VC picture is not nice (see all parameters in the slides). ASTRA tracking down to 14.44 m. Emittance optimization versus the main solenoid current is done: there are two minima and it seems that the experimental optimization was done for the wrong, larger one. The XFEL main solenoid calibration is questionable. The beam transport is not that nice for the wrong minimum (beam is large at the 1st cryomodule entrance). Emittance optimization versus gun phase shown that a better emittance is achievable (down to 0.7 mm mrad). A multidimensional optimization (main solenoid current, laser spot size, gun phase) improves emittance slightly. Going to the proper solenoid value could be problematic at XFEL, as all the quads downstream require new matching. Core+Halo simulations (different models) were done, including fast transition for 3D space charge model after the emission. Summary is presented -> asymmetric input with fast 3D space charge transition delivers worse emittance. This realistic model yields emittance values of 1-1.2 mm mrad. Beam size measurements in the XFEL injector section are needed to confirm the simulations.
3. HQ: ways to improve and preserve quality of extracted beam are discussed, CW and pulsed guns are compared in terms of beam quality factors, CW gun layouts are presented. CW guns have more tuning knobs, so it is not possible to do linear optimization; the possible solution is Multi-objective Genetic Optimization (MOGA): generate a population (a lot of initial parameters) -> selecting the best solutions and crossbreed them (mix initial parameters) ->repeat. The current state of the art of CW injectors performance is presented as well as planned improvements. Two different layouts were simulated by HQ: a NC VHF band gun and a SC L band gun. For the NC VHF gun transition the ellipsoidal laser decreases emittance by 30% compared with the flattop profile (0.1 um rad, 20 A

beam can be achieved), for the SC L gun the improvement is about 10%. A possible reason is the solenoid spherical aberration (depends on the solenoid field profile) – it is especially important for CW guns. CW guns photoemission should be optimized.

Protocol prepared by
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