

# HXRSS Update for March 2021

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on behalf of the HXRSS commissioning team

FEL R&D meeting  
Hamburg, 24.03.21



**HELMHOLTZ**  
RESEARCH FOR GRAND CHALLENGES

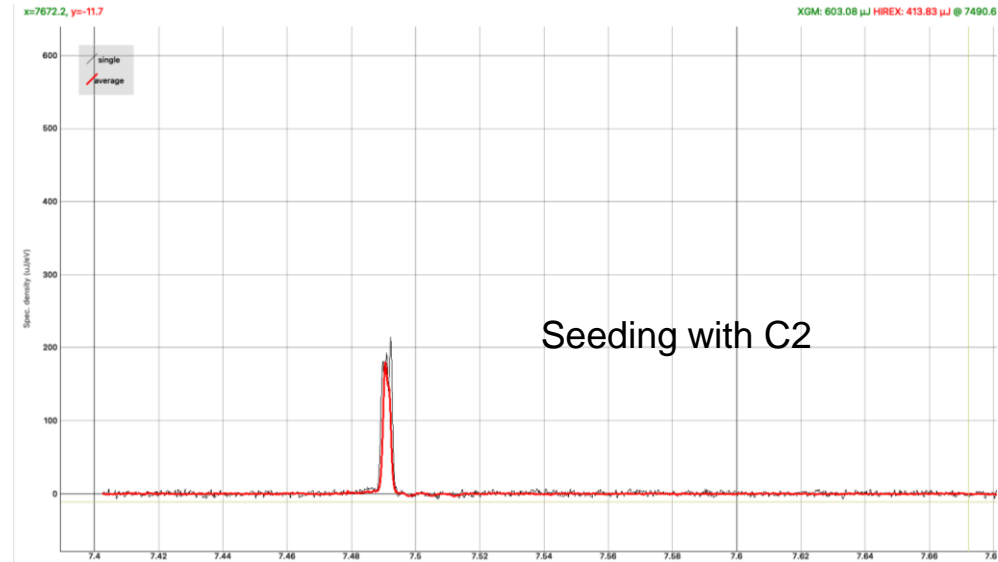
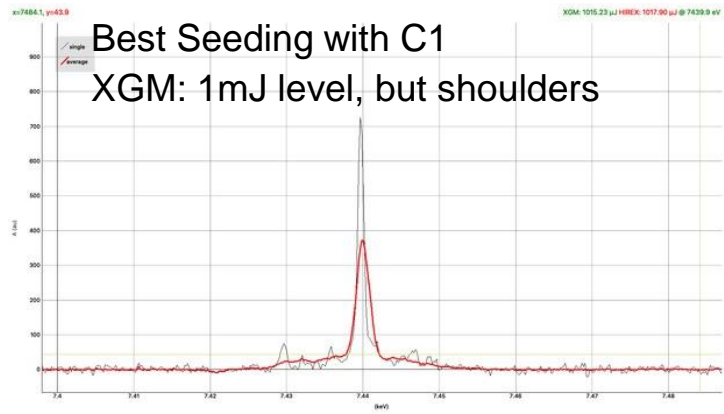
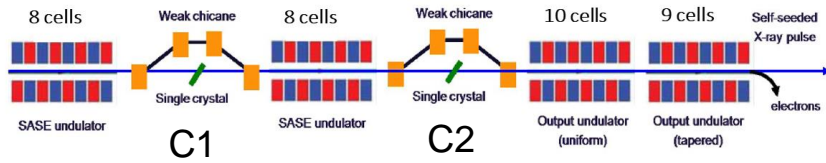


## Beam time in March

- KW09: 04.-05.03 +weekend → seeding at 7.5 keV
- KW10: 11.-12.03 +weekend → seeding at 7.5 keV and 8 keV
- KW11: 16.-17.03 → seeding at 10 keV
- KW12: 25.-26.03 +weekend → seeding at 7.5 keV
  - heat load study at high repetition rate
  - 2<sup>nd</sup> harmonic at 15 keV

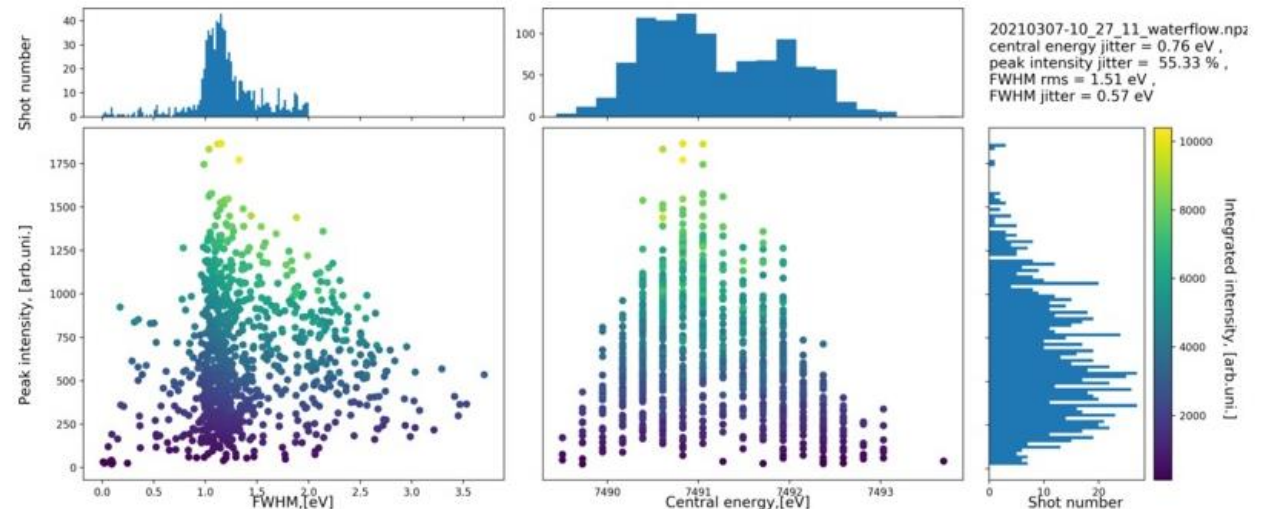
# Seeding @ 7.5 keV

# Seeding with 2 chicanes @ 7.5 keV



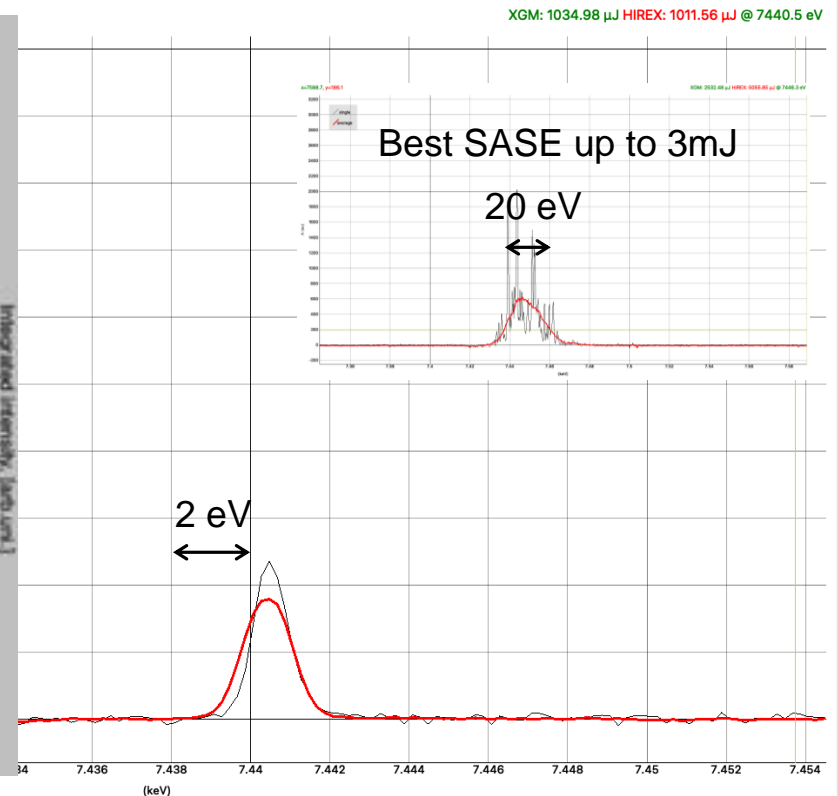
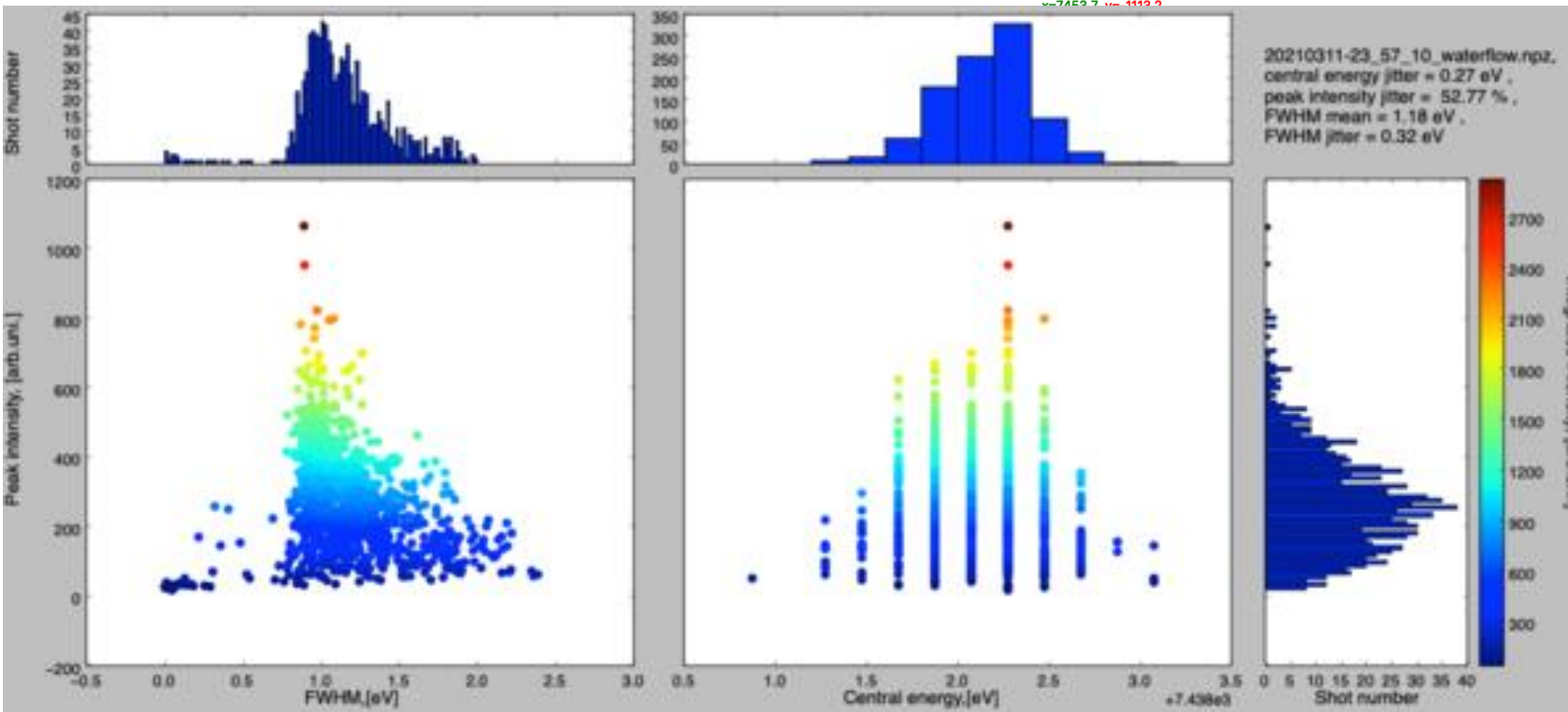
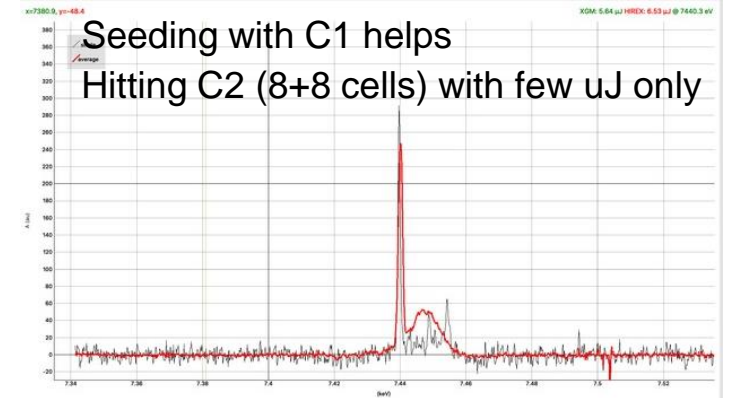
XGM level: 600 uJ with 30 uJ background (C2 detuned)

However, optimum impinging energy to few tens uJ on C2  
 → At lower photon energy, heat load increase



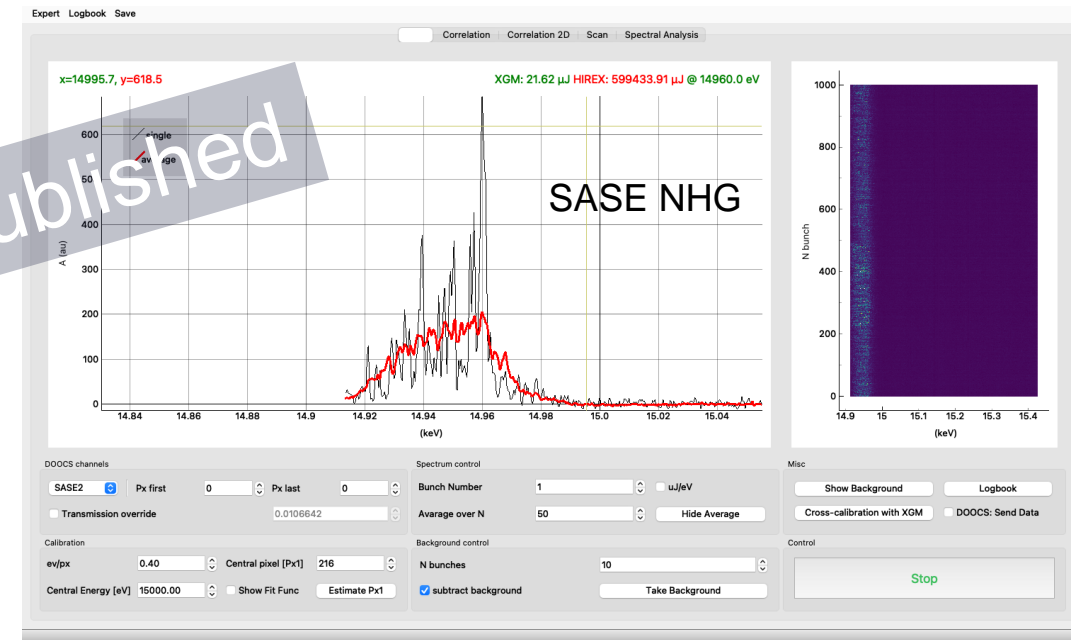
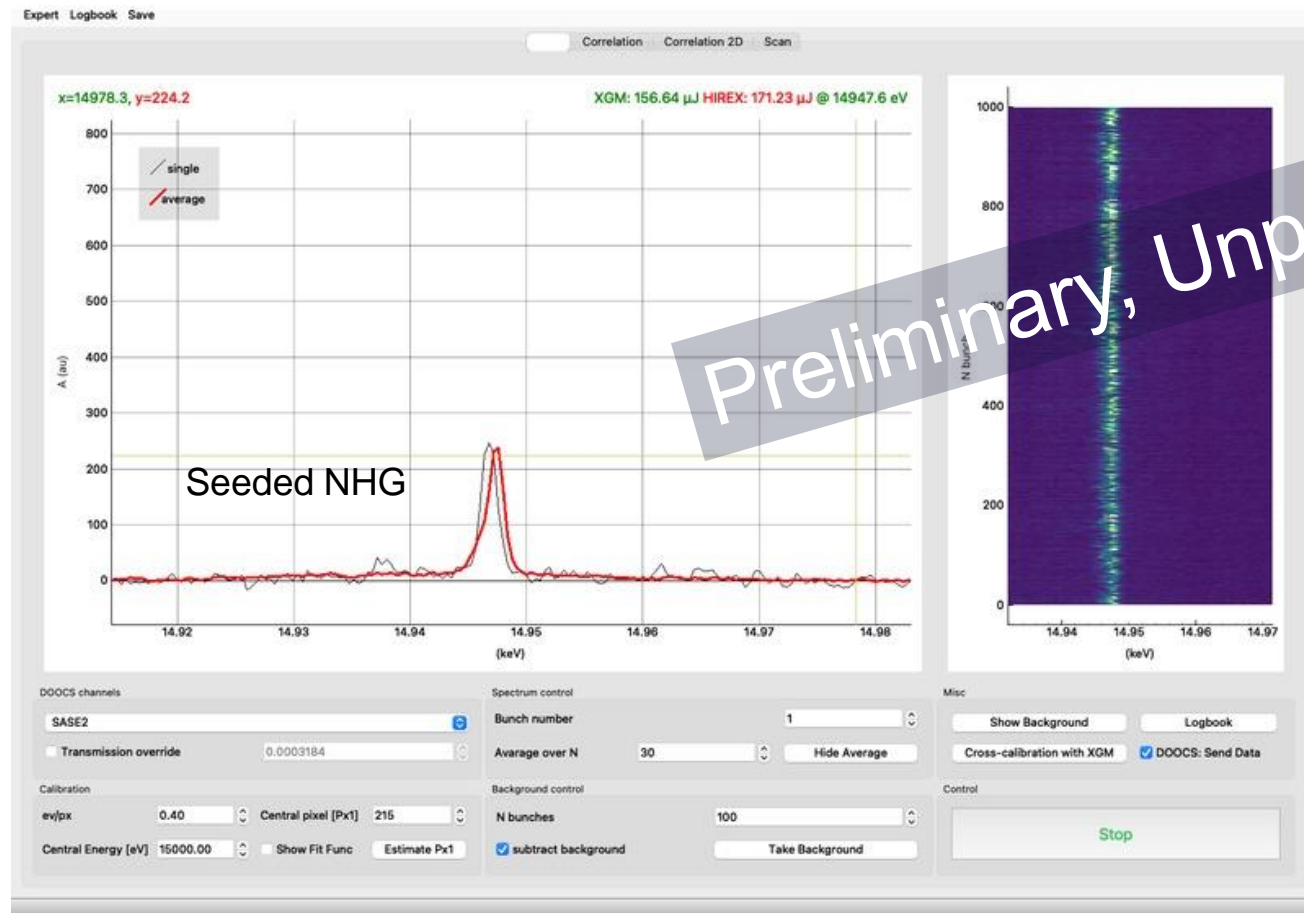
# Achieved best performance so far @7.5 keV

- Seeding with C1+C2 helps:
- It cleans the shoulders and keeps the impinging energy small
- XGM: 1mJ level with about 140uJ background



# 2<sup>nd</sup> harmonic lasing @15 keV

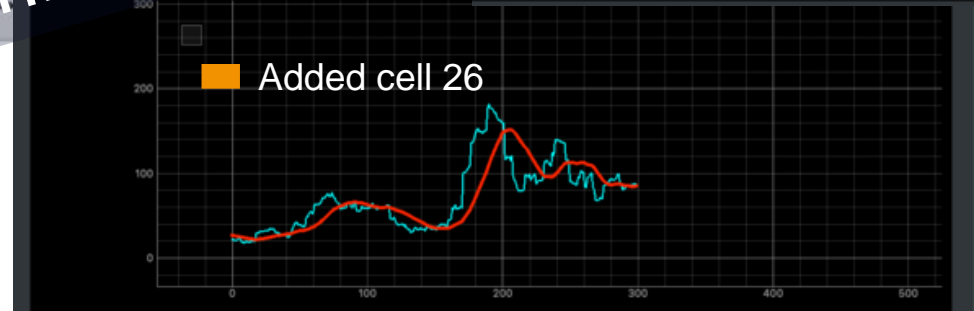
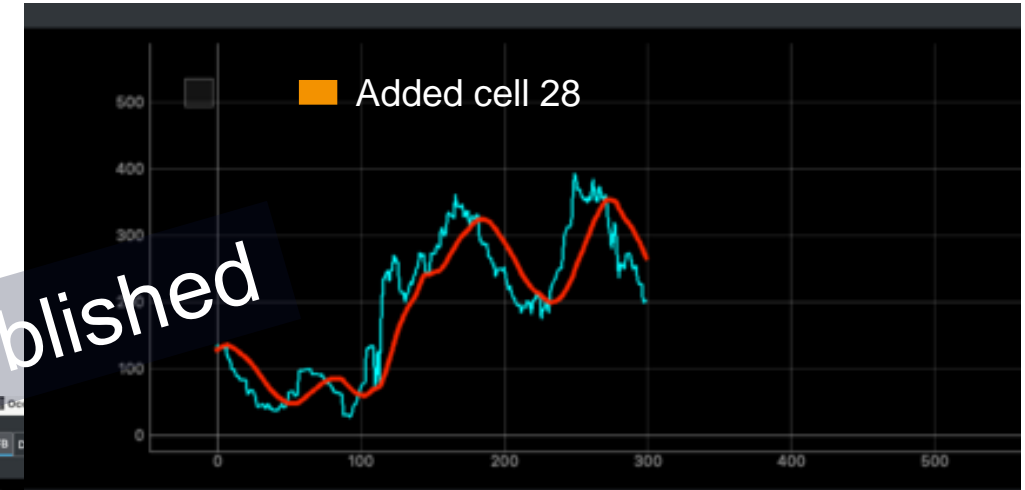
found signal from NHG at 15 keV with seeding and compared with SASE NHG



Preliminary, Unpublished



# 2<sup>nd</sup> harmonic lasing @15 keV



- Observed amplification of seeded signal at 15 keV with the first cells

Preliminary, Unpublished

Objective Function

A: XFEL\_FEL/XGM/XGM.2595.TG/INTENSITY\_RAW\_TRAIN

B: XFEL\_UTIL/DYNPROP/MISC/HREX\_AMPL

C:

Objective Function B

Active search

Delay between sets [s] 0.30

Noise amplitude [urad] 10.0

Period [s] 3.00

Start Search

Indication

Update Main Display

Load Settings

SASE2 launch

Start Feedback

Statistics Accum Off



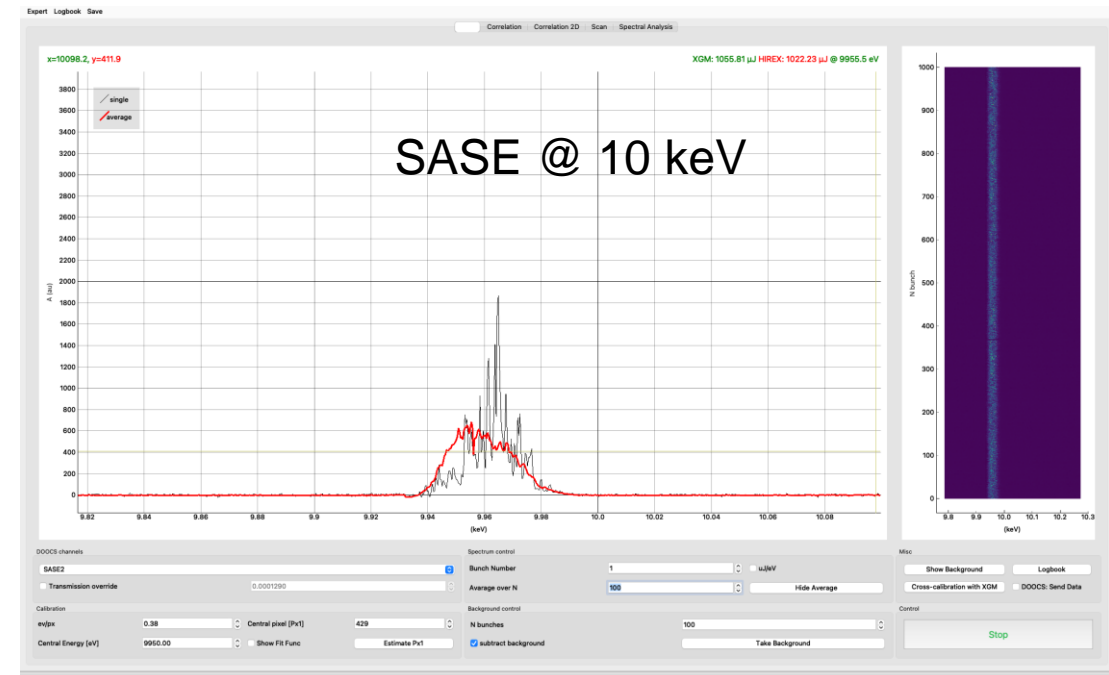
# Seeding @ 10 keV



# Initial Machine Condition

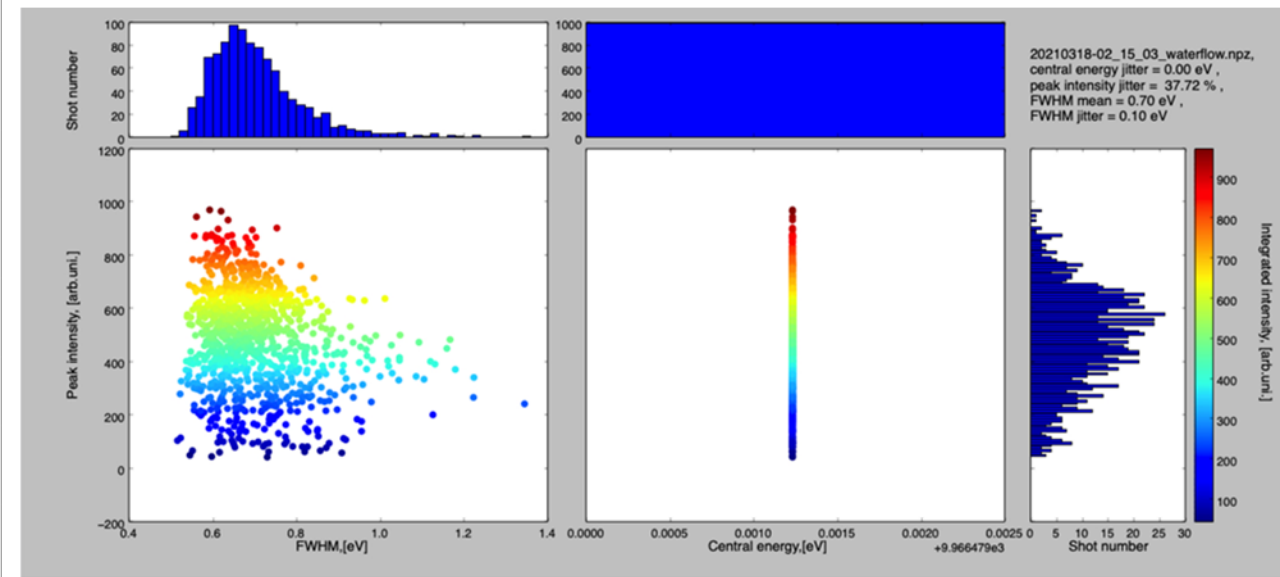
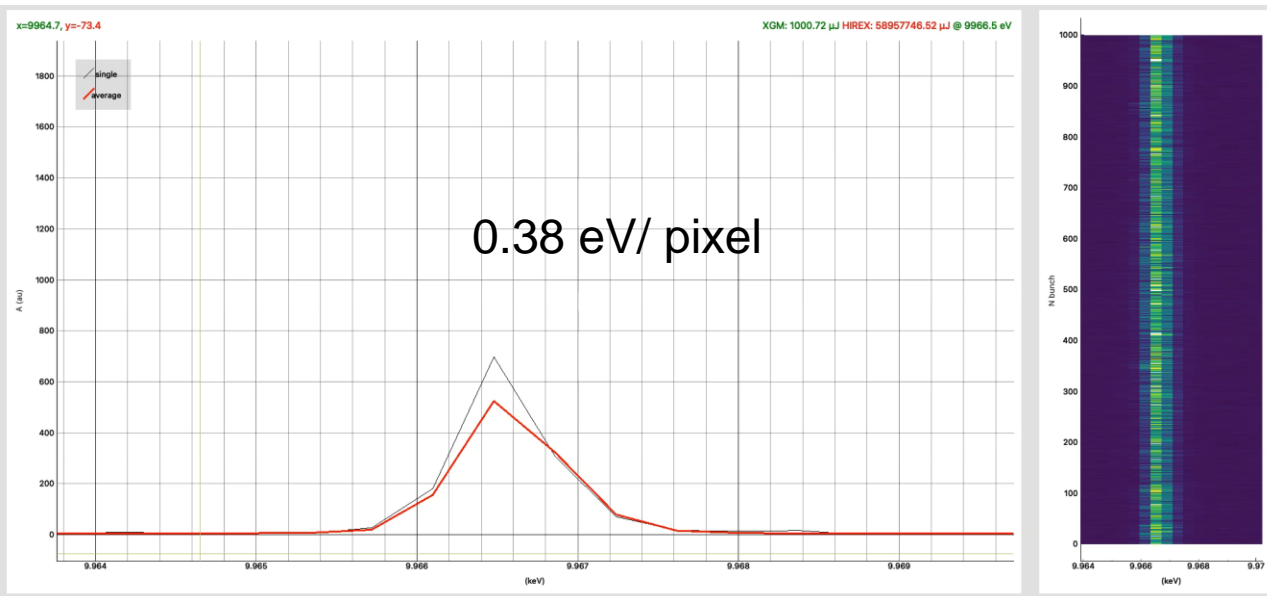
- 14 GeV, 250 pC @ 1.1 MHz
- Up to 2.6 mJ SASE @ 8keV from last week
- Up to 1.1 mJ SASE tuned (in 4 hours) @ 10 keV
- Naresh set-up HIREX @ 10 keV

20210316-11\_06\_04\_waterflow.npz

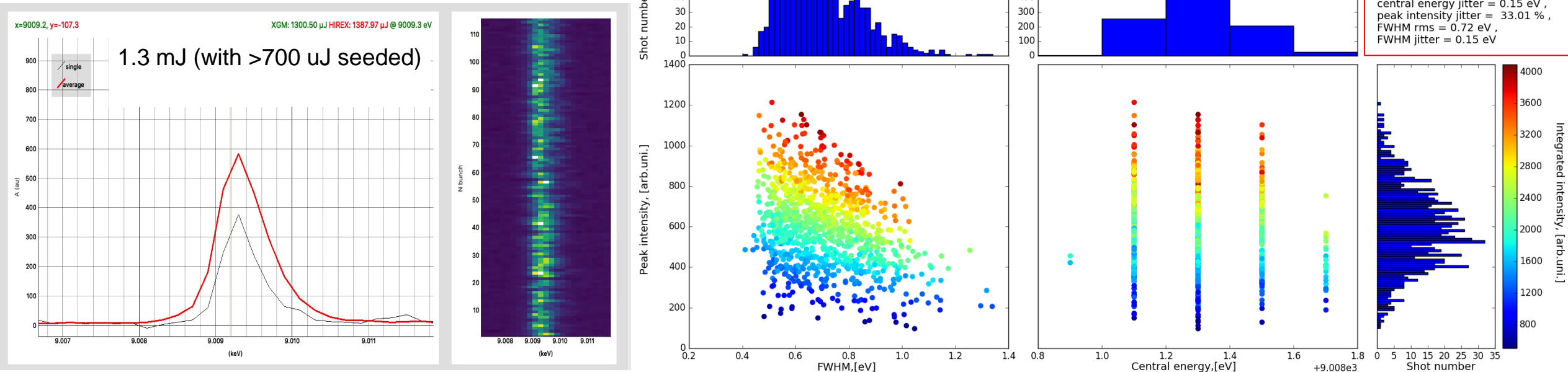


# Performance at 10 keV

- Seeding with 2<sup>nd</sup> chicane
- above 1 mJ with <200  $\mu$ J BG



# Reminder: best performance so far @ 9 keV in 2020



- Averaged pulse energy 1.3 mJ ( max. 850 uJ @ PAL) -> BG estimated by extracting crystal (<600 uJ)
- Peak intensity jitter ~33% (min. 40% @ PAL)
- Central energy jitter (0.15 eV) and FWHM ( $0.72 \pm 0.15$  eV)
- Statistics calculations are limited by the HIREX detector resolution (0.2 eV/ pixel)

# Summary and future plans

## ■ Seeding at 7.5 keV

- seeding with 2 chicanes to above **1mJ level** with  $\sim 140\mu\text{J}$  background (FWHM  $\sim 1.2\text{ eV}$ )

## ■ Seeding at 10 keV

- Seeding with 2<sup>nd</sup> chicane to above 1 mJ with  $<200\text{ }\mu\text{J}$  BG (FWHM  $\sim 0.7\text{ eV}$ )

## ■ Remaining user seeding point

- 11 keV (to be tested)
- 12.9 keV (tested last year)

# Thank you!