LUND UNIVERSITY

MAX IV LABORATORY

Accelerator and FEL development @ Lund University – points of collaboration?

Department of Physics
Lund University

Sverker Werin, Professor
Francesca Curbis, Associate Professor

Experience

SXL
FEL design
Study of special modes: HBSASE, EEHG, short pulses, tapering, …

Coherence - Fermi
EEHG –

ML TDC diagnostics (Phd Johan Lundquist)
Attosecond – VG+FC+XFEL/DESY (Gianluca Geloni, Marc Guetg)
(PhD Johan Ribbing)

Eurofel – IRUVX – FELsofEurope

(Test FEL MAX II injector LU+MAX IV+BESSY
CHG MAX I – 1989
FC: SRFEL @ Elettra, HHG seeding FLASH)

Currently recruiting
PhD – Ultra short pulses in linac based lightsources
Post Doc – Storage ring FEL studies

Jagelloinian Krakow 1340??
1600 talet occupied by Sweden

Italians at FEL facilities

Ferrario point

The SXL (Soft X-ray Laser) project

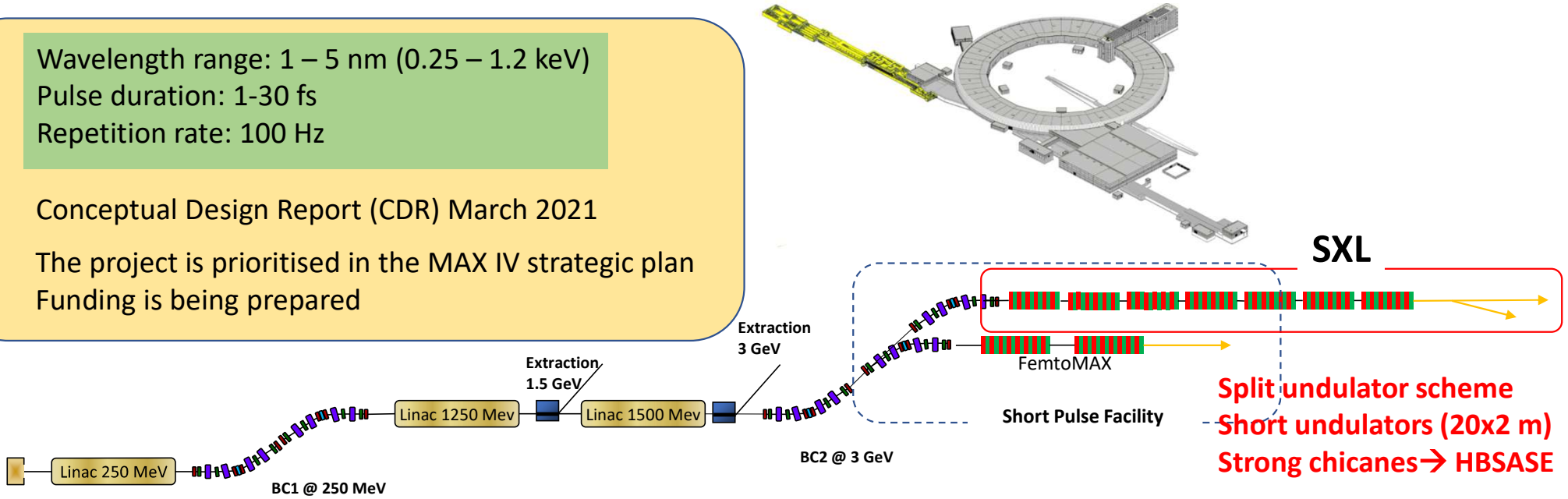
A SWEDISH USERS INITIATIVE

Knut and Alice Wallenberg fundation

Wavelength range: 1 – 5 nm (0.25 – 1.2 keV)
Pulse duration: 1-30 fs
Repetition rate: 100 Hz

Conceptual Design Report (CDR) March 2021

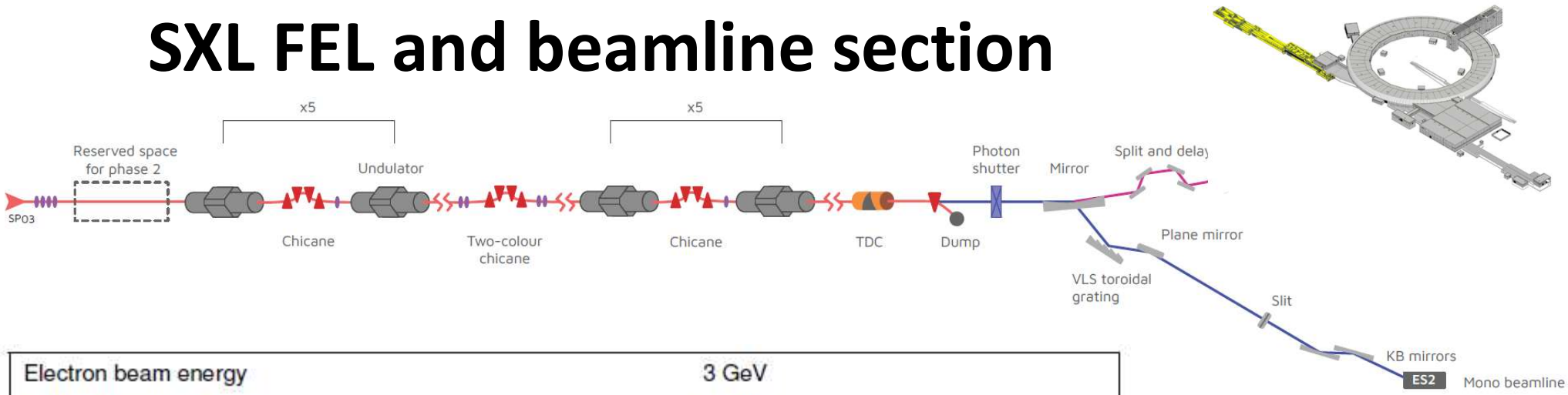
The project is prioritised in the MAX IV strategic plan
Funding is being prepared



- 3 GeV MAX IV linac
- Phase 1: SASE, 2 colour-2 pulses
- Phase 2: Seeding, ultra short pulses
- Apple X undulators

- 2 beamlines: Pink + Mono (+ two open ports)
- Pump laser (THz to XUV) , HHG

SXL FEL and beamline section



Electron beam energy	3 GeV
Charge per bunch	10 – 100 pC
Wavelength range	1 – 5 nm
Photon pulse duration (FWHM)	0.8 – 26 fs
Photon energy per pulse	0.015 – 1.5 mJ
Maximum repetition rate	100 Hz
Maximum peak brightness	4×10^{33} photons/s/mm^2/mrad^2/0.1%BW

Full polarization control with Apple-X undulators.

Extensive range of pump lasers, from IR to XUV.

Two-pulse/Two-colour, delays from few fs to few tens of ns

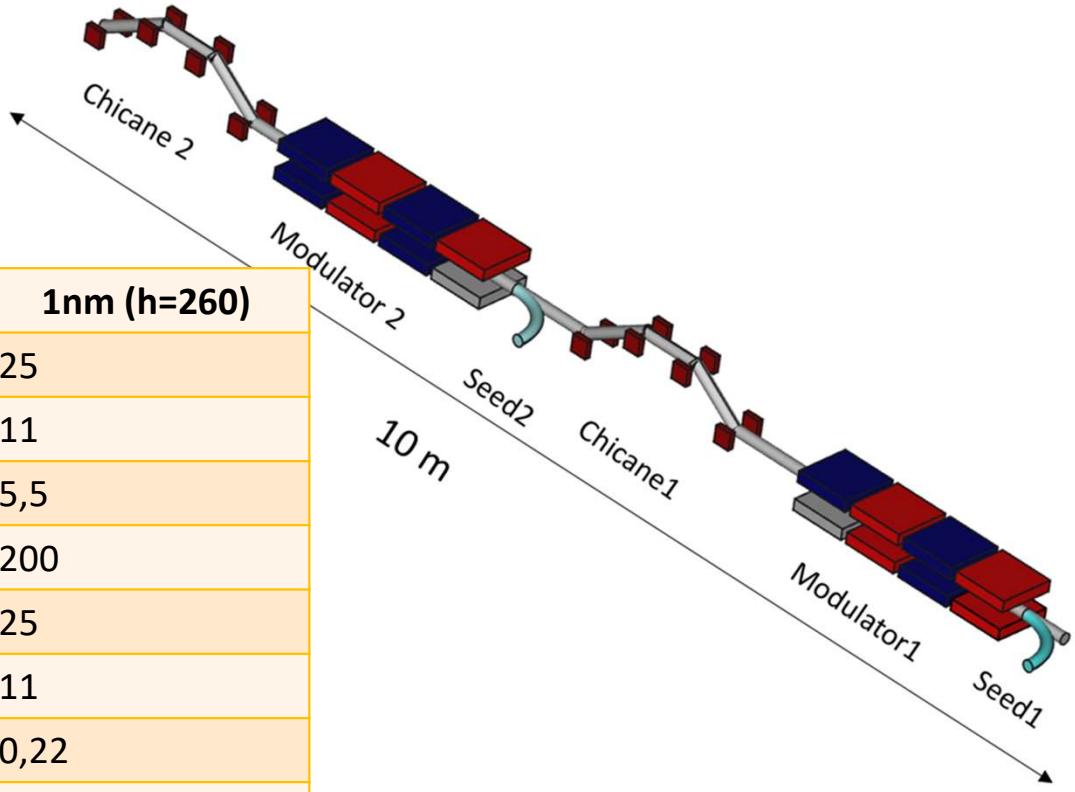
Prepared for future expansions: Echo-Enabled Harmonic Generation, High Brightness SASE, Self-Seeding

SXL – phase 2
Echo Enabled Harmonic Generation (EEHG)

M. Pop

Seed λ = 260 nm

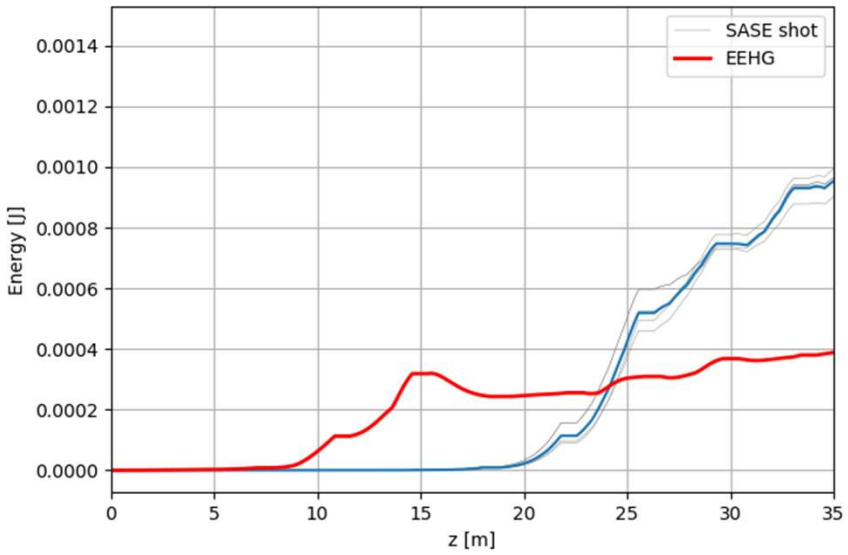
	5 nm (h=52)	1nm (h=260)
$\lambda_u^{(1)}$ [cm]	25	25
K1_planar	11	11
$R_{56}^{(1)}$ [cm]	1,2	5,5
Seed1 Power [MW]	200	200
$\lambda_u^{(2)}$ [cm]	25	25
K2_planar	11	11
$R_{56}^{(2)}$ [cm]	0,2	0,22
Seed2 Power [MW]	100	100
Bunching [%]	8 (6 actual)	2 (1.2 actual)
Decrease in L_sat due to bunching [m]	12	9

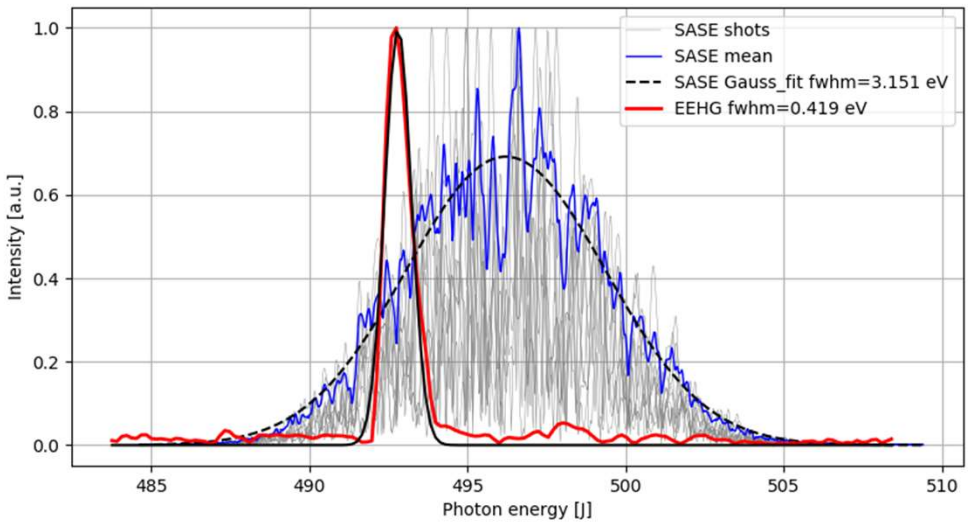


SXL – phase 2
EEHG

M. Pop

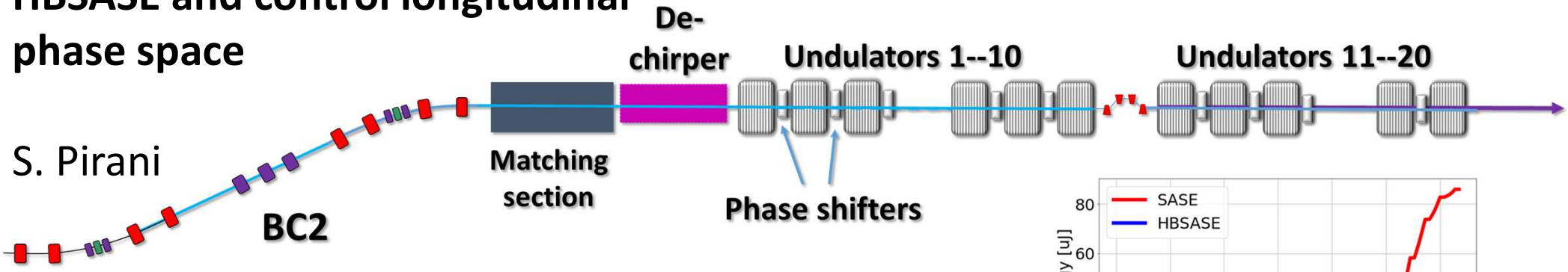
2.5 nm, with chirp 0.5 MeV/fs

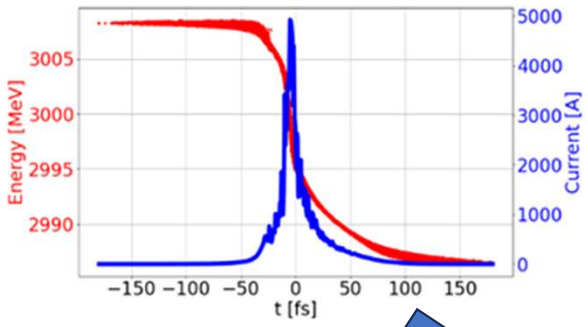


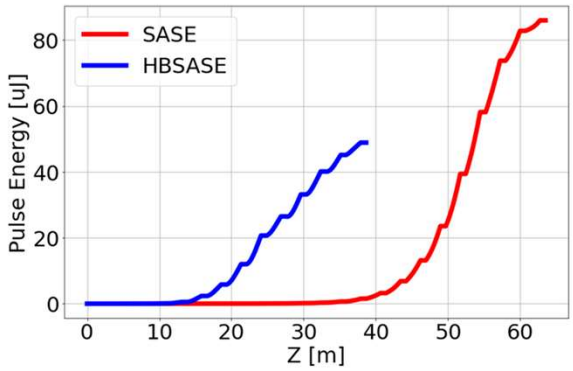


SXL – phase 2
HBSASE and control longitudinal phase space

S. Pirani

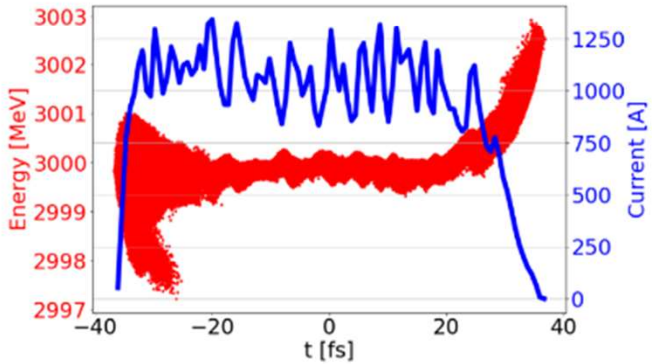


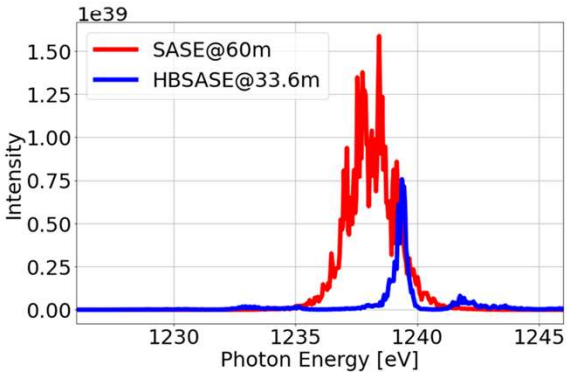




HBSASE performance

Overcompression
+ Rotation
+ De-chirping

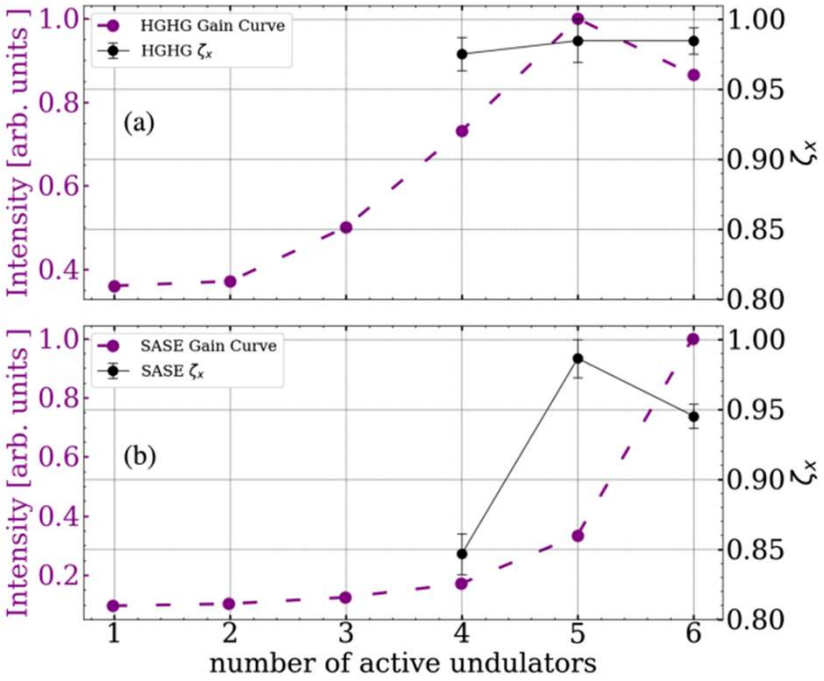


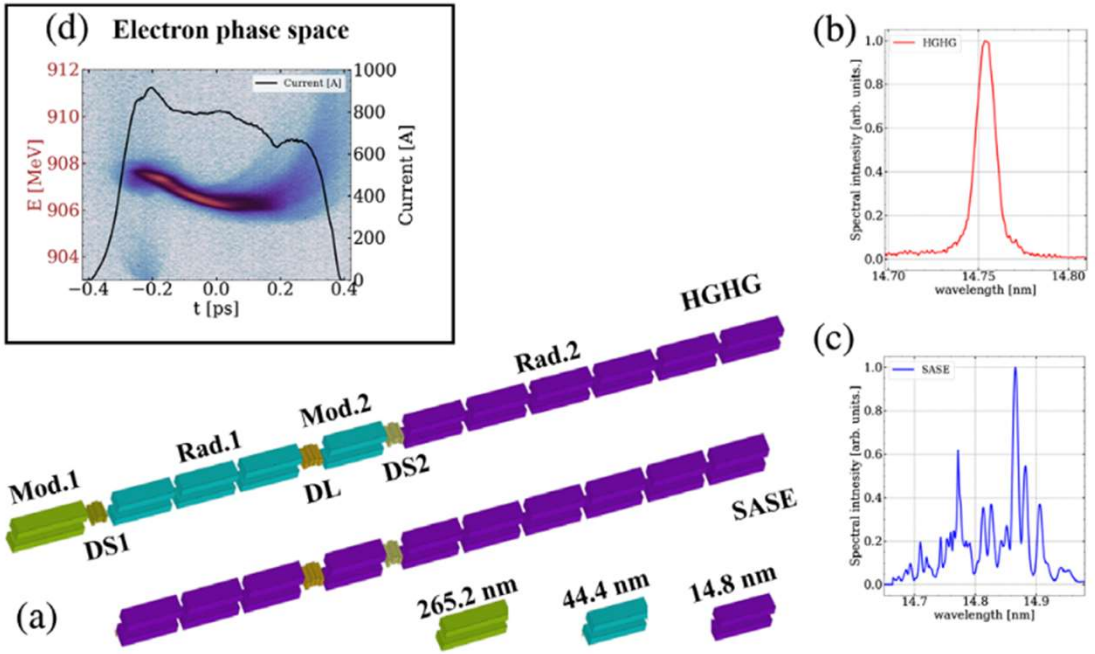


Fermi@Elettra
Single-shot transverse coherence in seeded and unseeded free-electron lasers: A comparison

M. Pop

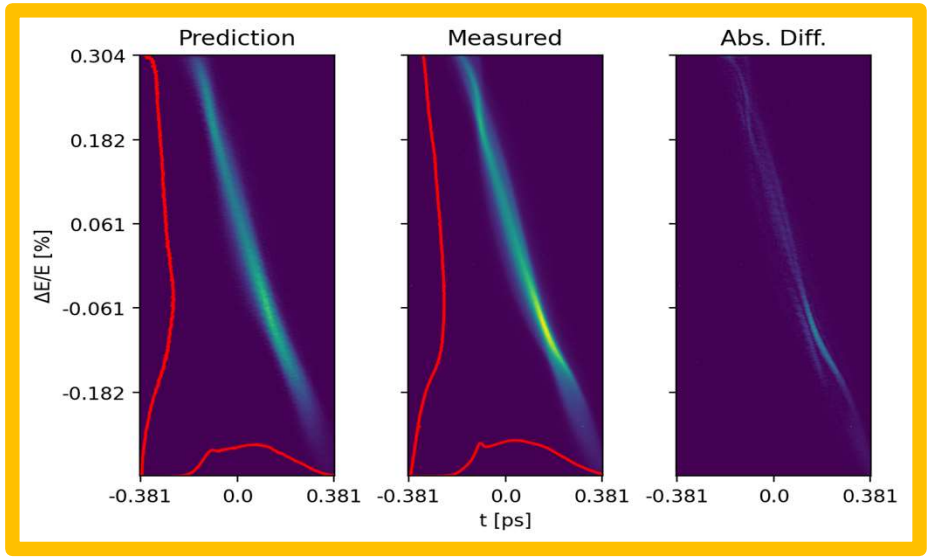
PHYS. REV. ACCEL. BEAMS **25,** 040701 (2022)

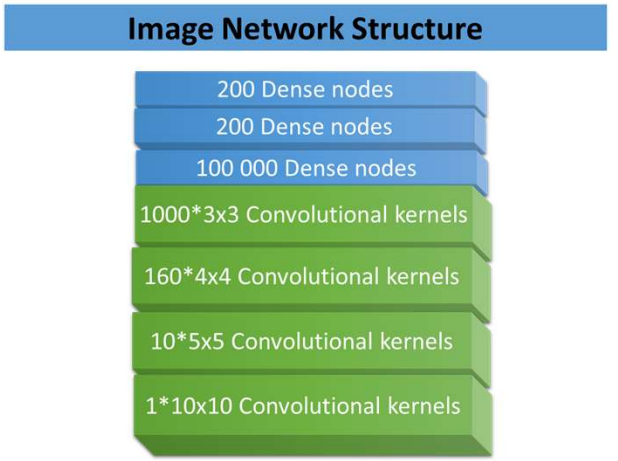




Virtual diagnostics
Predicting longitudinal phase space – Transverse deflecting cavity

J. Lundquist





ASPECT UU+LU+XFEL+DESY
Attosecond pulse generation

Johan Ribbing
(Vitaliy Goryashko, Francesca Curbis)

Chirp + Slippage + Taper

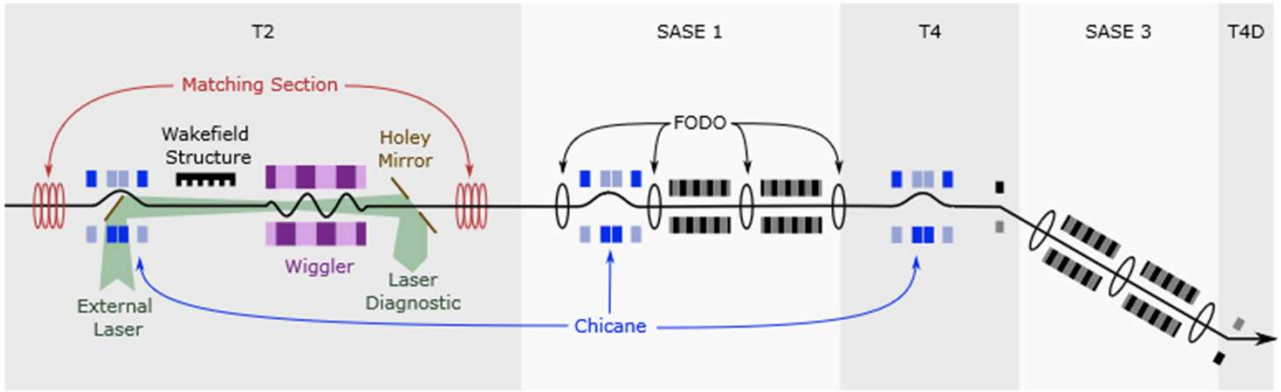
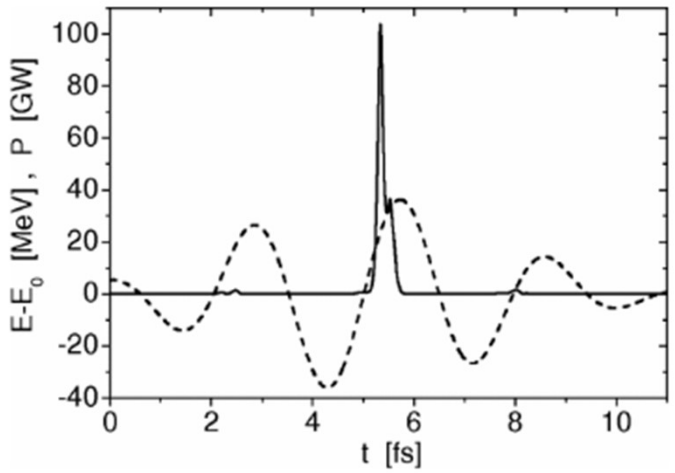


Figure 1: Schematic layout of the ASPECT project.



J. Yan, FEL2022

Test facility for FEL/CHG at the MAX II linac in collaboration with BESSY (EuroFEL-IRUVX)

Short pulses and their diagnostics – Open PhD position at LU with *Francesca Curbis*

Storage ring FEL – Open Post doc position at LU with *Sverker Werin*

EuPRAXIA@SPARC_LAB

- Drive-witness beam dynamics (PWFA)
- FEL set-ups, advanced modes studies (PWFA/LWFA)

- Longitudinal phase space diagnostics

- Drive witness test at MAX IV?
- Design of additional FEL lines?

(We need Italy to keep Acc Phys high on the agenda)

Francesca will be at Frascati 3-5 October for the LEDS workshop.