FLASH2020+

10th Progress Review Meeting

Welcome

Lucas Schaper
On behalf of all people contributing to the success of FLASH2020+
Hamburg, 08.03.2024

HELMHOLTZ

DESY.

Agenda

Start	End	Topic	Speaker	Duration
10:00	10:05	Welcome + Agenda	Lucas Schaper	5
10:05	10:35	Project Update	Lucas Schaper	20+10
10:35	11:05	Sub-Synchronisation	Sebastian Schulz	20+10
11:05	11:35	Seeding Updates	Pardis Niknejadi	20+10
11:35	12:05	Seed laser and Transport	Ingmar Hartl	20+10
12:05	13:05	Lunch Break		60
13:05	13:15	Science @ seeded high rep rate FELs	Markus Guehr	5+5
13:15	13:45	Tunnel Infrastructure	Olaf Rasmussen	20+10
13:45	14:25	Electron Beamline Installation	Christopher Gerth	25+15
14:25	14:45	Discussion and AOB	Lucas Schaper	20

FLASH2020+

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Project Update

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DESY.


Teamwork makes the beam work
FLASH
Accelerator - Lasers - Photon Science

One Mission: External Seeding

Remaining project goals will be realized in when resources are available

Credits: NASA

go to the moon

We choose to seed FLASH!

In this decade […]. Not because it is easy, but because it is hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win.

original by JFK on 12.09.1962

FLASH2020+

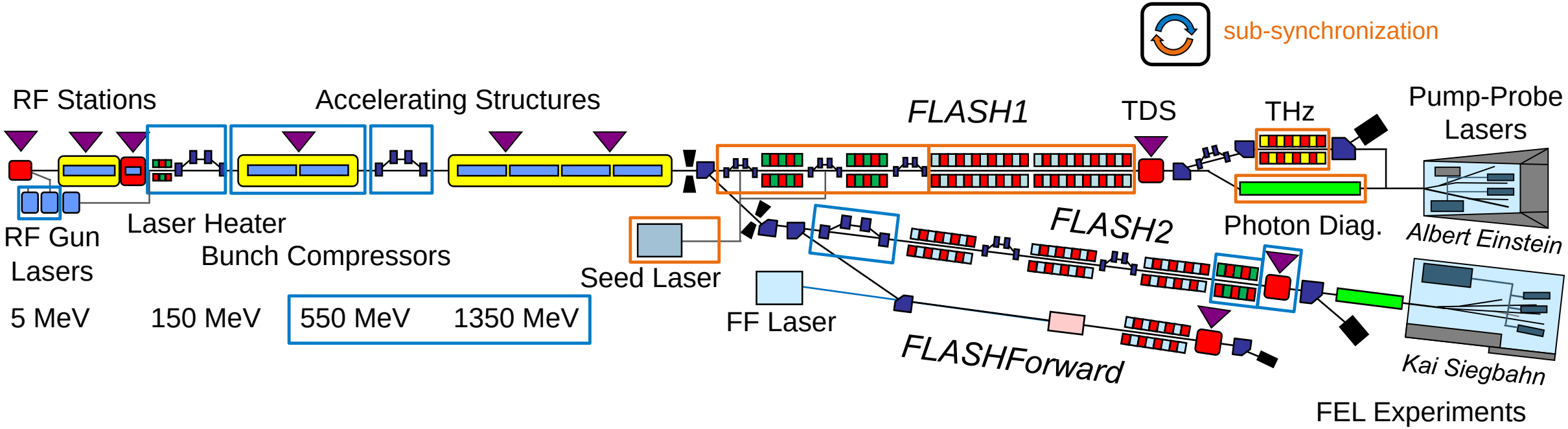
Modifications to FLASH facility

Tackled

3rd BC FLASH2	Injector laser
New BCs (linac)	Energy upgrade
Laser heater	Afterburner FLASH2
Fast orbit correctors	New beamline FL23 (FLASH2)
TDS (FLASH2)	Interim P-P laser (FLASH1)

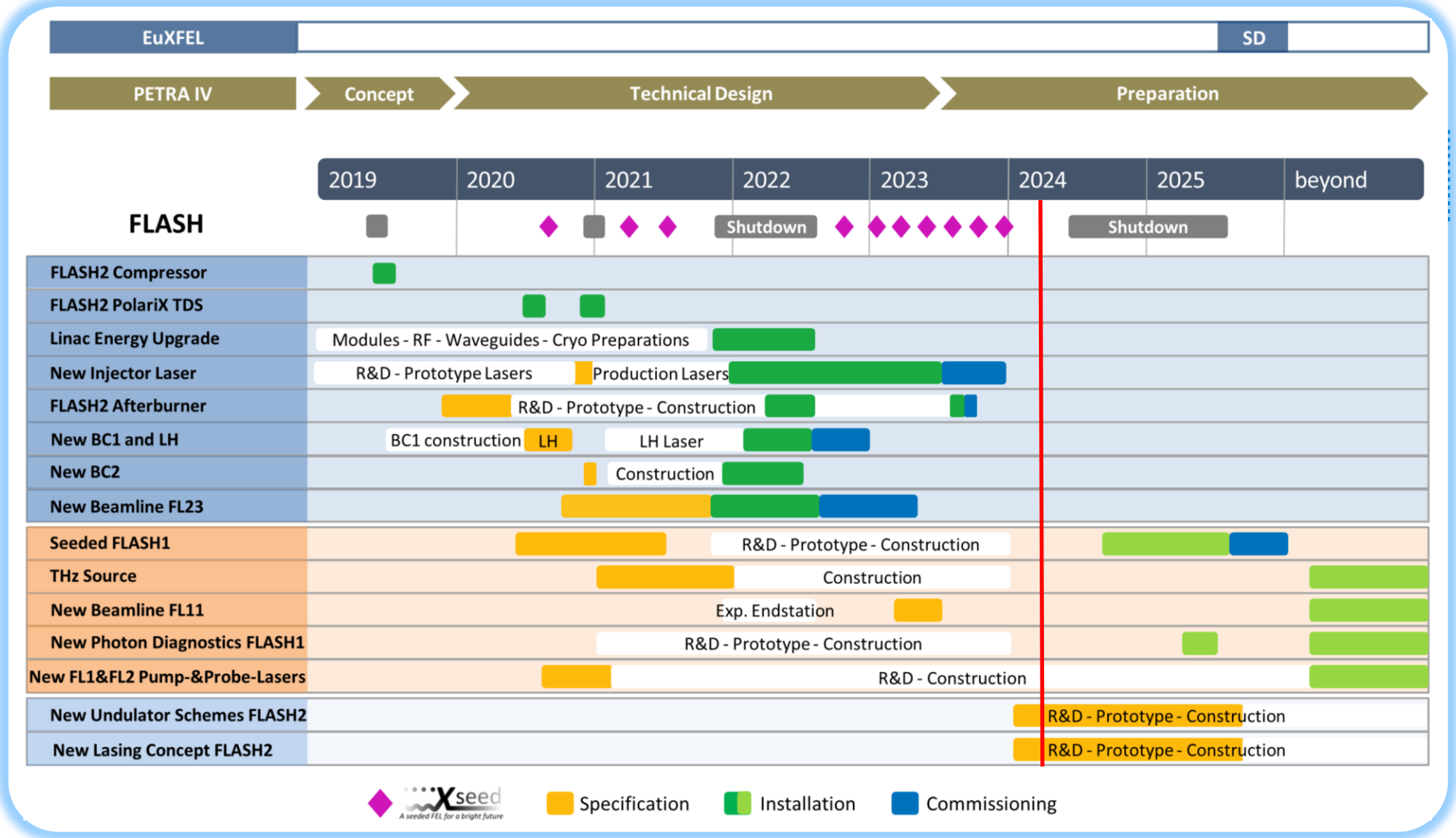
Now: Seeding

High rep. rate seeding (FLASH1)
Photon diagnostics (FLASH1)
THz Source



FLASH2020+

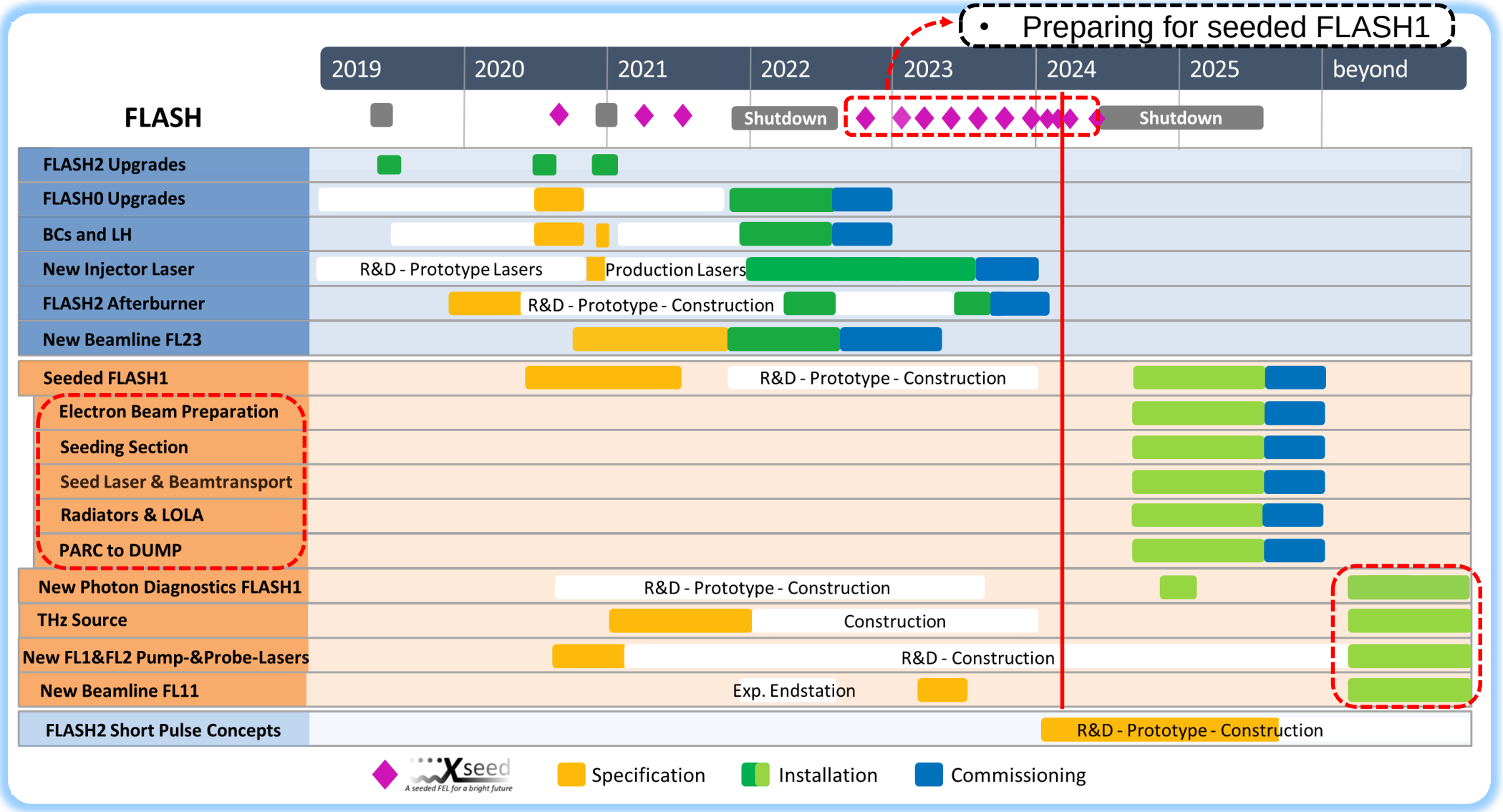
Project timeline



FLASH2020+

Project timeline

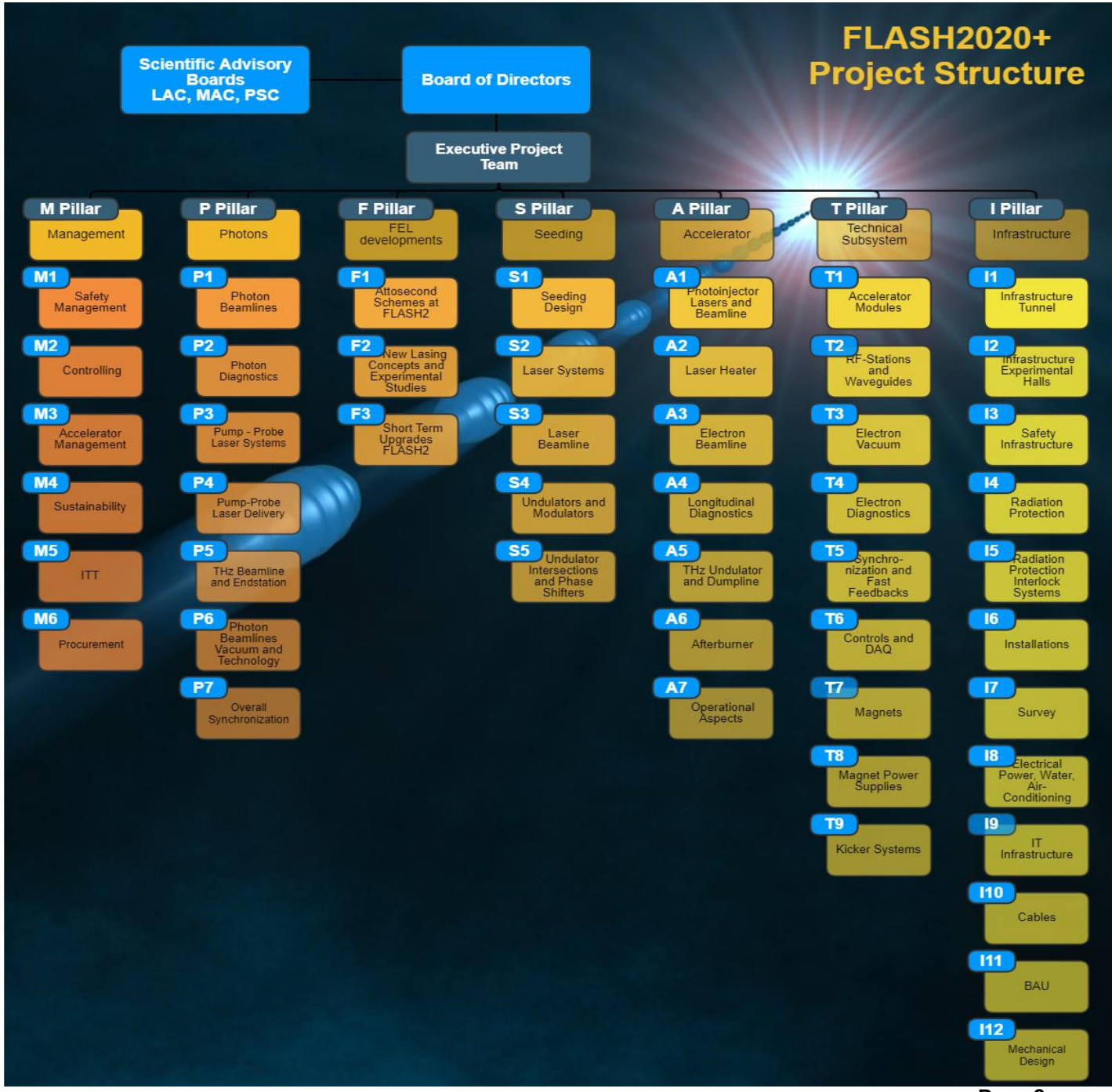
DAYS TO GO
95



FLASH2020+

Organization

- No changes in structure since last PRM
- Katja H. (WP M3) & Siegfried S. (EPT) currently on temporarily undefined sick-leave & unavailable for communication
  - (Interim) machine coordinator: Mathias Vogt
  - RSOs: Juliane Roensch-Schulenburg & Arne Brinkmann
  - LSO: Work in progress



Budget & controlling

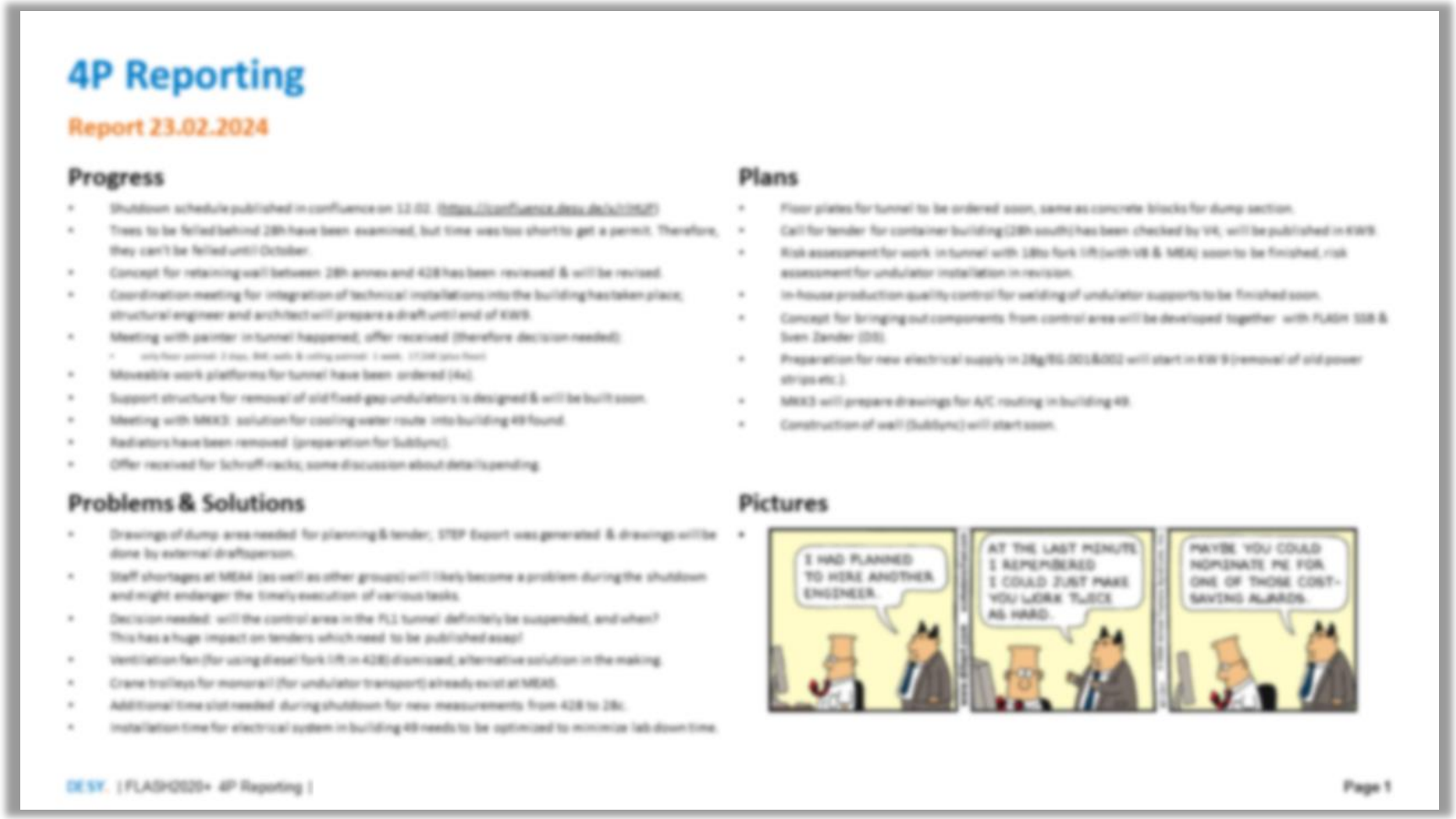
Highest priority project for FS & M (until end of shutdown)

- Project has been given highest priority by M and FS department
  - Full support of both directors → FLASH2020+ is crucial for mission success of DESYs
- Ordering, manufacture and preparation of installations for shutdown is key → Notify EPT in case of problems
  - Please participate in Monday 14:00 construction meeting
- No pot of gold for currently unforseen expenses or increase in prices → Notify EPT if there is any
  - Please keep FIRDs up to date to allow for better tracking
  - Please clearly indicate project context in ANY internal or external order (WA and PO) → **“FL2020+”**
  - PSPs from finished sub-projects of last shutdown have been closed
- Resources on manpower are very limited throughout most of DESY, a drastic change compared to the project start
  - E.g. for design and manufacturing the project survives on a delivery and installation slot driven prioritization
    - Should a change of priorities be required for specific components keep project lead in the loop

Project Status Reporting

New reporting format for faster turn-around

- Biweekly reporting format
- Filled out by subproject- and pillar leaders
  - All WPs kindly asked to contribute
- Usual status reporting for all WPs set on hold to evaluate if 4P is a sufficient and a suitable replacement



4P Reporting

Report 23.02.2024

Progress

- Shutdown schedule published in confluence on 12.02. (https://confluence.desy.de/x/1HbZF)
- Trees to be felled behind 28h have been examined, but time was too short to get a permit. Therefore, they can't be felled until October.
- Concept for retaining wall between 28h annex and 428 has been reviewed & will be revised.
- Coordination meeting for integration of technical installations into the building has taken place, structural engineer and architect will prepare a draft until end of KW9.
- Meeting with painter in tunnel happened, offer received (therefore decision needed):
- Moveable work platforms for tunnel have been ordered (4x).
- Support structure for removal of old fixed-gap undulators is designed & will be built soon.
- Meeting with MKK3: solution for cooling water route into building 49 found.
- Radiators have been removed (preparation for Subsync).
- Offer received for Schroff racks, some discussion about details pending.

Plans

- Floor plates for tunnel to be ordered soon, same as concrete blocks for dump section.
- Call for tender for container building (28h south) has been checked by V4, will be published in KW9.
- Risk assessment for work in tunnel with 18to fork lift (with VB & MEA) soon to be finished, risk assessment for undulator installation in revision.
- In-house production quality control for welding of undulator supports to be finished soon.
- Concept for bringing out components from control area will be developed together with FLASH 1SB & Sven Zander (DS).
- Preparation for new electrical supply in 28g/EG.001&002 will start in KW 9 (removal of old power strips etc.).
- MKK3 will prepare drawings for A/C routing in building 49.
- Construction of wall (Subsync) will start soon.

Problems & Solutions

- Drawings of dump area needed for planning & tender; STEP Export was generated & drawings will be done by external draftsperson.
- Staff shortages at MEA4 (as well as other groups) will likely become a problem during the shutdown and might endanger the timely execution of various tasks.
- Decision needed: will the control area in the FL1 tunnel definitely be suspended, and when? This has a huge impact on tenders which need to be published asap!
- Ventilation fan (for using diesel fork lift in 428) dismissed, alternative solution in the making.
- Crane trolleys for monorail (for undulator transport) already exist at MEA5.
- Additional time slot needed during shutdown for new measurements from 428 to 28c.
- Installation time for electrical system in building 49 needs to be optimized to minimize lab down time.

Pictures

DESY. | FLASH2020+ 4P Reporting | Page 1

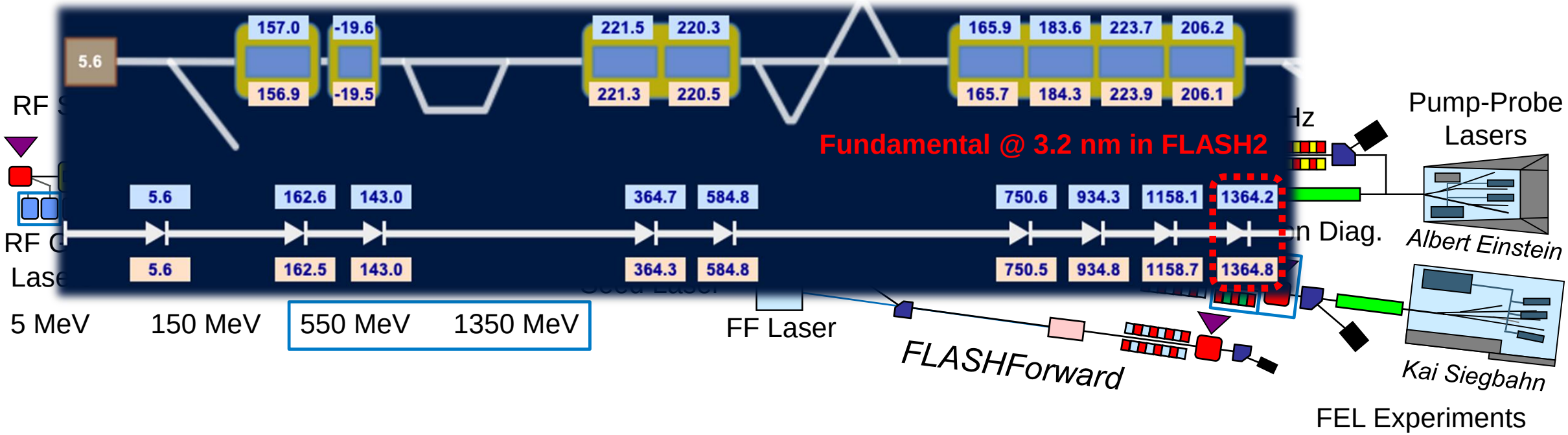
FLASH2020+

Modifications to FLASH facility

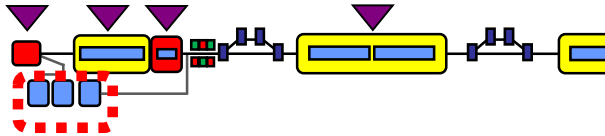
Tackled

3rd BC FLASH2	Injector laser
New BCs (linac)	Energy upgrade
Laser heater	Afterburner FLASH2
Fast orbit correctors	New beamline FL23 (FLASH2)
TDS (FLASH2)	Interim P-P laser (FLASH1)

- ✔ Improved electron beam & diagnostics
- ✔ New operation modes
- ✔ Increased parameter range
- ✔ Opportunities for new experiments

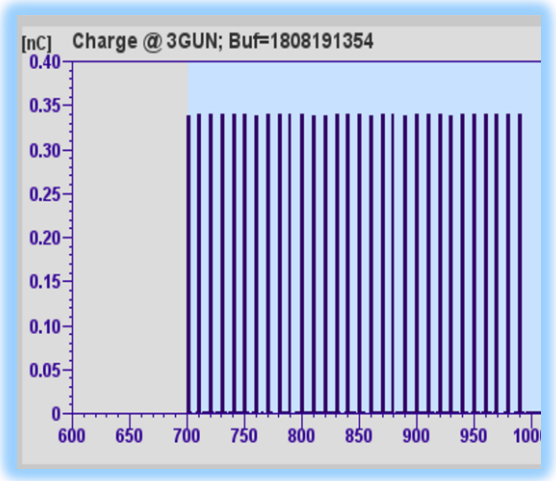


New injector lasers unlock new operation modes

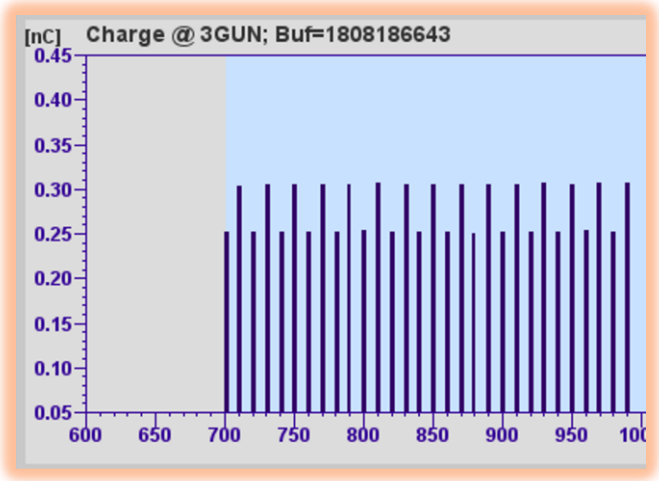


In regular user operation now!

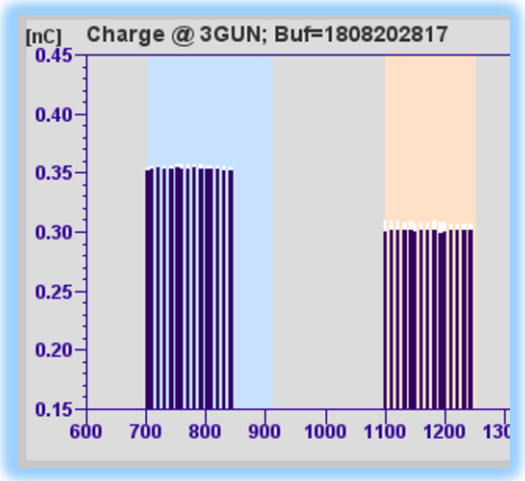
Constant charge



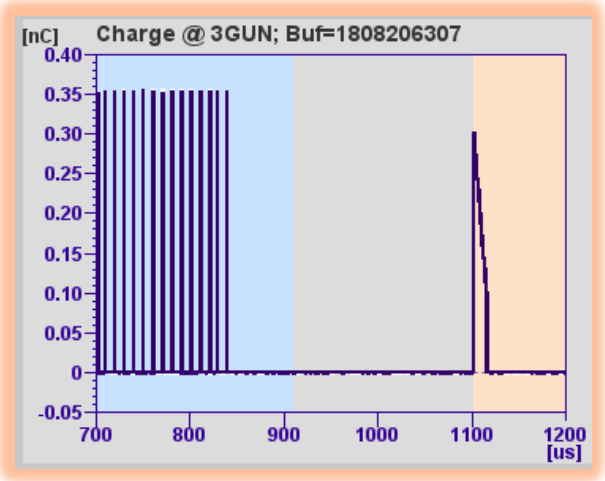
Variable charge pattern



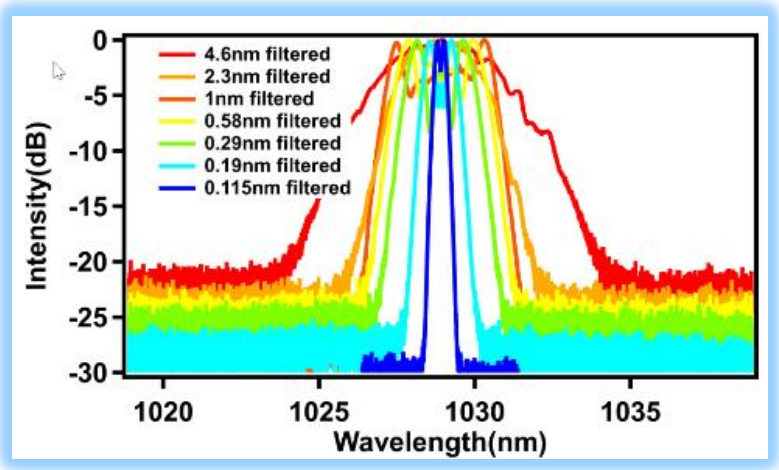
Single laser FL1 & FL2



Different patterns FL1 & FL2



Bandwidth control → pulse duration



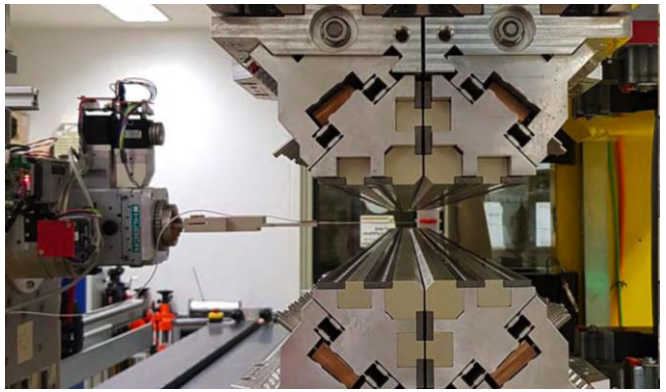
- two separate FEL branches FLASH 1 and FLASH2 with independent user experiments
- typically different requirements on charge, bunch length, rep-rate, etc

- Transited into user operation at beginning of 2024
- High flexibility in operation schemes
- Offer potential for new experiments, e.g. tunable SASE pulse duration

Courtesy F. Pressacco, C. Mahnke & I.Hartl

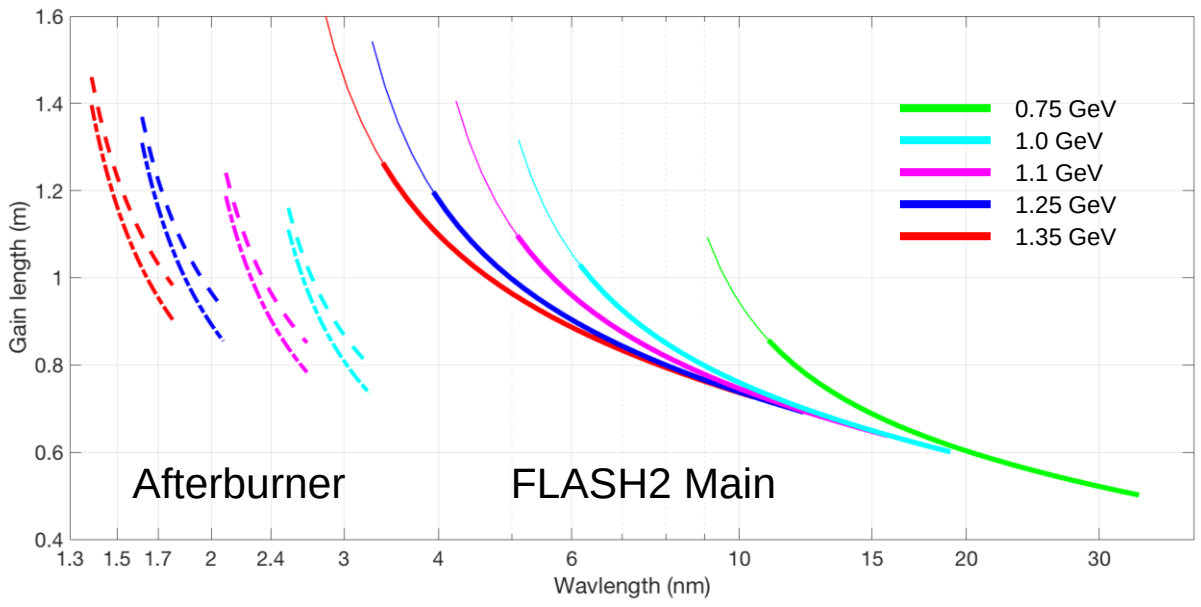
APPLE 3 radiators: Afterburner commissioning

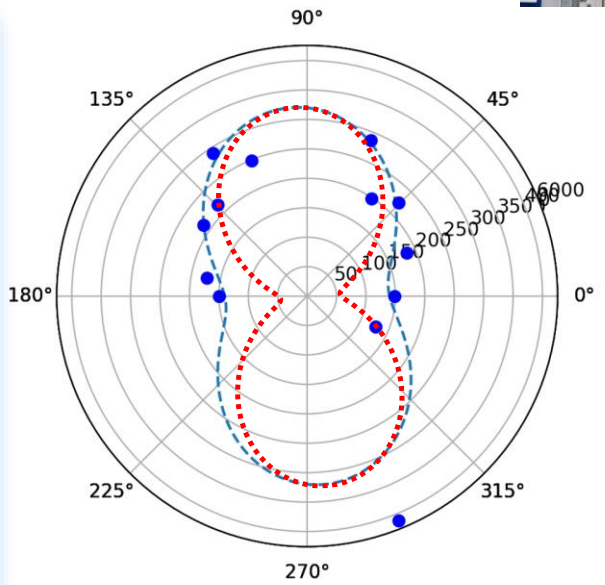
Demonstrated boost of 3rd harmonic and polarization control



- Very high circular polarization for “plus”
- Slight ellipticity for “linear vertical” (see red dots)
- Strong 3rd harmonic increase in resonance

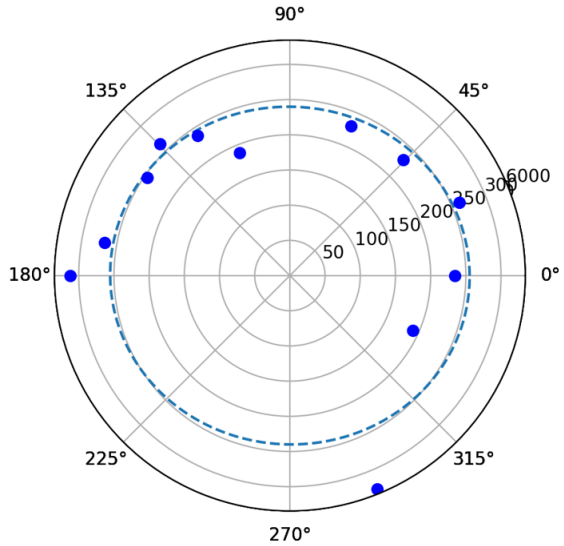
- 2 Experiments schedules before shutdown start on 10th of June!





➢ **Linear vertical**

➢ (red would be 100% linear)



➢ **Circular ‘plus’**

Courtesy P. Vagin, M. Braune, M. Ilchen, T. Otto, S. Savio

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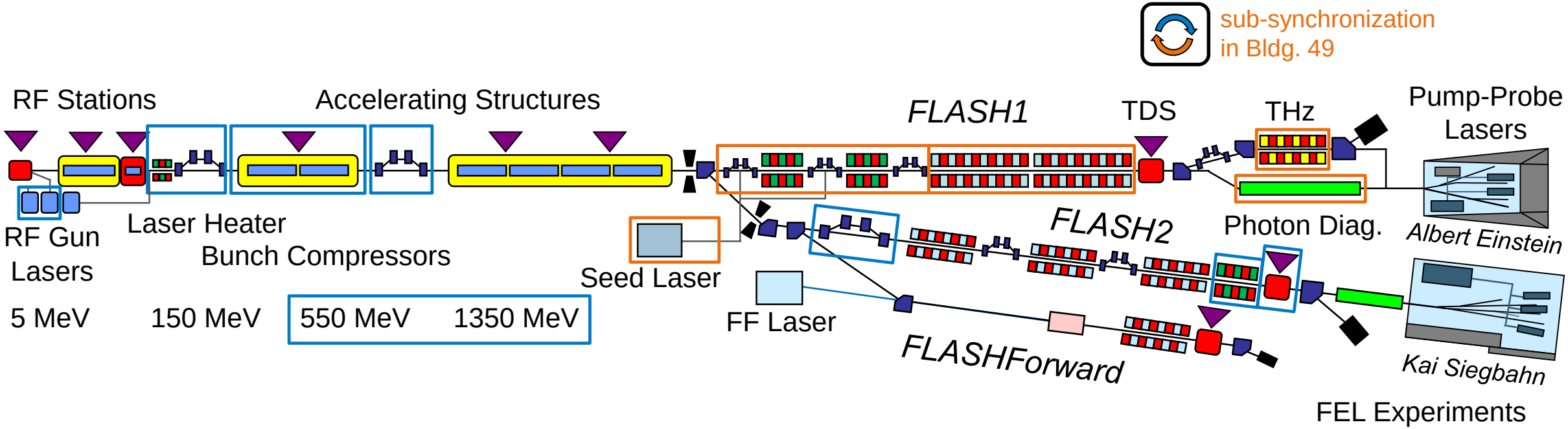
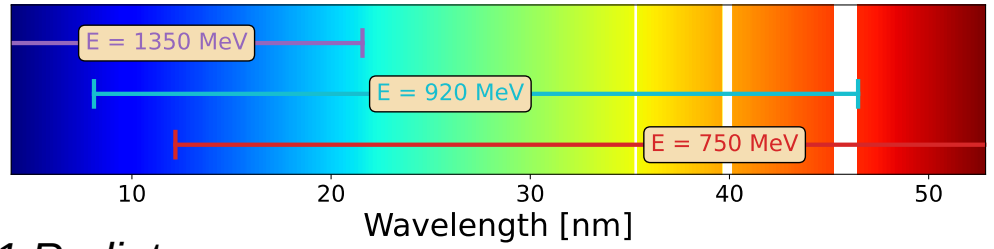
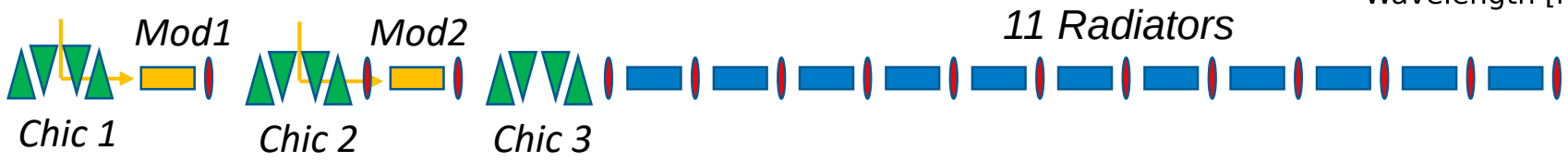


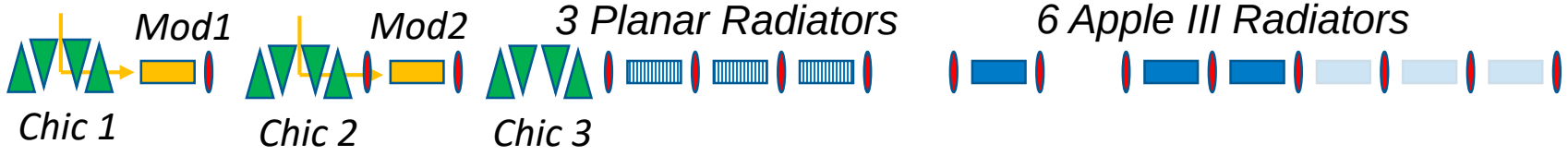
Capabilities of Seeded FLASH1

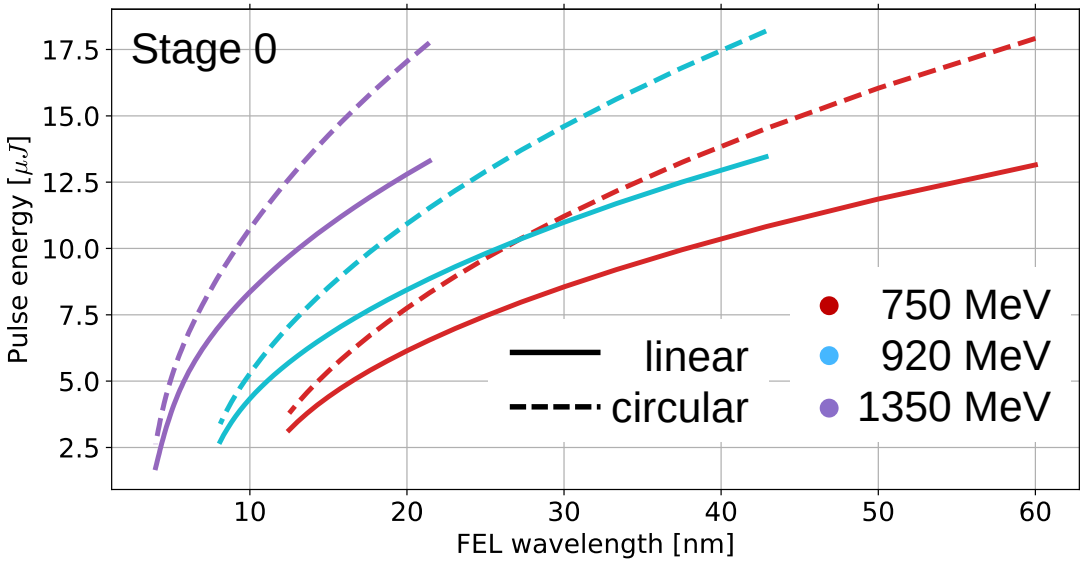
What we can build under given circumstances





Upgrade to full version when budget becomes available

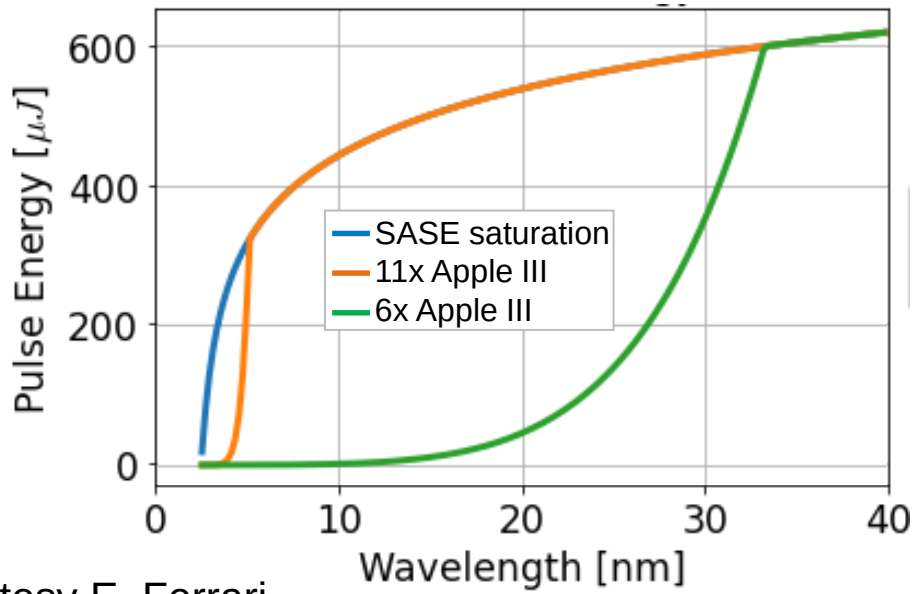




← Seeded operation

→ SASE operation

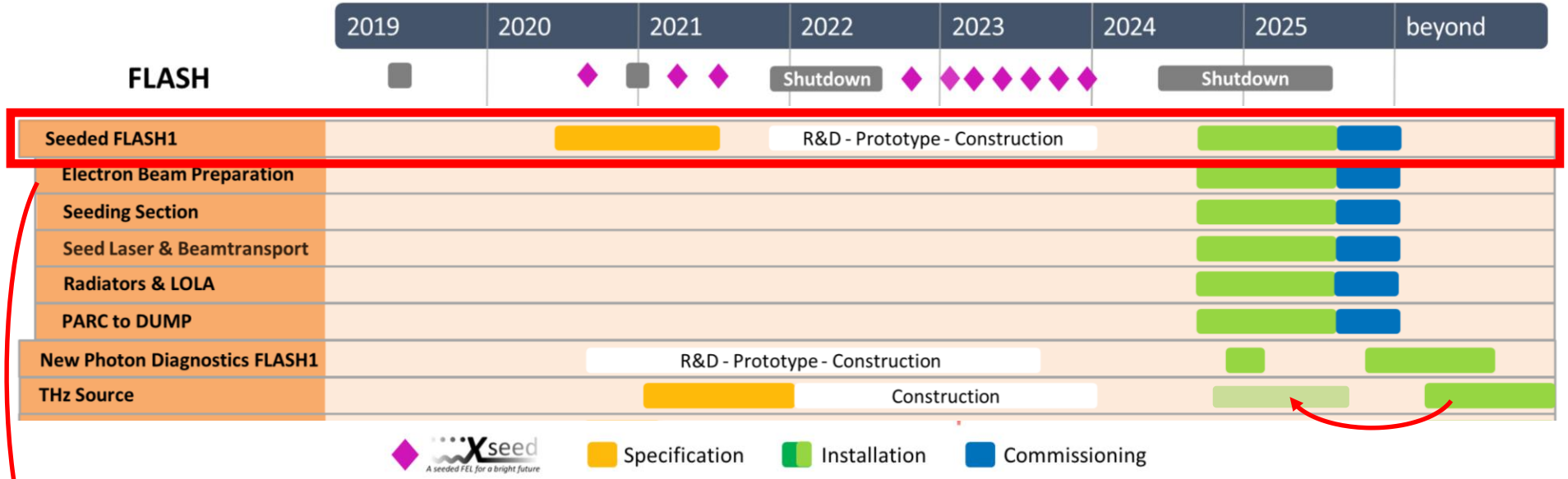
Seed laser availability is crucial for successful beam delivery & experiments!

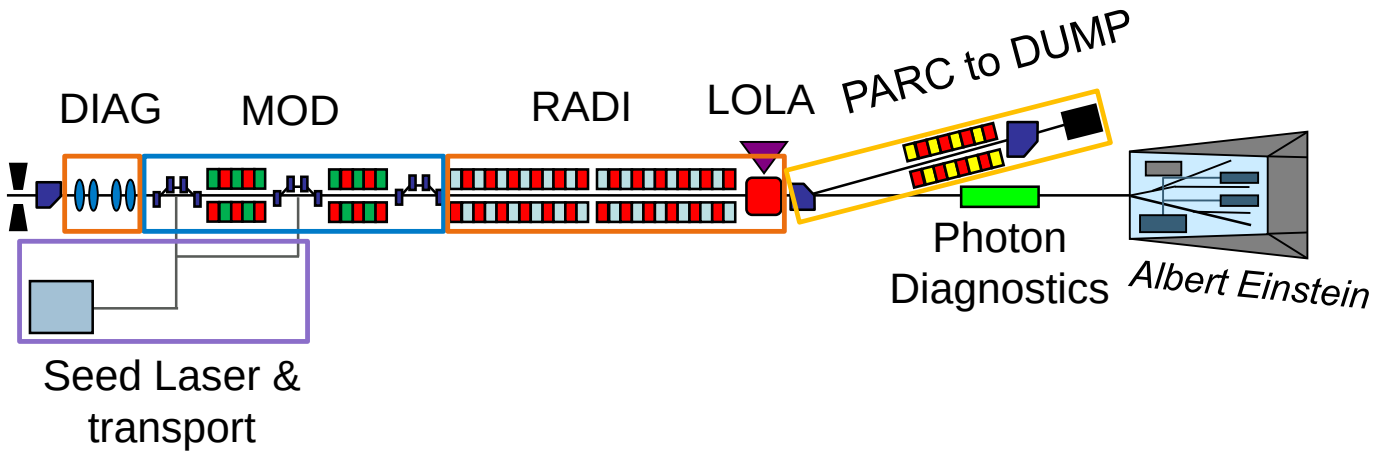


Courtesy E. Ferrari

FLASH1 sectional view

Breaking down into sections allows for more efficient planning and tracking





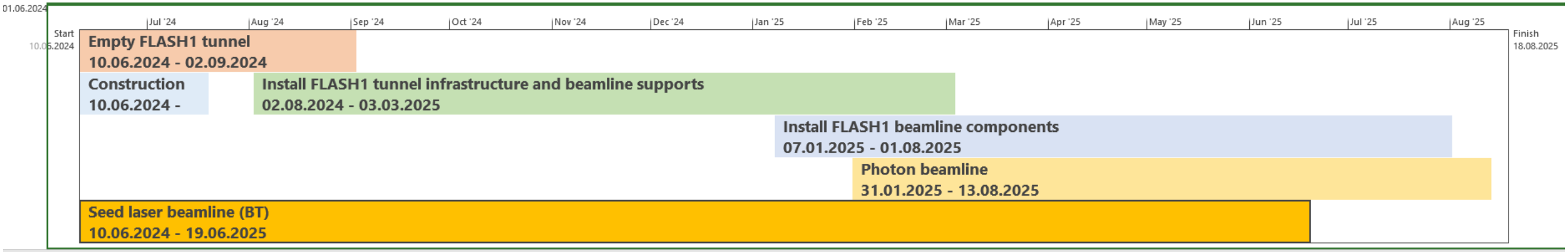
Seeded FLASH 1 in section perspective

- Seed Laser & Beamtransport
- Electron beam preparation
- Seeding Section
- Radiators & LOLA
- PARC to DUMP

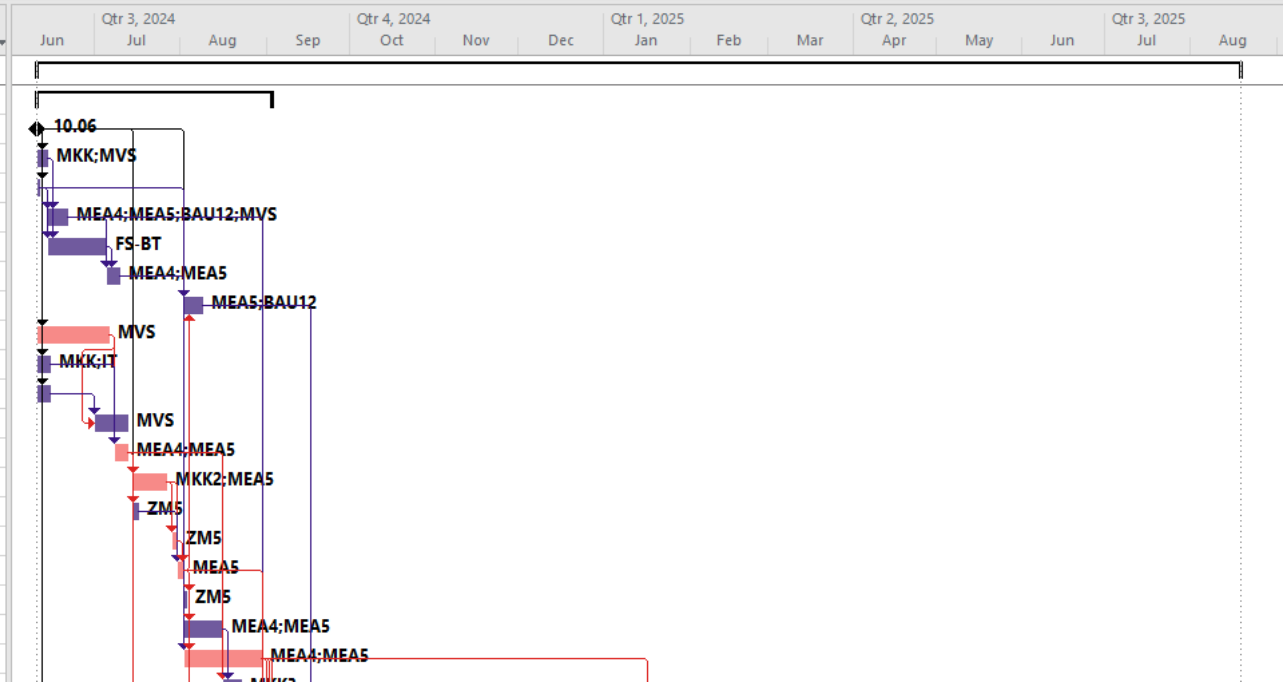
- Infrastructure → I-Pillar lead

Shutdown Planning

A glimps at timescales



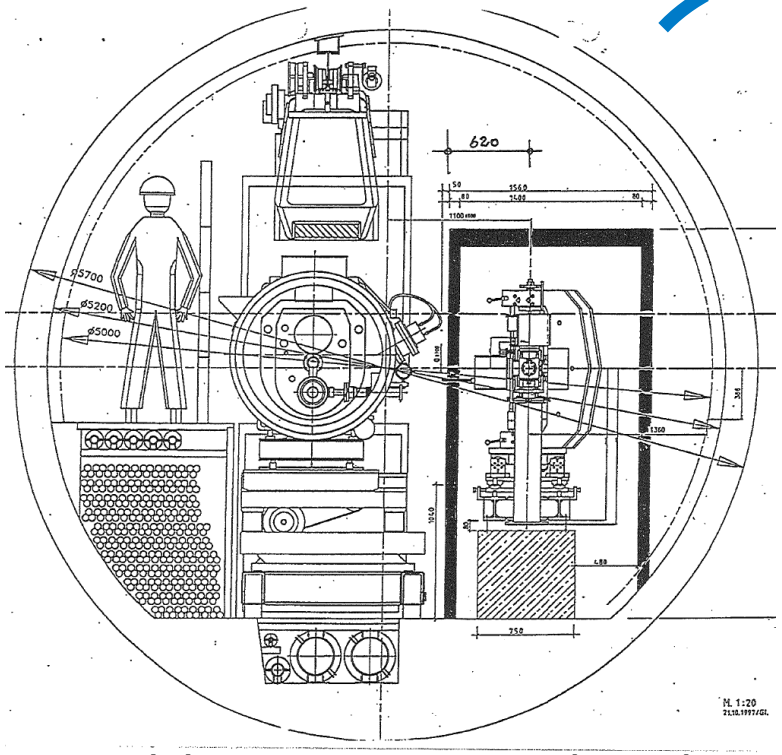
	Task Mod	Task Name	Duration	Start	Finish
1		FLASH SHUTDOWN 2024-2025 (FLASH1 Tunnel)	297 days	10.06.2024	18.08.2025
2		Empty FLASH1 tunnel	61 days	10.06.2024	02.09.2024
3		Begin of shutdown; tunnel open	0 days	10.06.2024	10.06.2024
4		THz+DUMP section: disconnect cables, water, diagnostics, vacuum	4 days	10.06.2024	13.06.2024
5		Mark components (stickers)	1 day	10.06.2024	10.06.2024
6		Remove THz-Undulator + Dump dipole + electron beamline	5 days	14.06.2024	20.06.2024
7		Remove photon beamline (DUMP area)	15 days	14.06.2024	04.07.2024
8		Remove beamline supports + stones (DUMP area)	3 days	05.07.2024	09.07.2024
9		Remove shielding stones in DUMP area + remove old dump (empty DUMP pit)	5 days	02.08.2024	08.08.2024
10		Disconnect / Ventilate Vacuum System	20 days	10.06.2024	05.07.2024
11		Empty and disconnect containers	5 days	10.06.2024	14.06.2024
12		SASE - TCOL: Disconnect cables, water, diagnostics	5 days	10.06.2024	14.06.2024
13		SASE -> TCOL: Disconnect and remove vacuum components	10 days	01.07.2024	12.07.2024
14		Remove containers	5 days	08.07.2024	12.07.2024
15		Remove old water pipes from Bilge (Bilge open, tunnel closed for traffic)	10 days	15.07.2024	26.07.2024
16		Cut old floor plate (Bogengang)	2 days	15.07.2024	16.07.2024
17		Install new floor plate support in Bogengang	2 days	29.07.2024	30.07.2024
18		Lay new floor plates	2 days	31.07.2024	01.08.2024
19		Install new stairs between 28a/b and 428	1 day	02.08.2024	02.08.2024
20		Remove Undulators (SASE+Xseed) + LOLA	10 days	02.08.2024	15.08.2024
21		SASE -> TCOL: Remove old electron beamline components + supports + stones	20 days	02.08.2024	29.08.2024



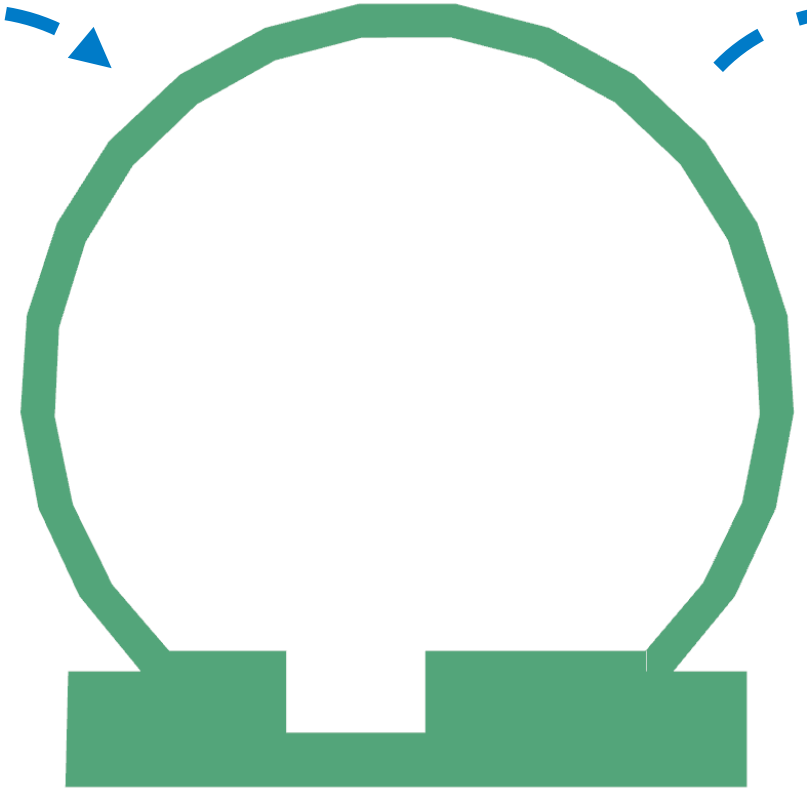
Shutdown in a nutshell: Empty and refill tunnel

Begin, intermediate and finished rebuild of FLASH1

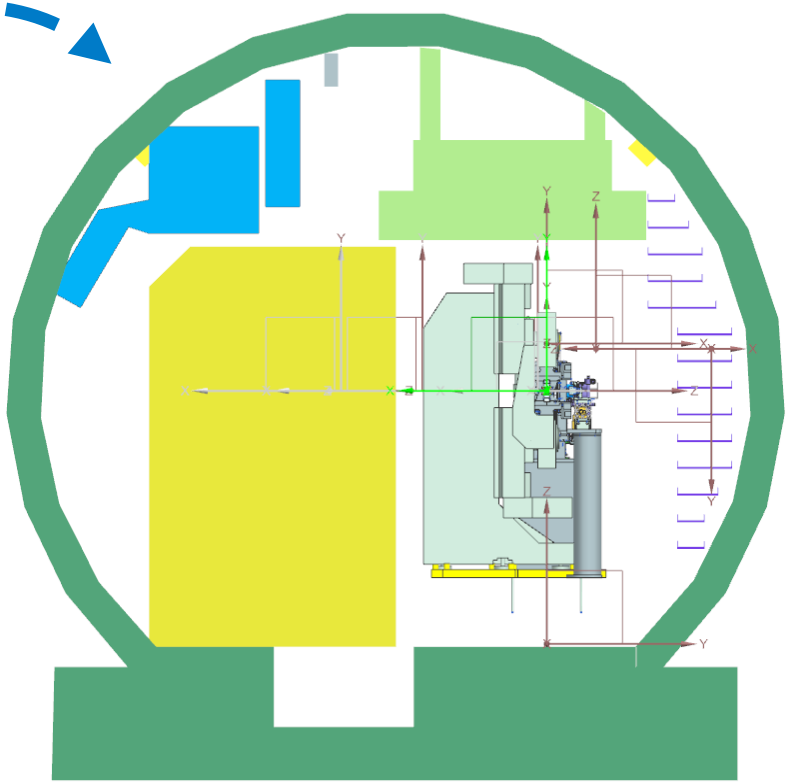
10.06.2024
Shutdown start

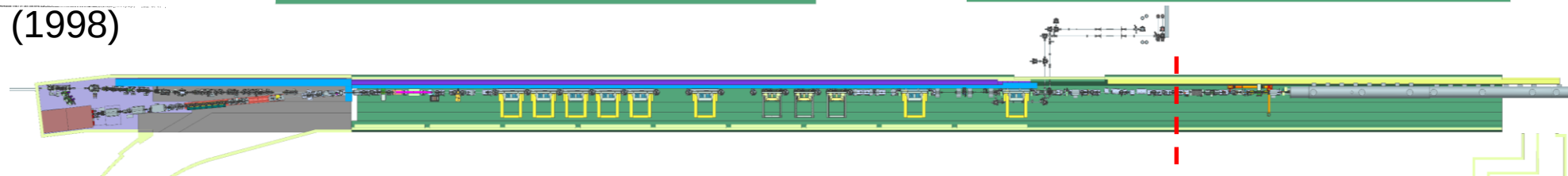


Ansicht aus Bauantrag (1998)



03.08.2024
Shutdown end



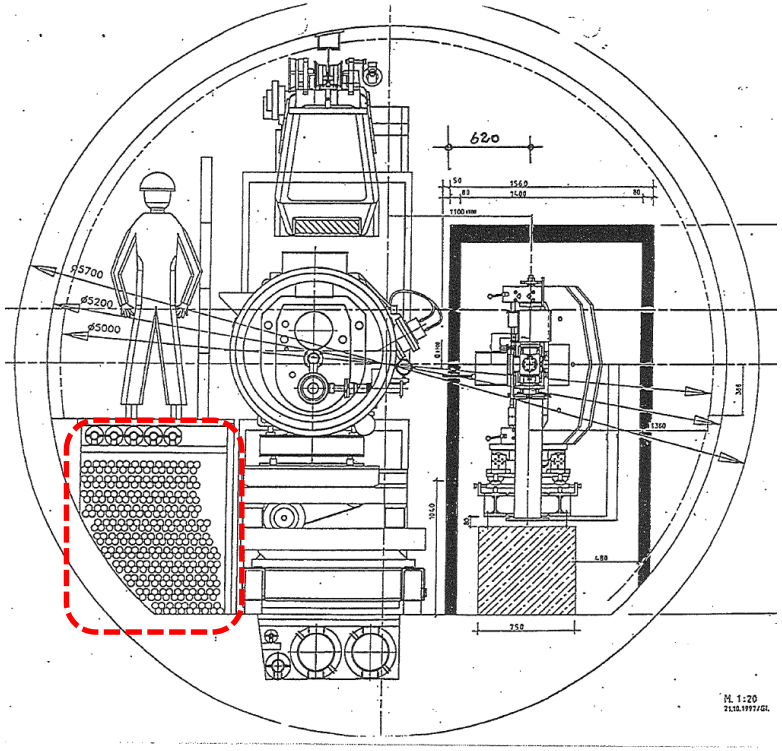


Cables and controlled access area

Completely empty tunnel allows lifting of radiation controlled area

- Cable-grave below walkway needs to be completely emptied
  - Currently working out different scenarios for removal process
    - External vs internal
    - Cost, time, compatibility to shutdown schedule, …
  - Once converged to a solution it will be presented!

- Once tunnel is emptied: Lifting of radiation controlled area possible
  - Allows for external companies to work in the tunnel without §25
  - Likely final position of separation zone around 160m
  - FLASH0 ”the linac” will remain controlled area
  - Currently working on solution for access during interlock exchange



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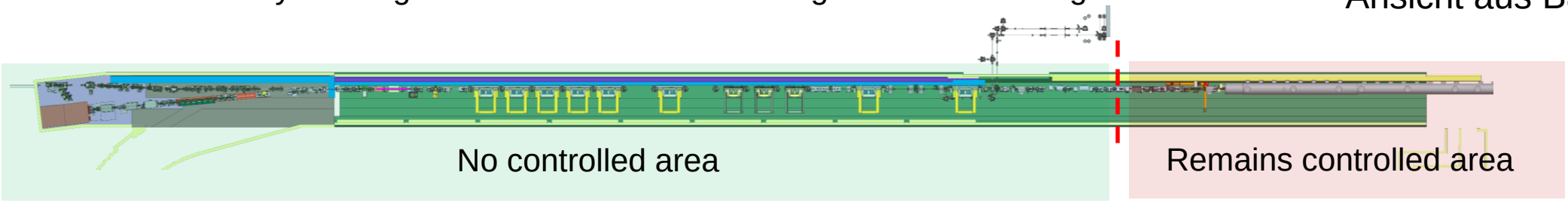
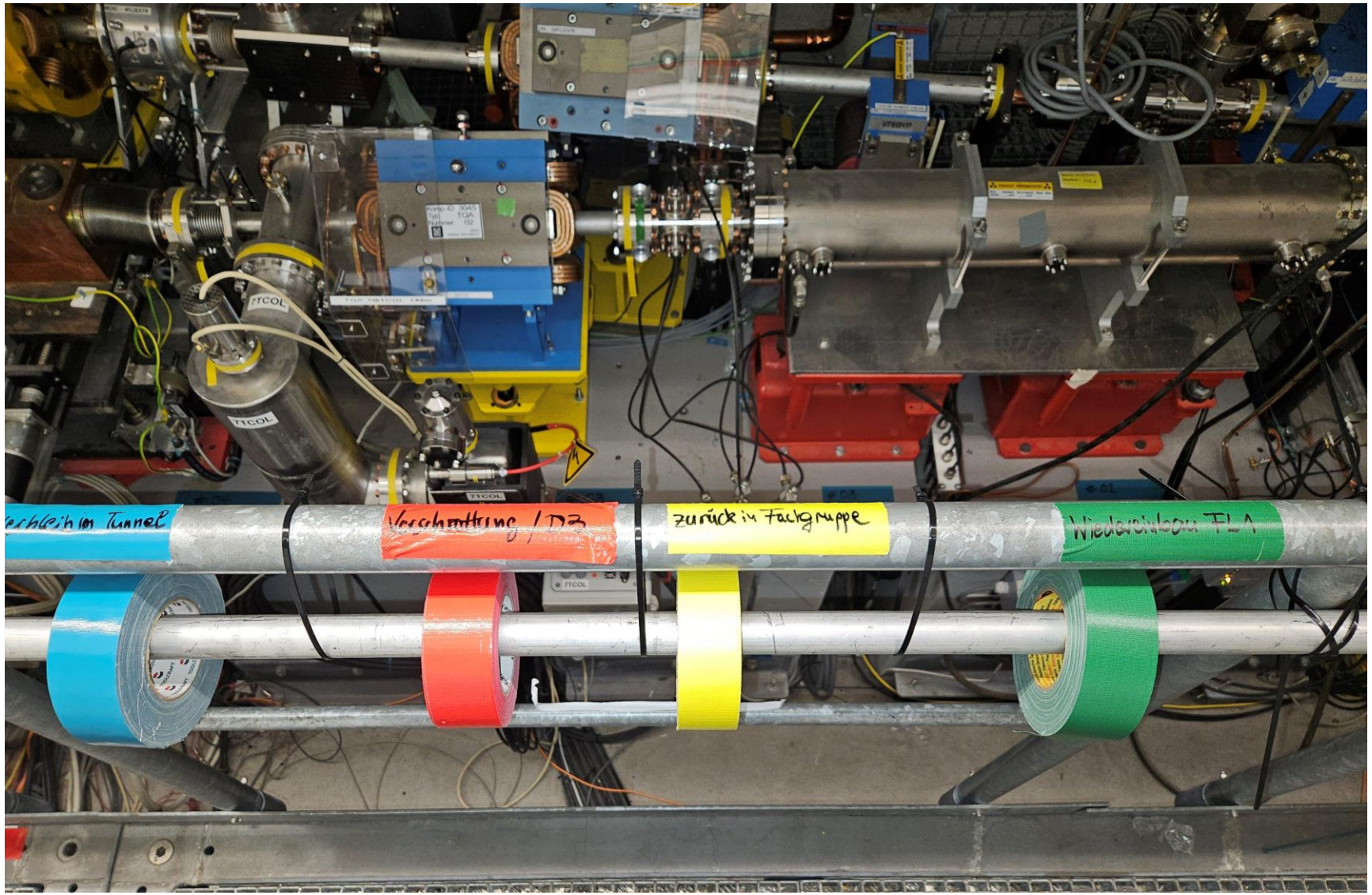


Rote, Gruene, Gelbe, Blaue

Liebe DESYaner kommt und labelt!



DAYS TO GO

95

Thanks for making good use of the maintenance days to prepare!

Next Opportunity: 16th April 2024

Potentially also 30th April 2024

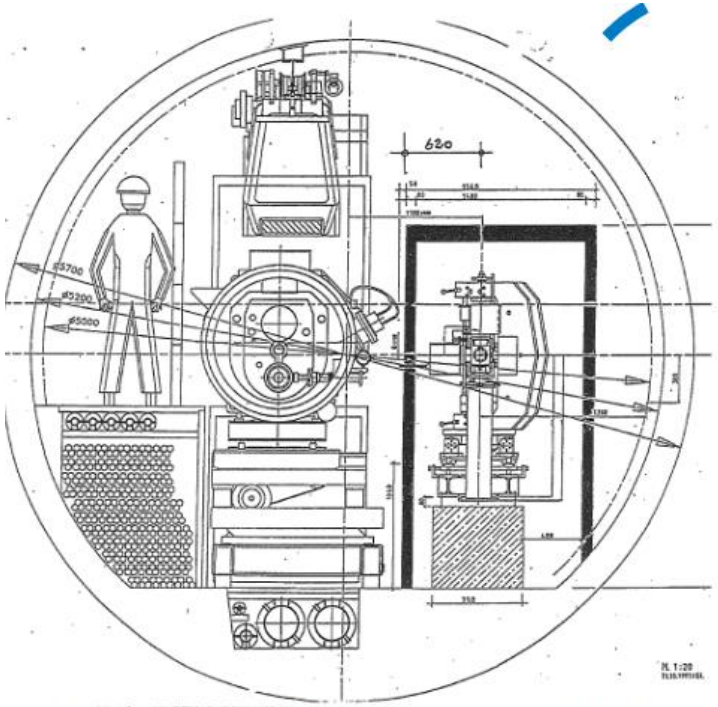
- All components without label will turn red by default
- Shutdown colour code:
  - Sell or Dispose
  - Back to owner
  - Reinstall at FLASH1
  - Remains in tunnel (optional)
- Include group, POC, phone number on label
- Include electronics and control boxes in containers!

Shutdown: Radiation safety

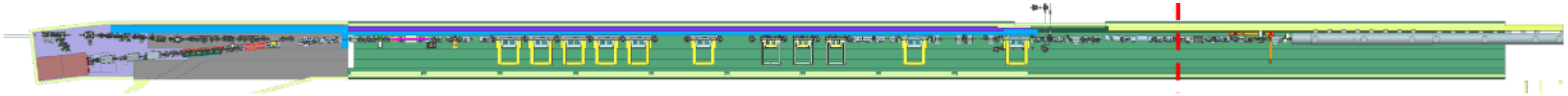
Removing components from the tunnel

Chronologisch

- Rolltor Hockeyschläger wird mit Schlüsselschalter versehen (Schlüssel nur an MEA, D3)
- Ausbau der Beschleunigerkomponenten von der Dumpseite zurück zum Septum (über Hockeyschläger)
- Ebenso Container, Kabel und Wasserleitungen (über Hockeyschläger)
- Abbau Dump folgt
- Leerer Tunnelbereich wird von D3 ausgemessen und Kontrollbereich aufgehoben (neues gelbes Gitter im Tunnel an der Kontrollbereichsgrenze, verdachst)



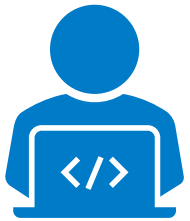
Ansicht aus Bauantrag (1998)

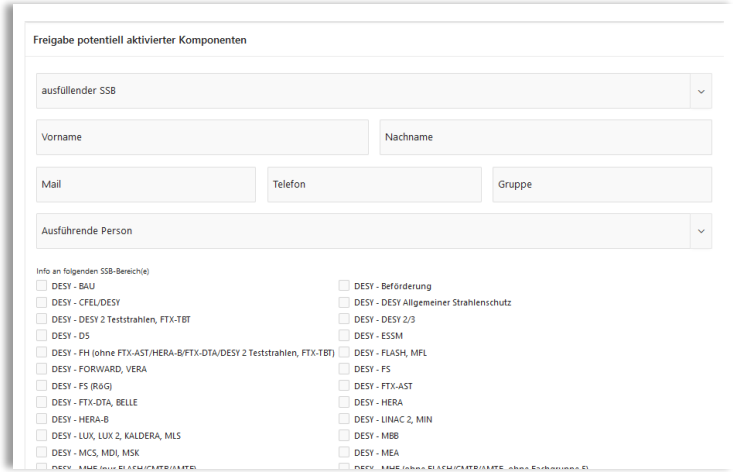


How to get stuff out?

Alles wie gewohnt: Ticketsystem und Formular zum Herausbringen

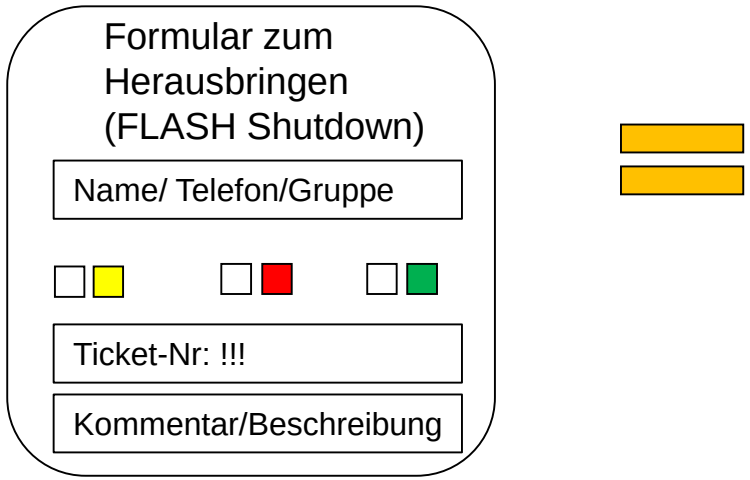
Anmeldung zum Herausbringen per Ticketsystem durch den SSB:





- möglichst mit Foto
- frühe Anmeldung erwünscht (mit geplanter KW)

Formular zum Herausbringen durch tätige Person vor Ort:



MEA

- Nach Farbe und Gruppe sortiert im Hockeyschläger bereitstellen
- Formular muss an Komponente/ Box etc befestigt sein

Colour determines trajectory

Vorsortierung auf Palette und Kisten nach Farbe

ungelabelt gilt als rot!

Kleinteile / Schrauben
(Schrott)

Gelbe Kiste im
FLASH-Tunnel

Kein Ticket

Halle 31a

alle Kabel,
alle Container,
alle Rohre

Reemtsmahalle 80b

Wenn Teile
freigegeben sind
(Rückmeldung über
das Ticketsystem)

D3-Ansprechpartner:
Kay-Uwe Hartz (92386),
Patrick Hartz (95549)
Simon-Lando Gerdt (93373)

Gruppen

80d

FLASH2020+

Modifications to FLASH facility

Tackled

3rd BC FLASH2	Injector laser
New BCs (linac)	Energy upgrade
Laser heater	Afterburner FLASH2
Fast orbit correctors	New beamline FL23 (FLASH2)
TDS (FLASH2)	Interim P-P laser (FLASH1)

Now: Seeding

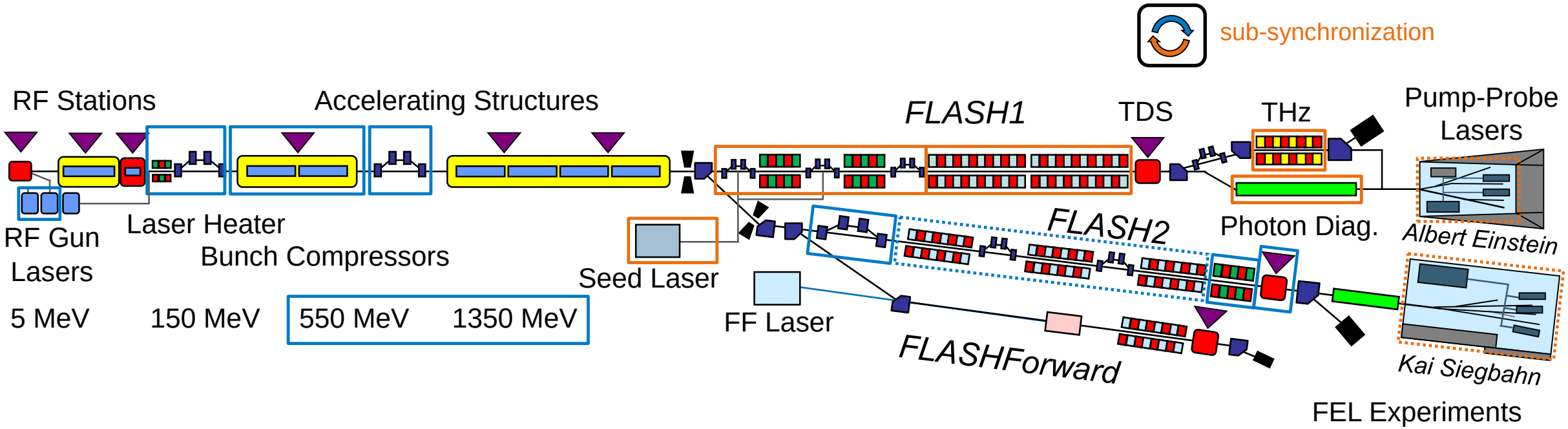
High rep. rate seeding (FLASH1)
Photon diagnostics (FLASH1)
THz Source

Actively delayed

Flexible pump-probe lasers
New beamlines
THz Source

Future

New undulator schemes (FLASH2)
New lasing concepts (FLASH2)



Thank you

Contact

Deutsches Elektronen-Synchrotron DESY

www.desy.de

Lucas Schaper

E-mail: Lucas.Schaper@desy.de
Phone: +49 (0)40 8998 5073

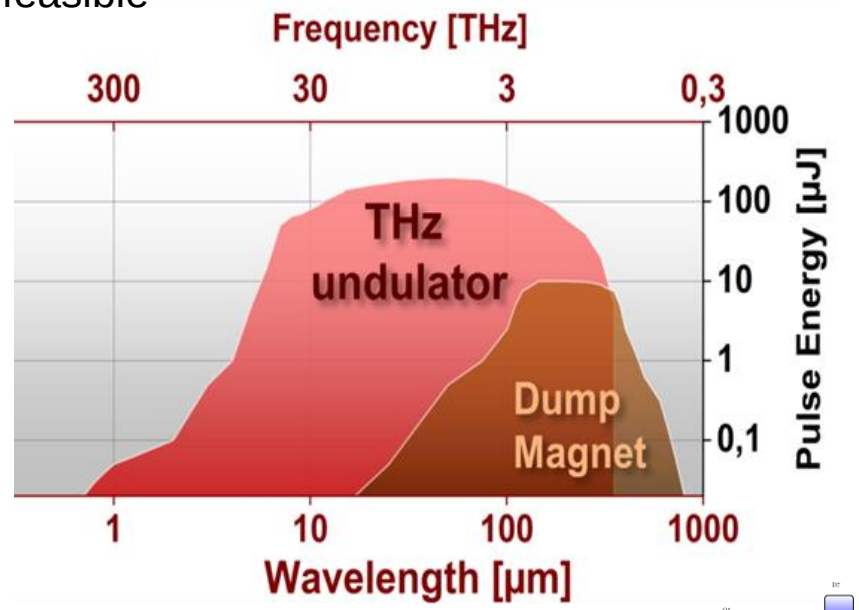
THz from FLASH1 after upgrade

Developing towards full parallel operability

Parallel to seeding: Post compression of electron beam required for meaningful THz intensity

- Without post compression: factor 1000 intensity reduction

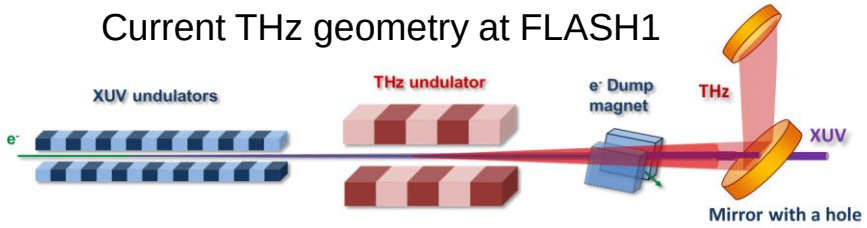
Dedicated THz only runs at high bunch compression without seeding feasible



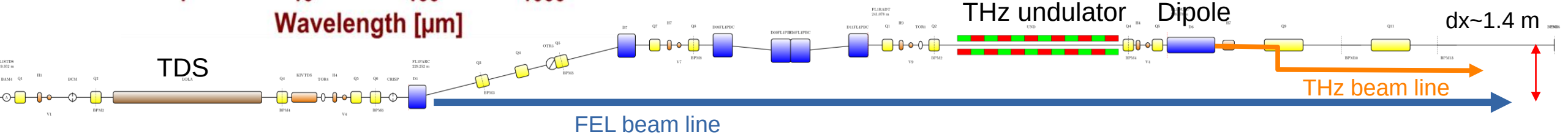
Upgrade path:

1. Install THz beam transport from tunnel to experiments
   - We are trying hard to make this possible during the next shutdown already
2. Pump probe laser for FL11
3. Install dedicated post compression chicane upstream THz undulator → full parallel operation to seeded FEL
   - THz + FEL + PP laser
   - THz standalone, FEL at other beamline

Current THz geometry at FLASH1

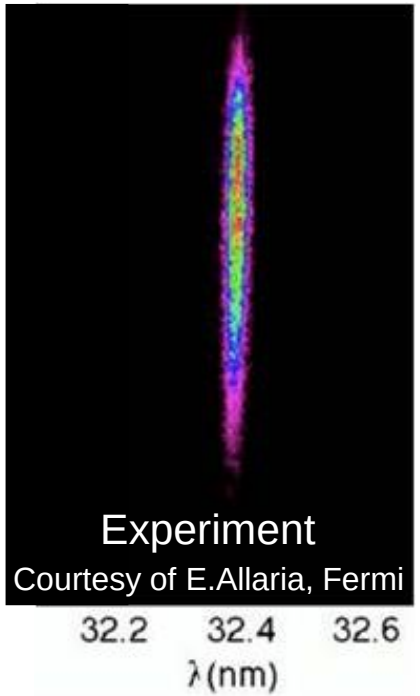


New THz geometry at FLASH1



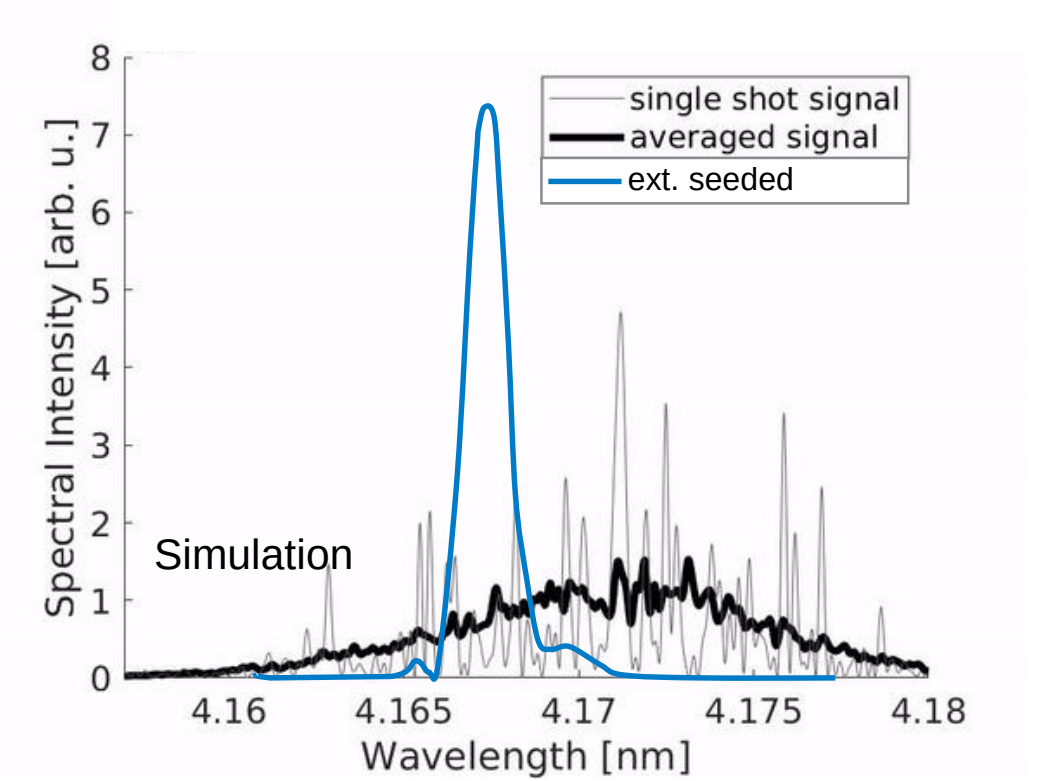
Next: External seeding

Unlocking new universe of beam properties

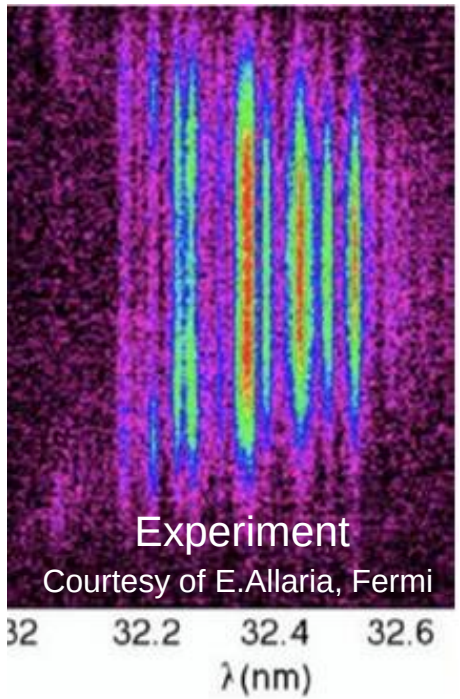


Seeded **FLASH1**

- Narrow bandwidth
- Stability
- Longitudinal coherence



Facility will provide both simultaneaously



SASE **FLASH2**

- Low complexity
- Pulse energy
- Shortest pulses
- Repetition rate