Relative Timing Jitter Effects on Two-stage Seeded FEL at SHINE

H.X. Yang¹,², K.S. Zhou³, H.X. Deng²*, B. Liu³, D. Wang³
¹Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai 201800, China
²University of Chinese Academy of Sciences, Beijing 100049, China
³Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai 201210, China
*denghaixiao@zjlab.org.cn

ABSTRACT
The synchronization between the ultrashort electron beam and external seed laser is essential for seeded FELs, especially for a multi-stage one. In this paper, we demonstrate a simple method to obtain the correlations between the pulse energy and relative timing jitter for evaluating the corresponding effects. In this method, the sensitivity of the output FEL performance against electron beam properties is demonstrated by scanning the electron beam and seed lasers, and the fitted curve is used to predict the pulse energy in different timing jitter by random sampling. The results indicate that the pulse energy of the first-stage EEHG is more stable than the second-stage HGHG. Meanwhile, the rise of bunch charge from 100 pC to 300 pC can reduce the timing control requirement by a factor of least 3 for the RMS timing jitter in our numerical simulations based on the parameters of Shanghai High-Repetition-Rate XFEL and Extreme Light Facility. The timing jitter study can demonstrate the feasibility of the EEHG-HGHG cascading scheme in different current profiles for generating Fourier transform-limited soft X-ray FEL.

12th International Particle Accelerator Conference
May 24-28, 2021, Foz do Iguazu, Brazil.

TUPAB078