



Performance of European XFEL SASE 3 beamline at high undulator K values

LCLS-II-HE 20-07

7/13/2020

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1 Question: does the FEL performance at high K undulator parameter agree with theory and simulation?

The question that LCLS II HE project wants to answer is whether the FEL performance at high K agrees with theory and simulation. This question was examined during LCLS-II Phase 1 for a 65 mm period undulator and it was concluded that the FEL theory was applicable.

Now there are experiments with SASE3 at European XFEL (EuXFEL) that are very close to what LCLS II HE is planning. We have asked our colleagues at EuXFEL /DESY, FEL physicists E.Schneidmiller, M Yurkov and a member of European XFEL Commissioning Team F. Brinker, whether they are able to say that theory/simulation agrees at certain level with SASE3 experiments.

2 Answer given by EuXFEL / DESY team

The short answer to the question is no. We think the FEL community is not at the position to test deviations from "standard FEL model". We would need to know precise information about electron beam which is a complex object by itself, but we are lacking precise and comprehensive diagnostics. At XFEL, for example, we do not even know the peak current as TDS after last bunch compressor is at the resolution limit. Currently, people are working hard to improve it and hopefully this will happen soon.

On the other hand, I do not see any reason to doubt the standard FEL theory at large K. SASE3 works very well, in general. There are some issues with misalignment of experiments w.r.t. undulator axis, but when we tune SASE being on-axis, we get good results like 10 mJ or 5th harmonic lasing [1]. The typical performance recorded during user runs is presented in in Figure 1 below (F. Brinker private information).

SASE 3 performance during user runs

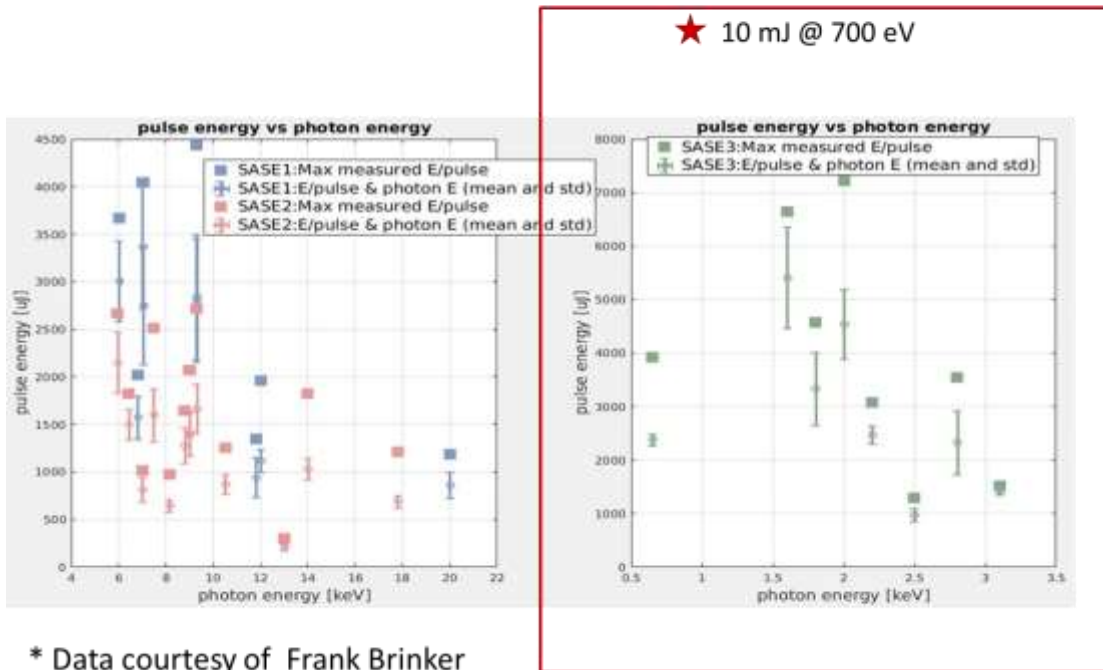


Figure 1 Sase 3 perfomance duringf user runs 2019/2020

References:

1. HARMONIC LASING OF THE EUROPEAN XFEL IN THE ANGSTROM REGIME, E.A. Schneidmiller*, F. Brinker, et. al., 10th Int. Particle Accelerator Conf. IPAC2019, Melbourne, Australia, JACoW Publishing ISBN: 978-3-95450-208-0 doi:10.18429/JACoW-IPAC2019-TUPRB025, <http://accelconf.web.cern.ch/ipac2019/papers/tuprb025.pdf>