Elettra Sincrotrone Trieste

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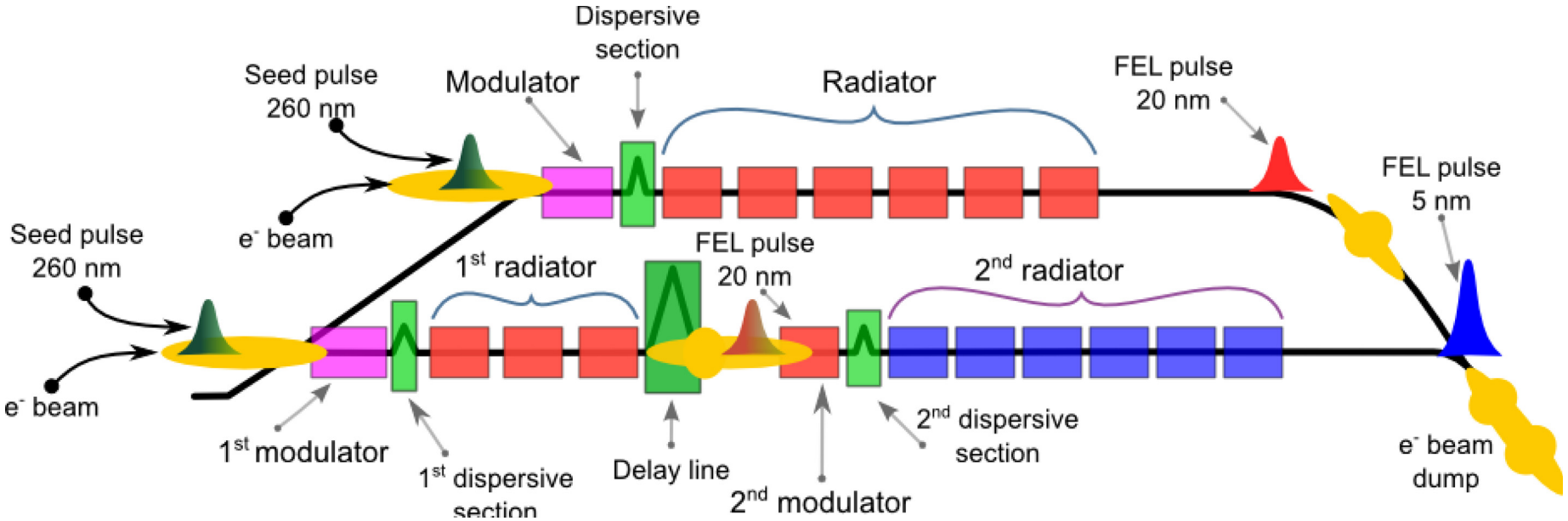
Trieste

First lasing of a free electron laser in the soft x-ray spectral range with echo enabled harmonic generation

E. Allaria
on behalf of the **FERMI team**
and **EEHG collaboration**

FERMI FELs: FEL-1 & FEL-2

FEL-1: **single** stage **HGHG** seeded by a **UV laser**, covers the range **100** nm – **20** nm.



FEL-2: **double** cascade HGHG to reach the wavelength **20** nm – **4** nm.

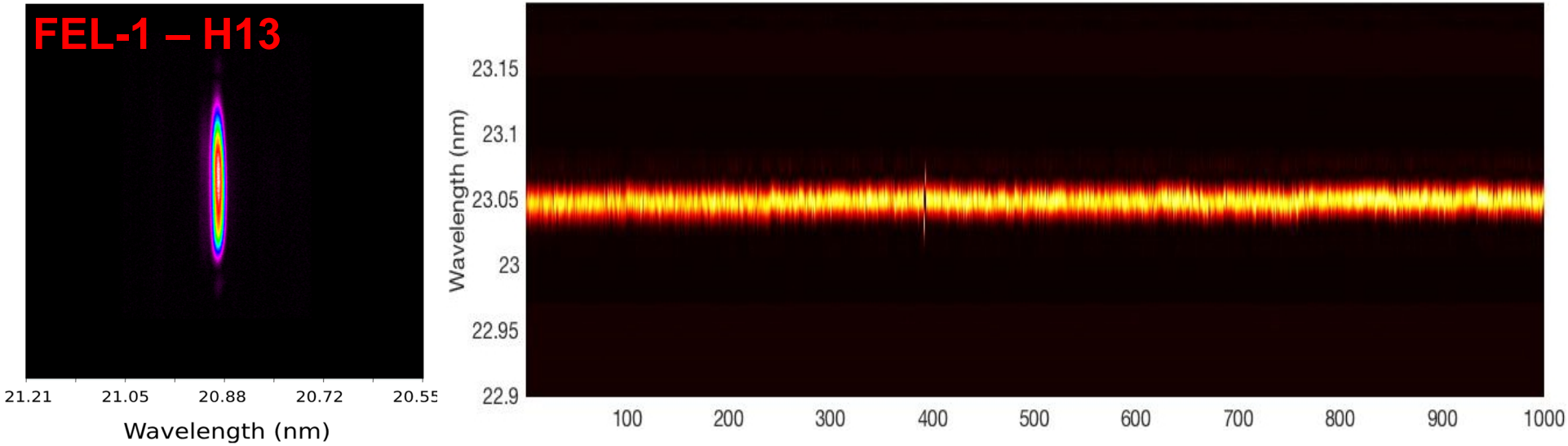
FEL-1 (Nat. Photon. **6**, 699 (2012))	
Tuning range	100-20 nm (12-60eV)
Relative bandwidth	1×10^{-3} (FWHM)
Pulse length	<100 fs
Pulse energy	20-100 μJ

FEL-2 (Nat. Photon. **7**, 913 (2013))	
Tuning range	20-4 nm (60-300eV)
Relative bandwidth	1×10^{-3} (FWHM)
Pulse length	~50 fs
Pulse energy	10-70μJ

Both FELs have APPLE-II undulators in the final radiator allowing **polarization control**.

FERMI FELs: FEL-1 & FEL-2

High quality and **stable spectra** has become an **important** feature of FERMI



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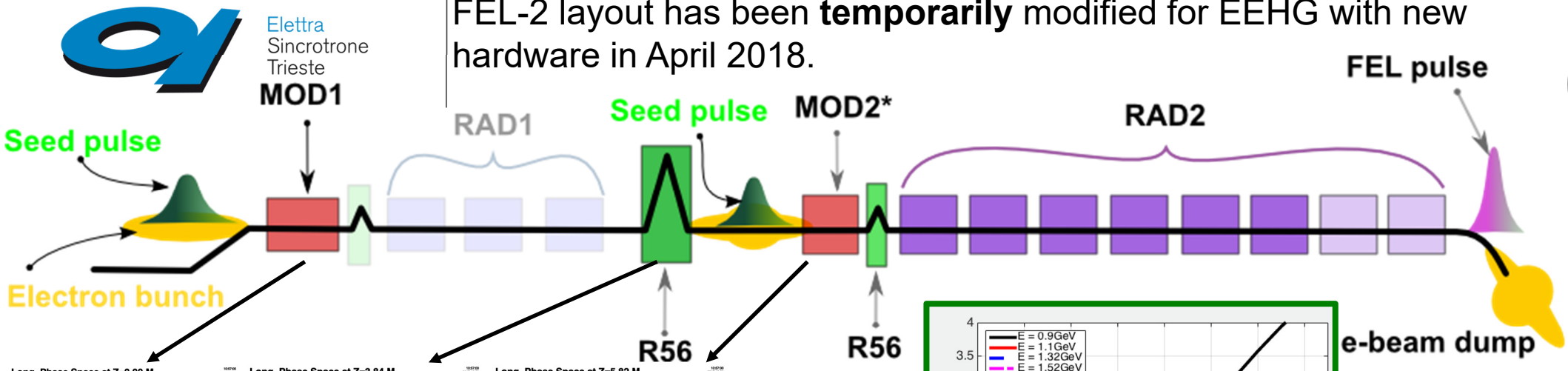
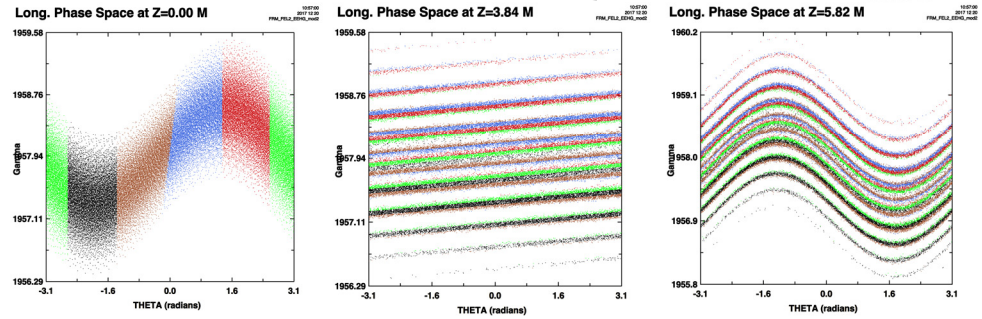
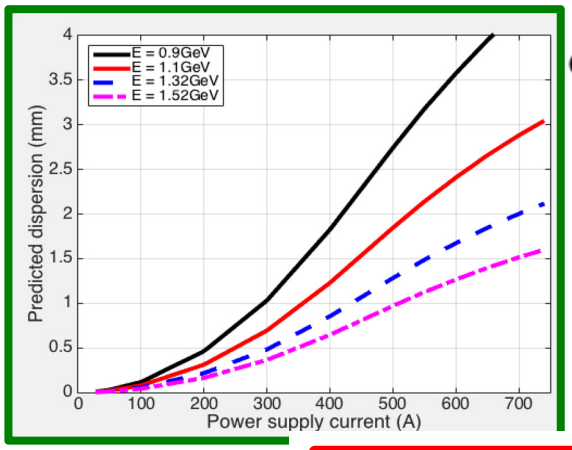
FEL-2: from HGHG-FB to EEHG

FEL-2 layout has been **temporarily** modified for EEHG with new hardware in April 2018.







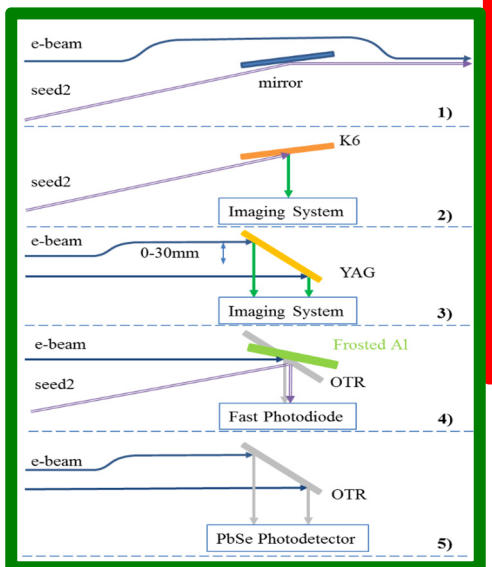
Delay line: new position of magnets and new power supply for 750 A increasing R56.

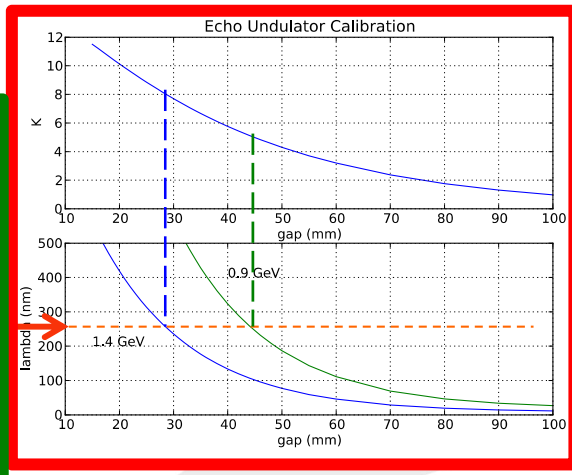
Second modulator: changed the undulator.

Seed laser: new seed laser for EEHG.

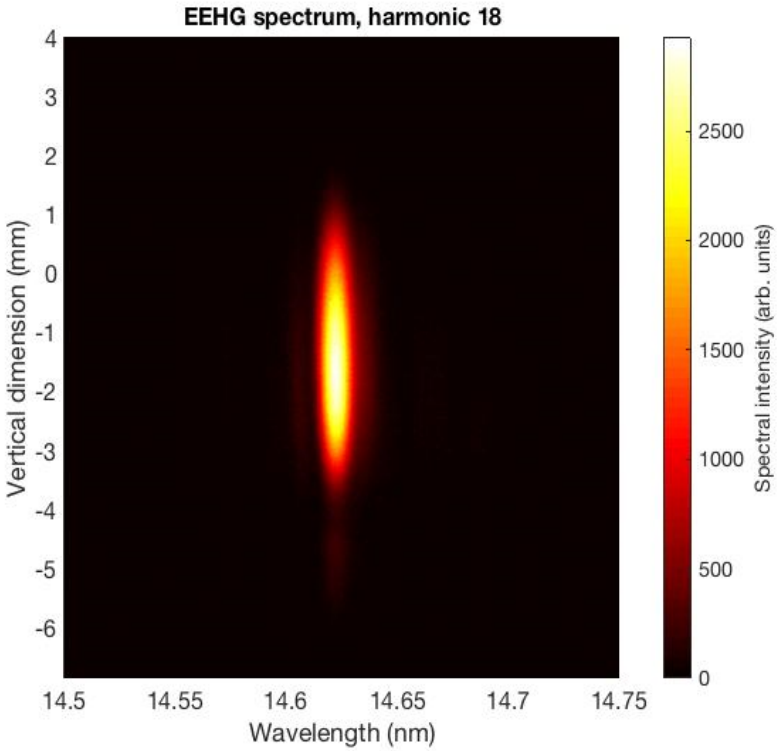
Diagnostic: new optical table for seed and electron diagnostic.

Photon diagnostic: VUV CCD on PRESTO

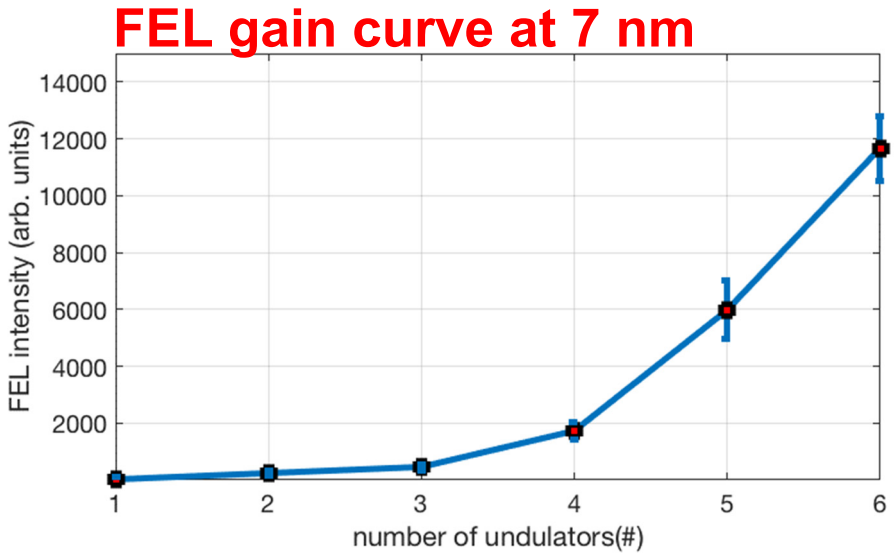




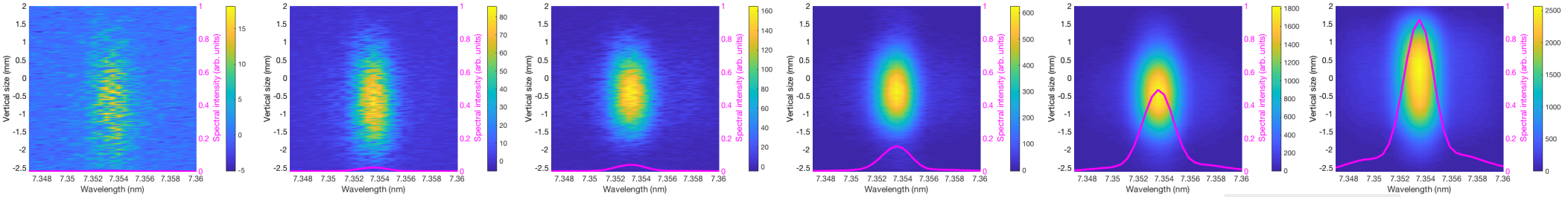
EEHG bouncing and amplification



From the very beginning we had a clear indication that EEHG allows generation of very narrow bandwidth FEL pulses.



Quality of the beam is preserved allowing the FEL amplification in the final radiator



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Conclusions

With a **temporary** setup we **successfully** operated FERMI's FEL-2 in **EEHG** mode.

With the FERMI experiment we have **studied** several aspects of **EEHG**.

More information at:

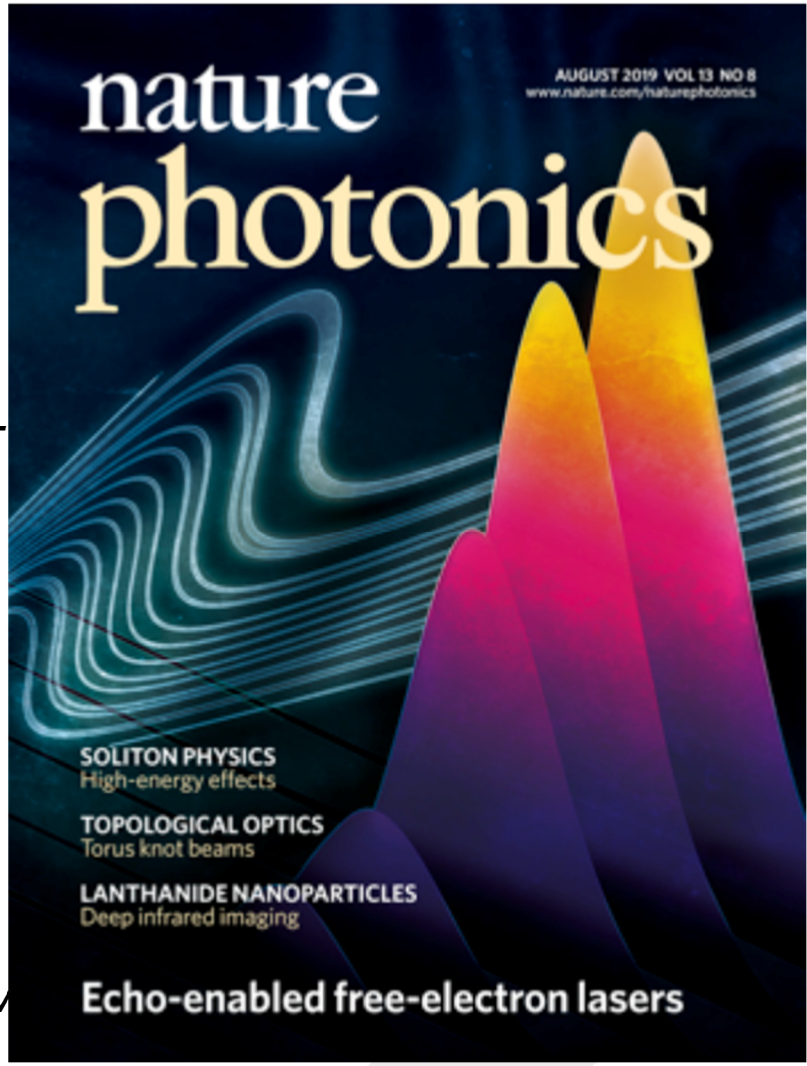
TUB01, Tuesday at 11:00: P. Rebernik, "*Echo-Enabled Harmonic Generation Lasing of the FERMI FEL in the Soft X-Ray Spectral Region*".

***TUP081**: M. Danailov, "Critical Aspects and New Configurations of the FERMI Seed Laser*".

TUP083: S. Spampinati, "*Energy Spread Impact on HGHG and EEHG FEL Pulse Energy*".

TUP082: N.S. Mirian, "*Measurements of the Impact of Seed Laser Chirp on EEHG FEL Spectra*".

THP079: L. Giannessi, "*Status and Perspectives of the FERM FEL Facility (2019)*".



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Acknowledgements

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DESY.

Argonne NATIONAL LABORATORY

SINAP

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European XFEL

SOLEIL SYNCHROTRON

MAX IV

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Thank you!