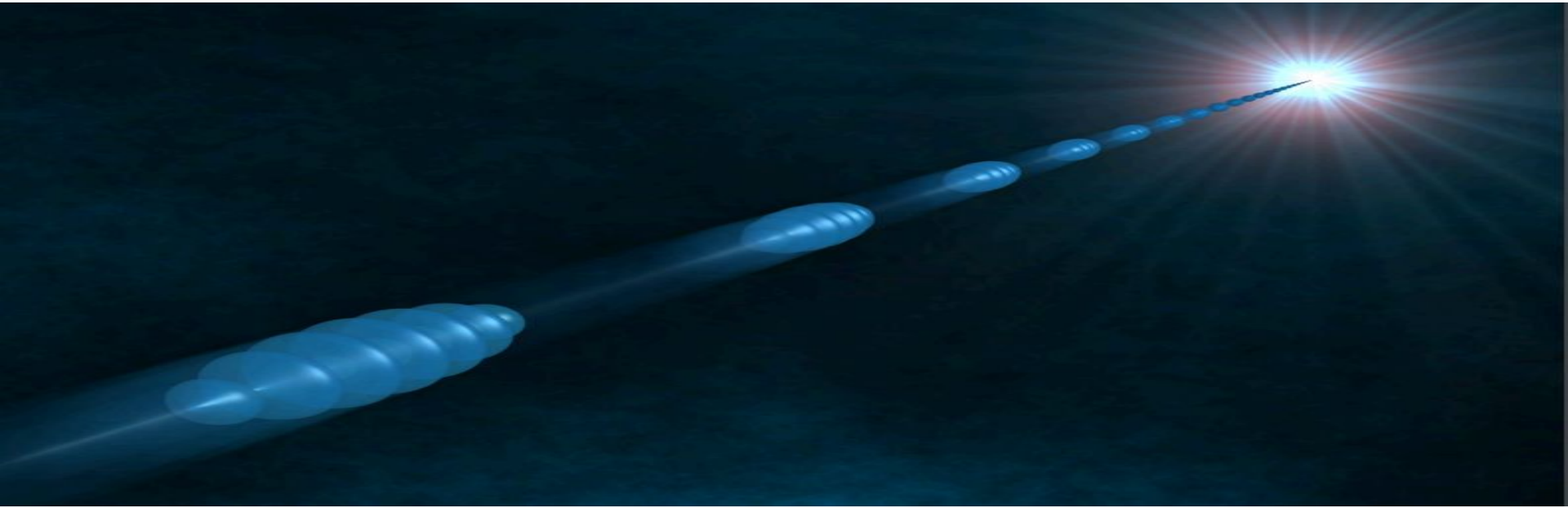
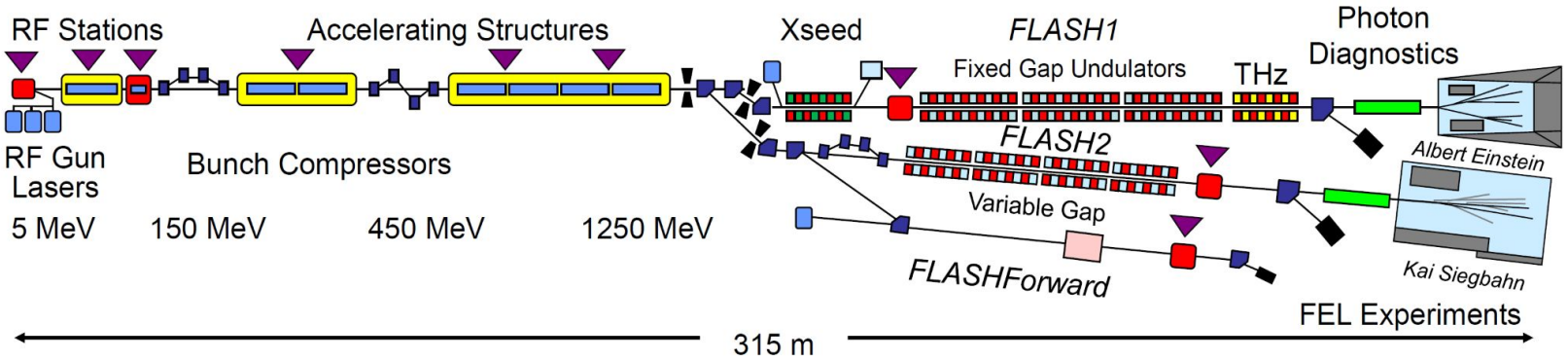


Welcome to the FLASH2020+ Simulation Workshop 27-02-2024 & 28-02-2024.

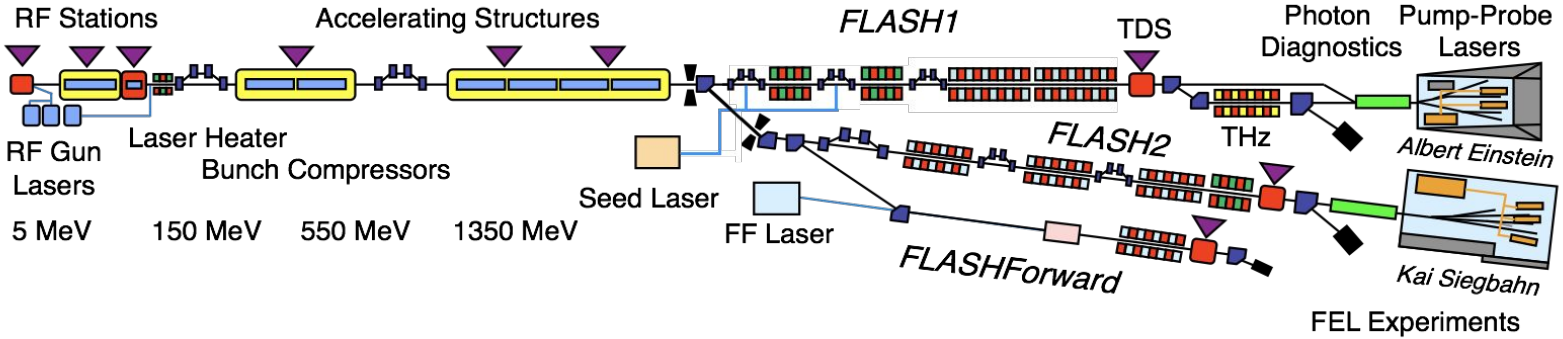
The free electron user facility FLASH

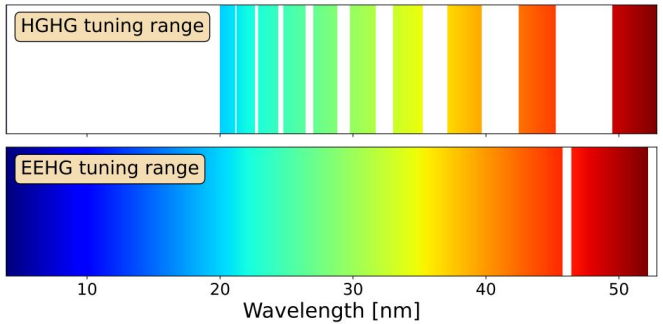


- Superconducting linac@**1MHz burst**, up to 8000 pulses/sec
- Two SASE beamlines **FLASH1** (fixed gap) and **FLASH2**
- **4-90 nm**
- **R&D** projects (Xseed & FFW)
- Upgrade: **FLASH2020+**
  - Up to **1.25 GeV** →up to **1.35GeV**
  - **Laser Heater**

FLASH2020+ project: Seeding at FLASH1

Fully coherent soft x-ray pulses at 1MHz



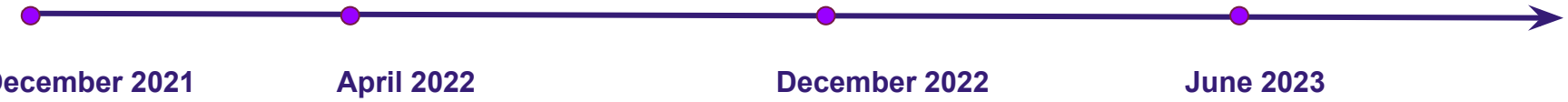


- Echo-Enabled Harmonic generation (EEHG) down to **4nm**
- Wavelength tunability with EEHG and HGHG **4nm - 60nm**
- First high rep. rate seeding worldwide at **1MHz**

Successful seeding relies on **high quality** e-beam and seed lasers:

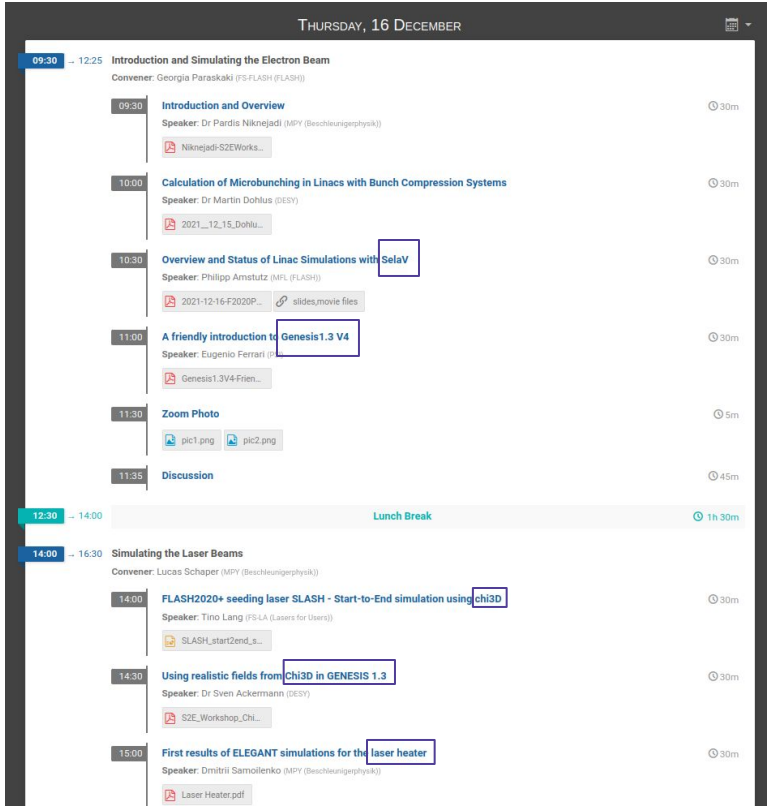
- Electron bunch preparation
- R&D for optimal lasers
  - *Seed1:* ~343nm, 100MW, 500fs
  - *Seed2:* ~297-317nm, 300MW, 50fs

FLASH2020+ S2E Simulation Workshops



- Bringing experts together
- Introducing simulation codes being used
- Updating on status of S2E

1st S2E Simulation Workshop



THURSDAY, 16 DECEMBER

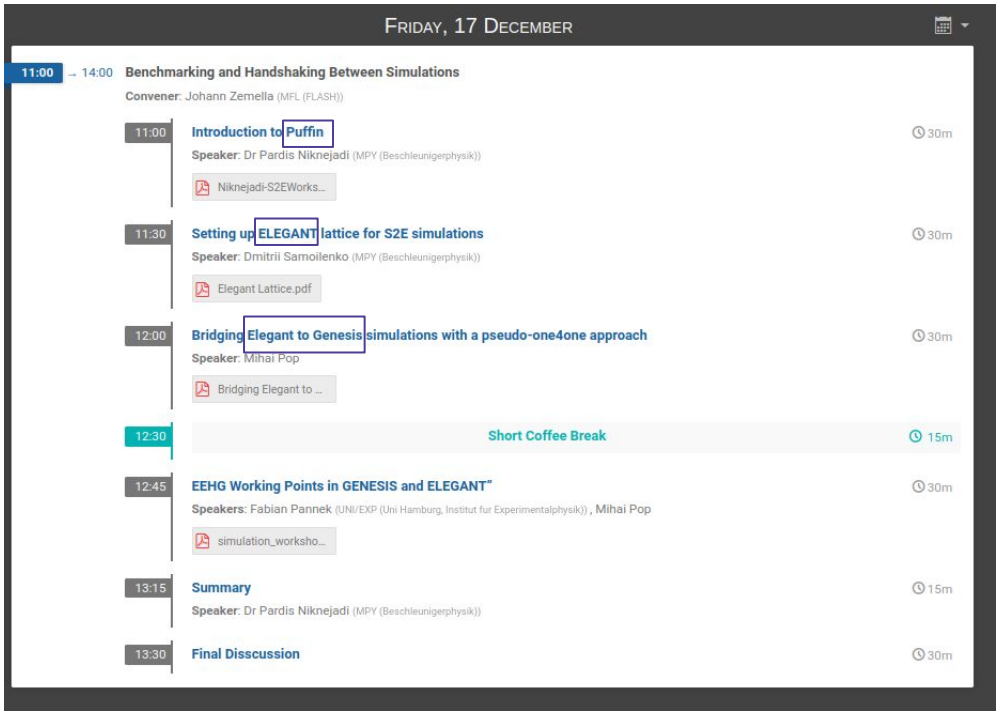
09:30 → 12:25 **Introduction and Simulating the Electron Beam**
Convener: Georgia Paraskaki (FS-FLASH (FLASH))

- 09:30 **Introduction and Overview** — 30m
  Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))
  Niknejadi-S2EWorks...
- 10:00 **Calculation of Microbunching in Linacs with Bunch Compression Systems** — 30m
  Speaker: Dr Martin Dohlus (DESY)
  2021_12_15_Dohlu...
- 10:30 **Overview and Status of Linac Simulations with SelaV** — 30m
  Speaker: Philipp Amstutz (MFL (FLASH))
  2021-12-16-F2020P... slides,movie files
- 11:00 **A friendly introduction to Genesis1.3 V4** — 30m
  Speaker: Eugenio Ferrari (P...)
  Genesis1.3V4-Frien...
- 11:30 **Zoom Photo** — 5m
  pic1.png pic2.png
- 11:35 **Discussion** — 45m

12:30 → 14:00 **Lunch Break** — 1h 30m

14:00 → 16:30 **Simulating the Laser Beams**
Convener: Lucas Schaper (MPY (Beschleunigerphysik))

- 14:00 **FLASH2020+ seeding laser SLASH - Start-to-End simulation using chi3D** — 30m
  Speaker: Tino Lang (FS-LA (Lasers for Users))
  SLASH_start2end_s...
- 14:30 **Using realistic fields from Chi3D in GENESIS 1.3** — 30m
  Speaker: Dr Sven Ackermann (DESY)
  S2E_Workshop_Chi...
- 15:00 **First results of ELEGANT simulations for the laser heater** — 30m
  Speaker: Dmitrii Samoilenko (MPY (Beschleunigerphysik))
  Laser Heater.pdf



FRIDAY, 17 DECEMBER

11:00 → 14:00 **Benchmarking and Handshaking Between Simulations**
Convener: Johann Zemella (MFL (FLASH))

- 11:00 **Introduction to Puffin** — 30m
  Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))
  Niknejadi-S2EWorks...
- 11:30 **Setting up ELEGANT lattice for S2E simulations** — 30m
  Speaker: Dmitrii Samoilenko (MPY (Beschleunigerphysik))
  Elegant Lattice.pdf
- 12:00 **Bridging Elegant to Genesis simulations with a pseudo-one4one approach** — 30m
  Speaker: Mihai Pop
  Bridging Elegant to ...

12:30 **Short Coffee Break** — 15m

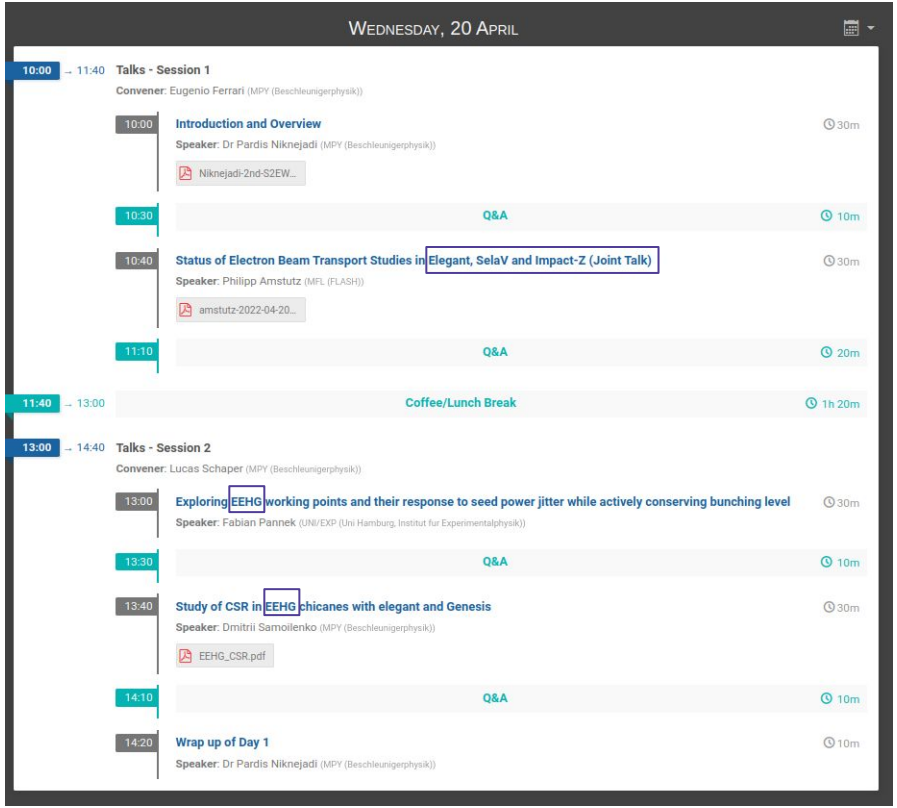
- 12:45 **EEHG Working Points in GENESIS and ELEGANT"** — 30m
  Speakers: Fabian Pannek (UNI/EXP (Uni Hamburg, Institut fur Experimentalphysik)) , Mihai Pop
  simulation_worksho...
- 13:15 **Summary** — 15m
  Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))
- 13:30 **Final Disscussion** — 30m

FLASH2020+ S2E Simulation Workshops

- Bringing experts together
- Introducing simulation codes being used
- Updating on status of S2E

- First benchmarking Elegant, SelaV and Impact-Z
- Studying EEHG in detail

2nd S2E Simulation Workshop



Wednesday, 20 April

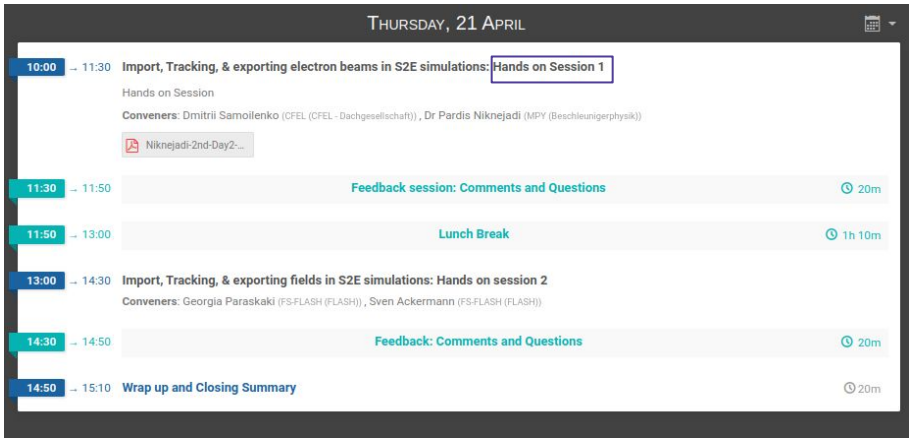
10:00 → 11:40 **Talks - Session 1**
Convener: Eugenio Ferrari (MPY (Beschleunigerphysik))

- 10:00 **Introduction and Overview** — 30m
  Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))
  Niknejadi-2nd-S2EW...
- 10:30 **Q&A** — 10m
- 10:40 **Status of Electron Beam Transport Studies in Elegant, SelaV and Impact-Z (Joint Talk)** — 30m
  Speaker: Philipp Amstutz (MFL (FLASH))
  amstutz-2022-04-20...
- 11:10 **Q&A** — 20m

11:40 → 13:00 **Coffee/Lunch Break** — 1h 20m

13:00 → 14:40 **Talks - Session 2**
Convener: Lucas Schaper (MPY (Beschleunigerphysik))

- 13:00 **Exploring EEHG working points and their response to seed power jitter while actively conserving bunching level** — 30m
  Speaker: Fabian Pannek (UNI/EXP (Uni Hamburg, Institut fur Experimentalphysik))
- 13:30 **Q&A** — 10m
- 13:40 **Study of CSR in EEHG chicanes with elegant and Genesis** — 30m
  Speaker: Dmitrii Samoilenko (MPY (Beschleunigerphysik))
  EEHG_CSR.pdf
- 14:10 **Q&A** — 10m
- 14:20 **Wrap up of Day 1** — 10m
  Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))



Thursday, 21 April

10:00 → 11:30 **Import, Tracking, & exporting electron beams in S2E simulations: Hands on Session 1**
Hands on Session
Conveners: Dmitrii Samoilenko (CFEL (CFEL - Dachgesellschaft)) , Dr Pardis Niknejadi (MPY (Beschleunigerphysik))
Niknejadi-2nd-Day2-...

- 11:30 → 11:50 **Feedback session: Comments and Questions** — 20m
- 11:50 → 13:00 **Lunch Break** — 1h 10m
- 13:00 → 14:30 **Import, Tracking, & exporting fields in S2E simulations: Hands on session 2**
  Conveners: Georgia Paraskaki (FS-FLASH (FLASH)) , Sven Ackermann (FS-FLASH (FLASH))
- 14:30 → 14:50 **Feedback: Comments and Questions** — 20m
- 14:50 → 15:10 **Wrap up and Closing Summary** — 20m

FLASH2020+ S2E Simulation Workshops

December 2021

- Bringing experts together
- Introducing simulation codes being used
- Updating on status of S2E

April 2022

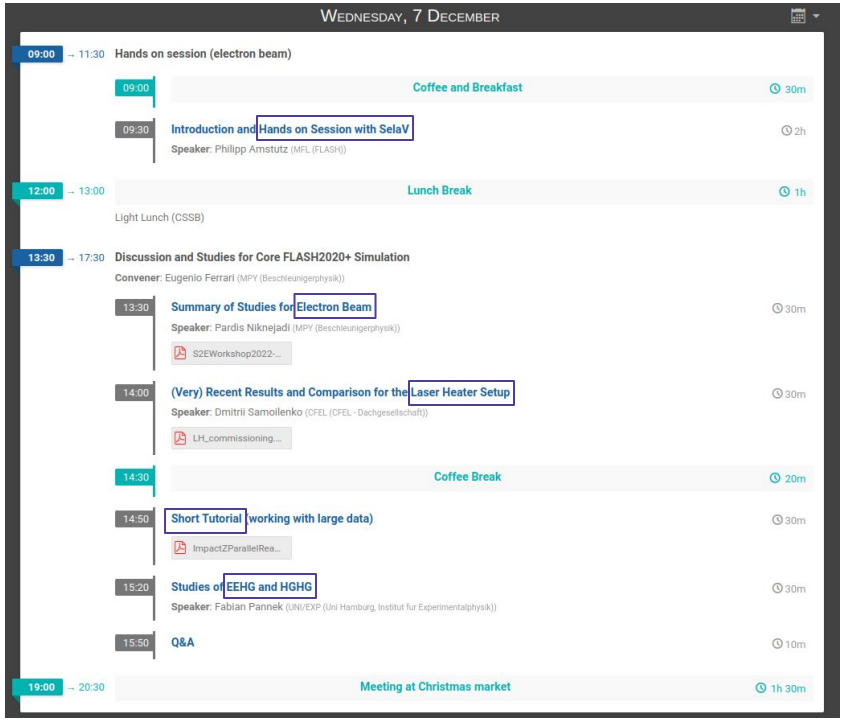
- First benchmarking Elegant, SelaV and Impact-Z
- Studying EEHG in detail

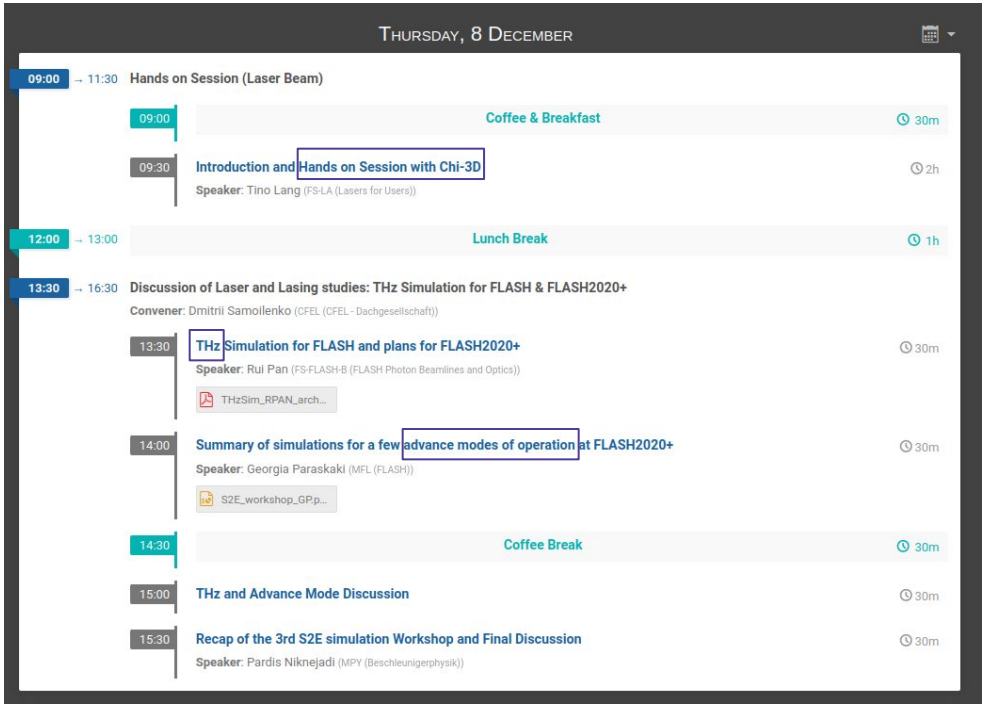
December 2022

- Several hands-on sessions hybrid format
- First discussion on advanced modes
- First results with Laser Heater

June 2023

3rd S2E Simulation Workshop





FLASH2020+ S2E Simulation Workshops

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- Studying EEHG in detail

December 2022

- Several hands-on sessions hybrid format
- First discussion on advanced modes
- First results with Laser Heater

June 2023

- Benchmarking with different codes → reduce resources
- Exploring a faster workflow
- External participants sharing their experience
- S2E simulations & machine operation needs

Highlights from FLASH2020+ Start to End Work Flow

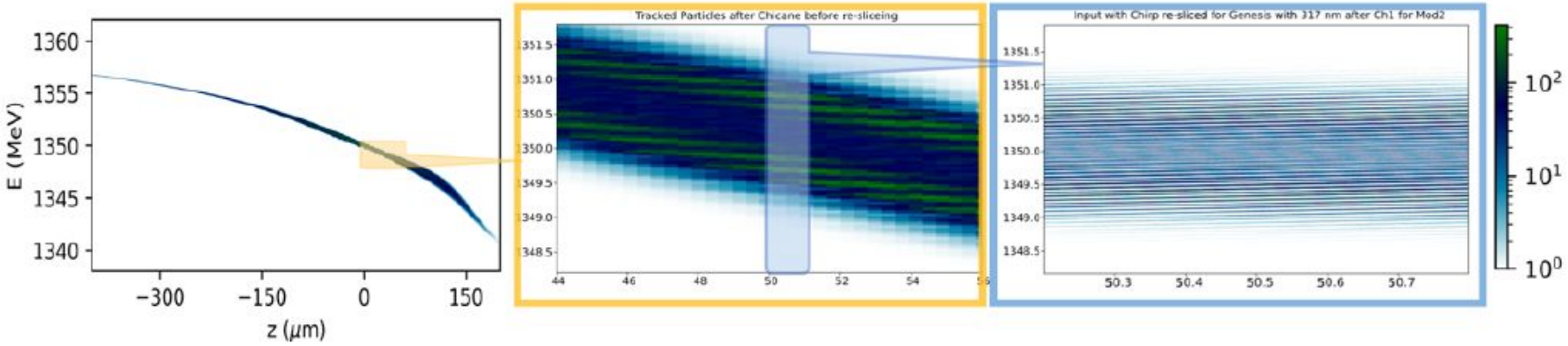
Strong Focus on Desired Features

- Standard electron beam file format in SI unit (SU) & Genesis to SU and Elegant to SU convertors
- Matching and Upsampling scripts
- Genesis Python toolbox for data visualization and analysis
- Basic documentation and simple Jupyter notebooks with several examples

Future Goals

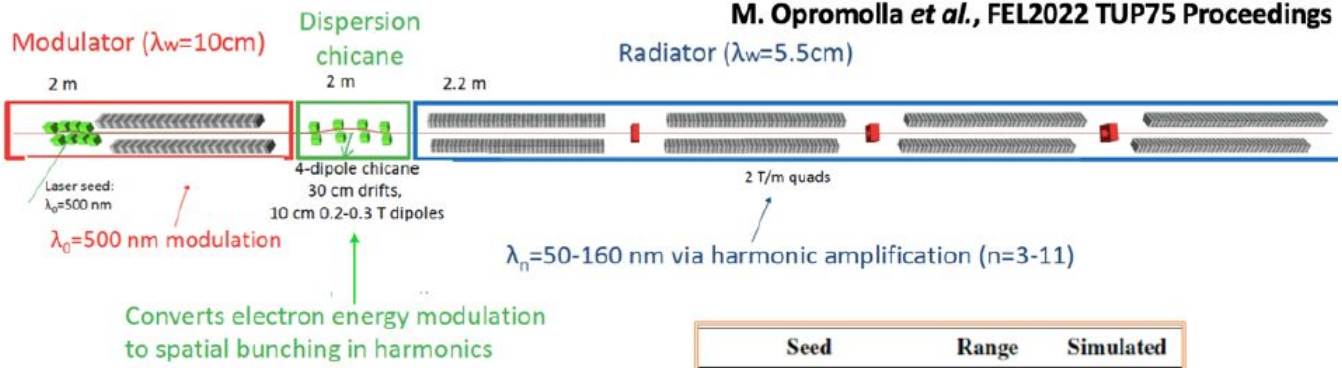
- Full Wiki and documentation
- Extended notebooks and examples
- Convertors for SRW and other codes*

*SU files can always be converted

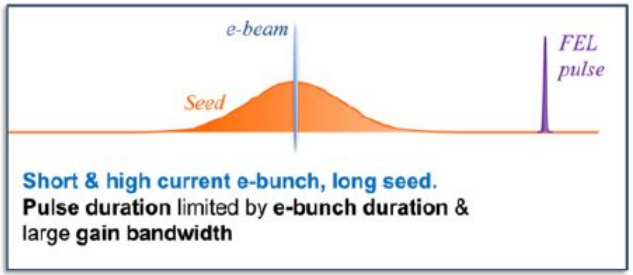


ARIA baseline layout

M. Opromolla *et al.*, FEL2022 TUP75 Proceedings



Seed	Range	Simulated
Wavelength (nm)	410-560	460
Pulse energy (μJ)	1-30	6-30
FWHM Duration (fs)	150-200	170



Short & high current e-bunch, long seed.
Pulse duration limited by **e-bunch duration** & large **gain bandwidth**

Long & low current e-bunch, long seed.
Pulse spectral width limited by **e-bunch energy correlation → wavelength linewidth stability by seed coherence**

Different and complementary to long-e bunch, low current and short seed (FERMI style)

Goals and Current Status

Elettra Sincrotrone Trieste

Goals: Provide a start-to-end framework for performing simulations of the linac and FEL lines, and for storing the data in a standardised format in a common location.

General requirements:
- Allow configuration of all machine parameters.
- Read the lattice:
  - From a lattice file.
  - Live from the control system.
  - From a measurement file.
  - Custom setups.
- Save parameters to a database and a common location.
- Scan single parameters.
- Optimise parameters.

E-Beam:
- Include collective effects.
- Generate initial bunch, or load from file (measured or simulated).
- Injector simulation.

FEL:
- Send files to cluster and execute.
- Load electron beam profile.
- Transition between GENESIS and OCELOT/ELEGANT for chicanes / drifts.
- All polarisation states available.
- One4one simulations.
- Two seeds available.
- Exotic configurations (ultrafast polarisation switching, attosecond pulses....).

Motivations:
- It is hard to keep track of all your simulations and to store them logically.
- Interfacing between the machine and tracking codes is useful for benchmarking.
- Files are not often saved consistently and in a common format.
- Simulations are run differently by different people.
- Comparisons between codes can be laborious.

Available
In progress
Not available

alexander.brynes@elettra.eu

General Particle Tracer (GPT)

- About GPT
  - Proprietary code in development since 1996
  - 3D particle tracking in time domain (adaptive stepsize)
    - Macroparticles
  - Complete freedom in particle distribution and beamline element orientation
  - Use custom fieldmaps
  - Users can create customized elements (not black box)
- Learning curve
  - Detailed manuals with examples
  - GUI interface available for Windows

FLASH2020+ Simulation Workshop: today's program

Tuesday, 27 February

09:30 → 10:00 **Welcome and Update from past workshops** — 30m
Speaker: Georgia Paraskaki (MFL (FLASH))

10:00 → 10:30 **Intro on GEIST library** — 30m
What is possible now and what is planned
Speaker: Dr Pardis Niknejadi (MPY (Beschleunigerphysik))

10:30 → 12:00 **Tutorial session: How to Get started with GEIST (with Hands-on)** — 1h 30m
Examples:
Simple Lattice Scan
Genesis input file parameter scans
Speaker: Hendrik Wenzel (U HH (Universitaet Hamburg))

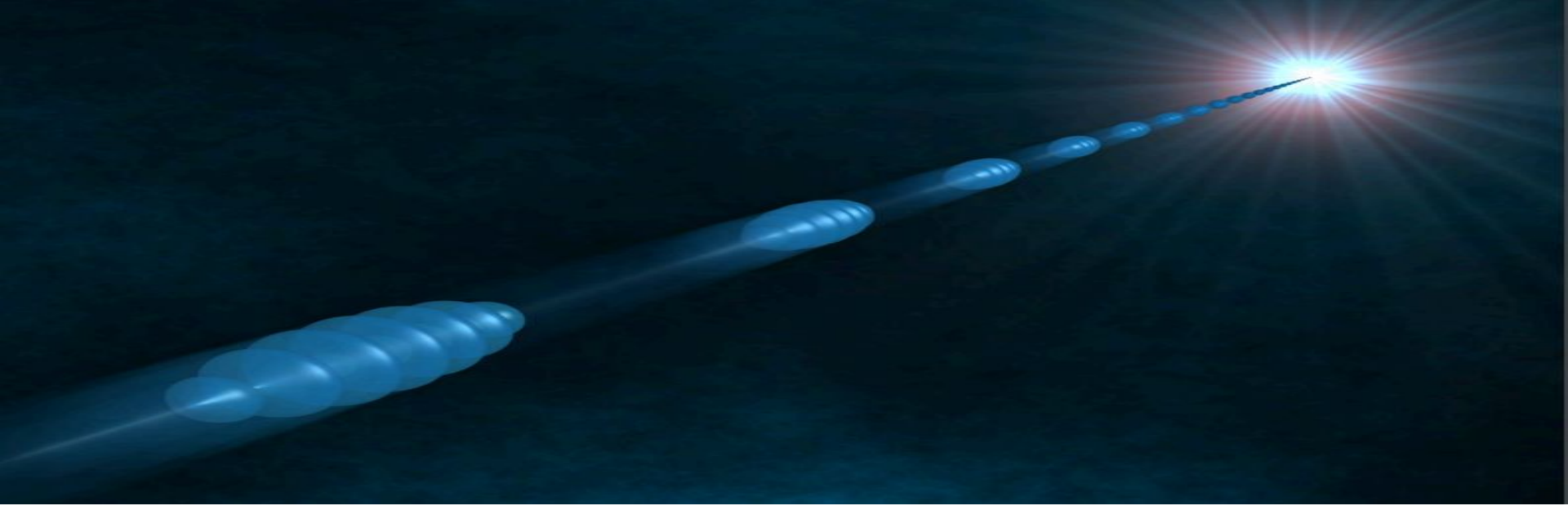
12:00 → 13:30 **Lunch** — 1h 30m
A light lunch will be provided

13:30 → 14:00 **3D FEL simulations in GPT using transverse Gauss-Laguerre modes.** — 30m
Speaker: Bas van der Geer (Pulsar Physics)

14:00 → 14:30 **Impact of space charge in HGHG FEL** — 30m
Speaker: Enrico Allaria (XFEL (XFEL))

14:30 → 16:00 **GEIST System check and Convert lattice (from MAD files)** — 1h 30m
Example: FLASH2
Speakers: Dmitrii Samoilenko (CFEL (CFEL - Dachgesellschaft)), Dr Pardis Niknejadi (MPY (Beschleunigerphysik))

16:00 → 16:30 **Discussion and Q&A** — 30m



Warm welcome to the workshop!

We hope for fruitful discussions and we are available for any questions or concerns

pardis.niknejadi@desy.de, georgia.paraskaki@desy.de, margarit.asatrian@desy.de

Links to our workshops:
1st S2E Simulation Workshop
2nd S2E Simulation Workshop
3rd S2E Simulation Workshop
4th S2E Simulation Workshop
Simulation Workshop