39th International Free-Electron Laser Conference
FEL19
Hamburg, Germany
26-30 August 2019
Universität Hamburg, Main building

First Lasing of the SXFEL

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Aug. 26th , 2019

SXFEL: Project Scope

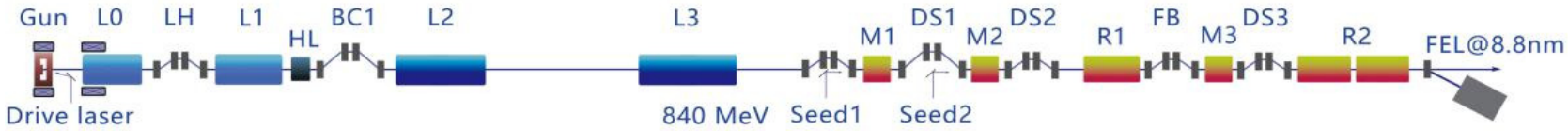
‘phased’ project

- **1. SXFEL Test Facility (SXFEL-TF)**
  - Schedule: 2014.12 - , under commissioning
  - Budget: $35M
  - Design goals: ~300m tunnel, 840 MeV Linac, 8.8nm seeded FEL
  - Source: national funding agency

- **2. SXFEL User Facility (SXFEL-UF)**
  - Schedule: 2016.10 -, under construction
  - Budget: ~$110M
  - Design goals: add 250mx50m FEL and experiment halls, upgrade to 1.5 GeV, 2 FEL lines, 5 end-stations
  - Source: local and national funding agencies

The SXFEL Test Facility in 2016

SXFEL Test Facility



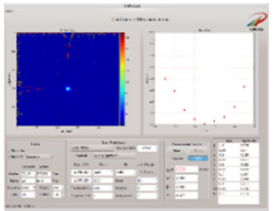
Linac

Bunch charge (nC)	0.5	√
Beam energy (MeV)	840	√
Normalized emittance (mm.mrad, rms)	≤ 2.5	√
Peak current (A)	≥ 500	√

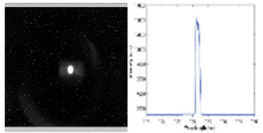
FEL

Radiation wavelength (nm)	< 9	√
FEL Pulse length (fs)	100-200	√
Peak power (MW)	≥ 100	commissioning

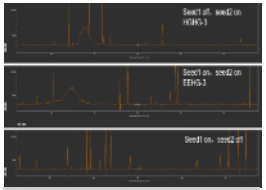
SXFEL-TF commissioning milestones



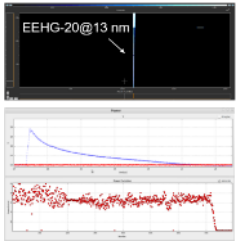
Start commissioning of the injector and main linac during the installation of undulators



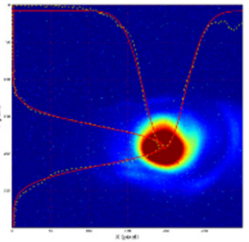
First coherent signal from the 1st stage HGHG



Amplification of the 1st stage EEHG. Pulse energy of the 3rd harmonic radiation exceeds 1 mJ



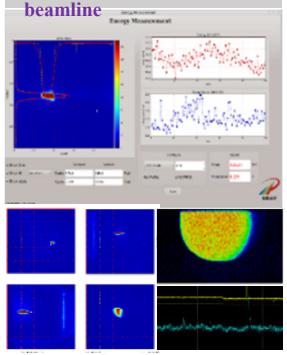
Amplification of EEHG-20



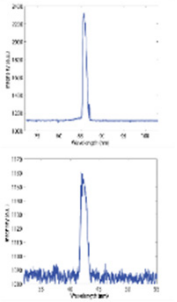
Cascaded HGHG FEL lased at 30th harmonic (8.8nm)

2016 2017 2018 2019

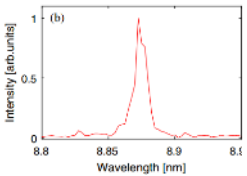
first soft x-ray radiation from the undulator beamline



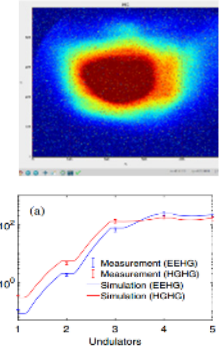
HGHG: 2nd to 6th harmonic



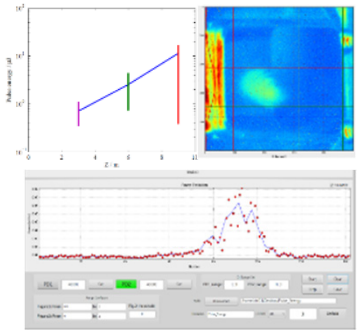
Coherent signal from EEHG-30@8.8nm



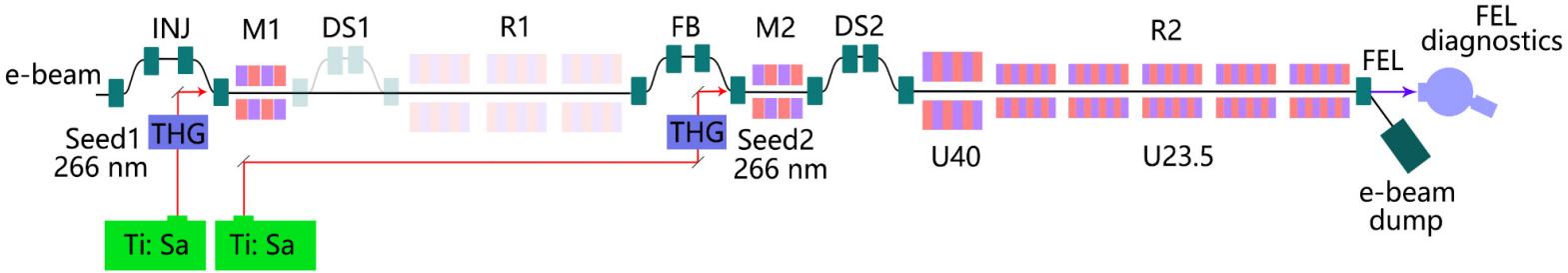
Saturation of HGHG-11 and EEHG-11

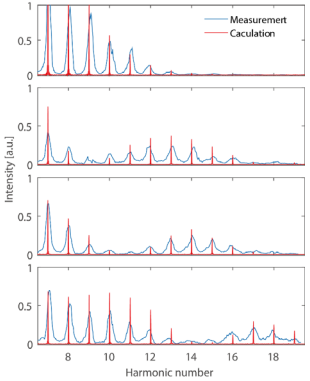


Lasing of the 1st stage HGHG at 6th harmonic and get coherent signal from the 2nd stage HGHG with "fresh bunch"

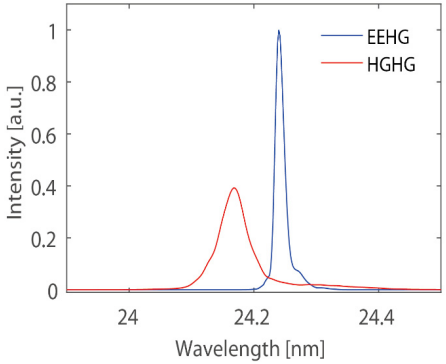


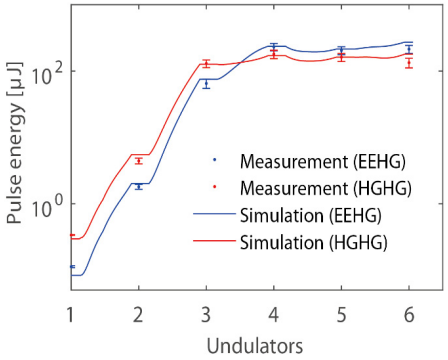
Lasing of EEHG-11@24nm at SXFEL-TF





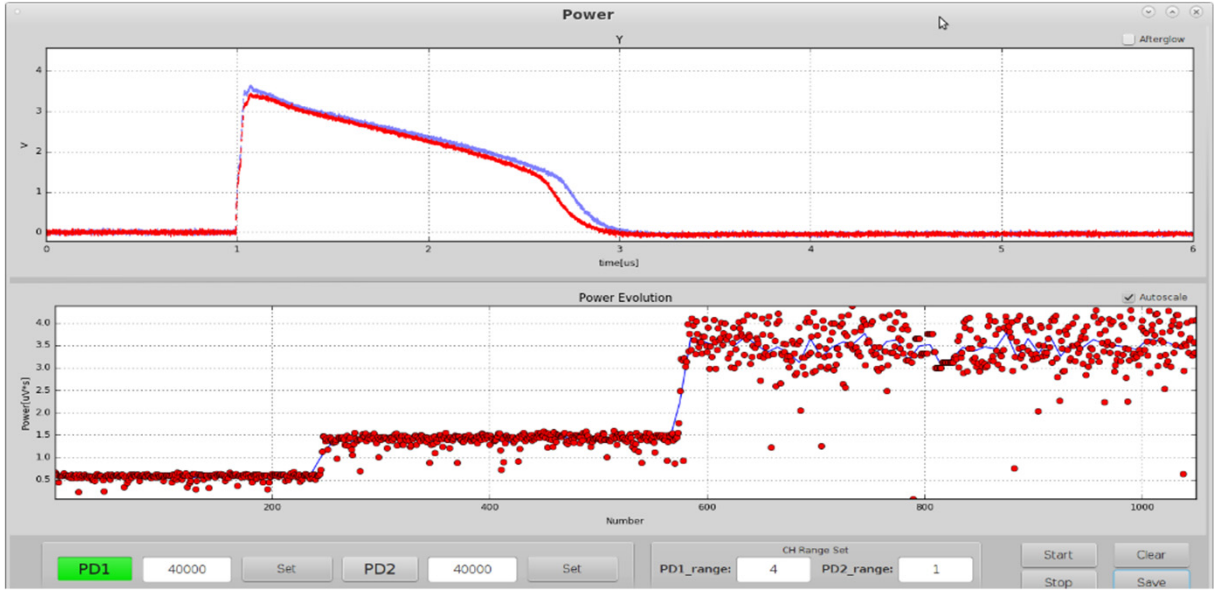
HGHG/EEHG comparison

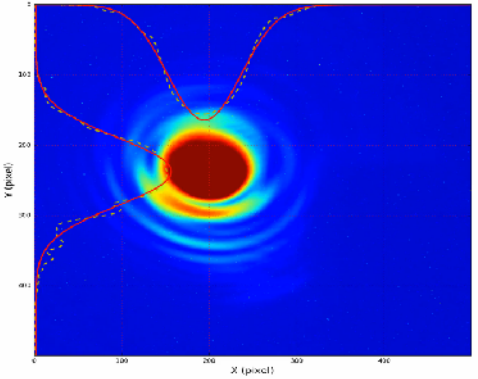


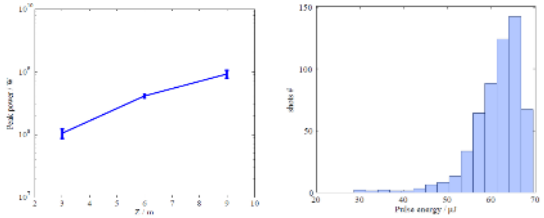


Lasing of EEHG-11@24nm

Amplification of the 1st stage HGHG at 44nm

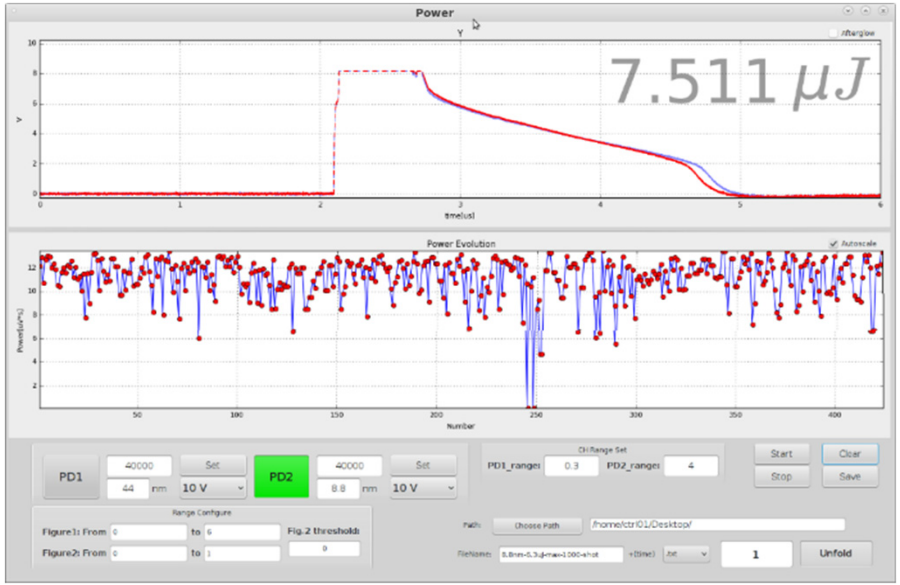


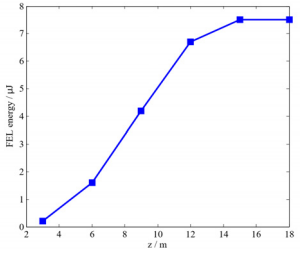


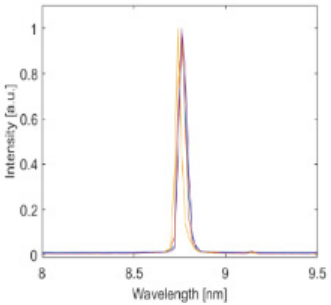


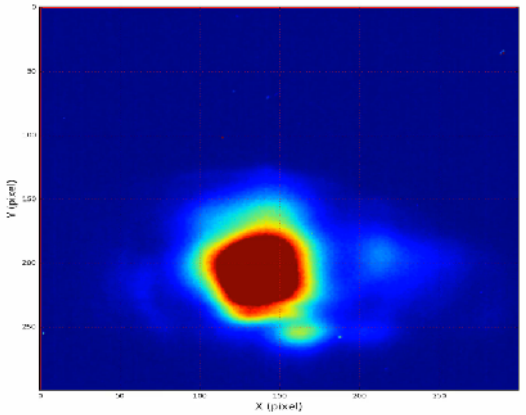
- Three undulators
- Pulse energy >20μJ, Peak power >100MW

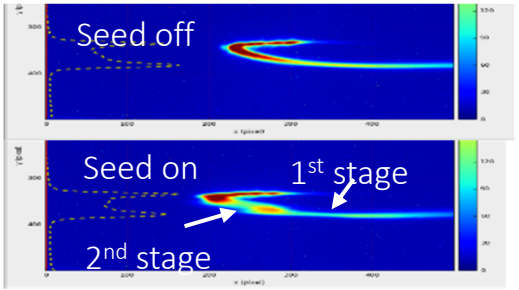
Amplification of the 2nd stage HGHG at 8.8nm









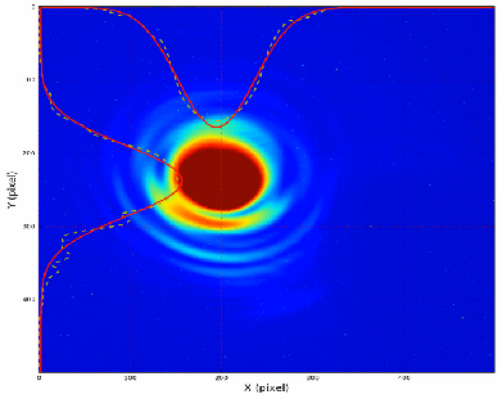


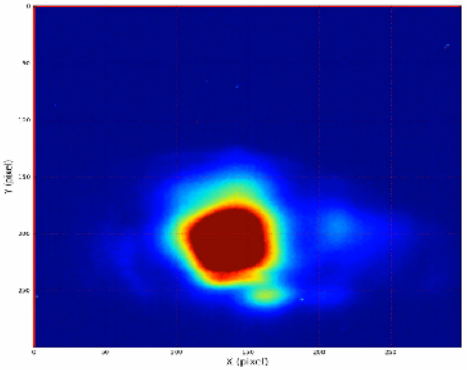
- 8.8 nm FEL successfully amplified, its pulse energy is several μJs, and the peak power is around a few tens of MWs

Summary

- EEHG Lasing @24nm
  - Pulse energy > 100 μJ
  - Peak power > 100 MW
- **First stage FEL (44nm, HGHG)**
  - Pulse energy > 20 μJ
  - Peak power > 100 MW
- **Second stage FEL (8.8nm, HGHG-HGHG)**
  - Pulse energy > 7.5 μJ
  - Peak power > 30 MW

Commissioning is still going on, and the final goal (100MW) is not far …






Thanks for your attention!