Contribution ID: **226** Contribution code: **TUP20** Type: **Contributed Poster**

Frequency Mixing Experiments at the European XFEL

Tuesday, 23 August 2022 17:40 (20 minutes)

Frequency mixing was studied experimentally at SASE3, the soft X-ray undulator of the European XFEL. Two frequencies were generated in the first part of the undulator in alternating K configuration. The mixing process occurred in the second part with detuned undulator segments used to generate R56. Finally, the difference frequency was radiated and amplified in a third part of the SASE3 undulator. Experiments were performed at several electron energies (11.5 GeV, 14 GeV, and 16.5 GeV) with frequency mixing generation at photon energies between 500 eV and 1.1 keV. Pulse energies were on the mJ level, depending on the length of the radiator part. A practical application of frequency mixing at European XFEL is a possible extension of the operating range of the SASE3 undulator towards lower photon energies, by using a relatively short afterburner with longer period.

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Session Classification: Tuesday posters

Track Classification: Novel acceleration and FEL concepts