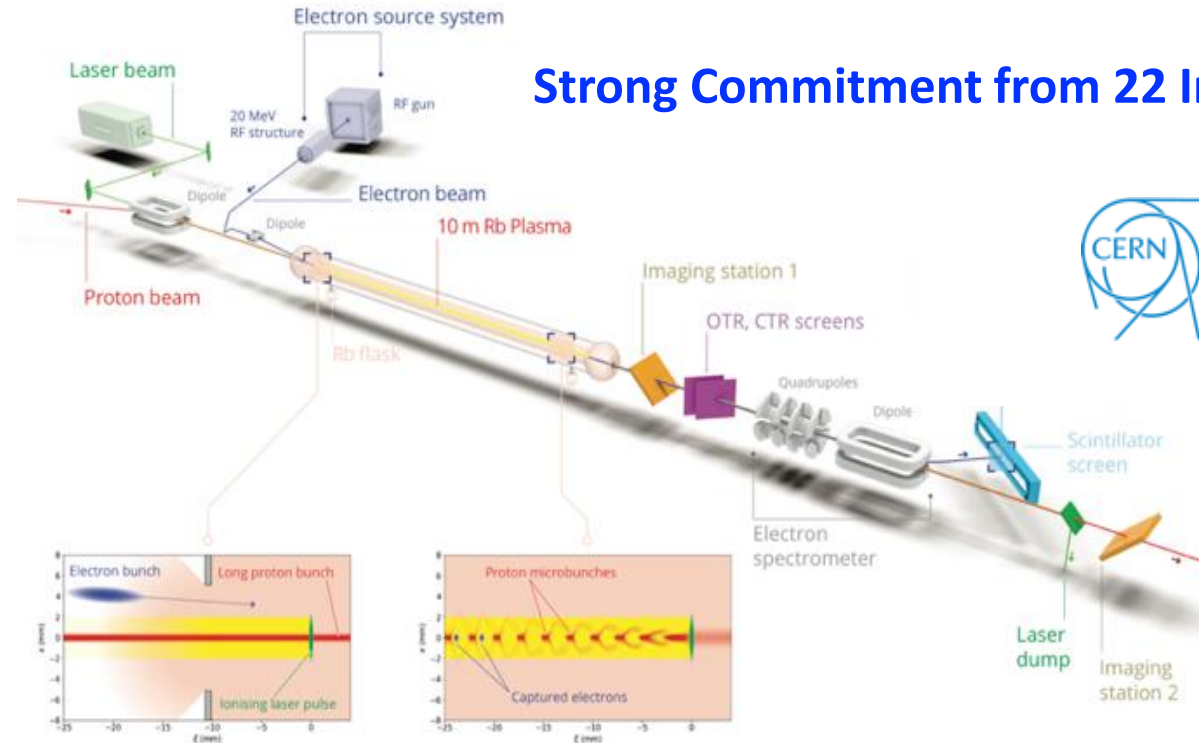

AWAKE Run 2c/d Kick-Off Meeting

Edda Gschwendtner

16 July 2024, CERN

AWAKE – Organization

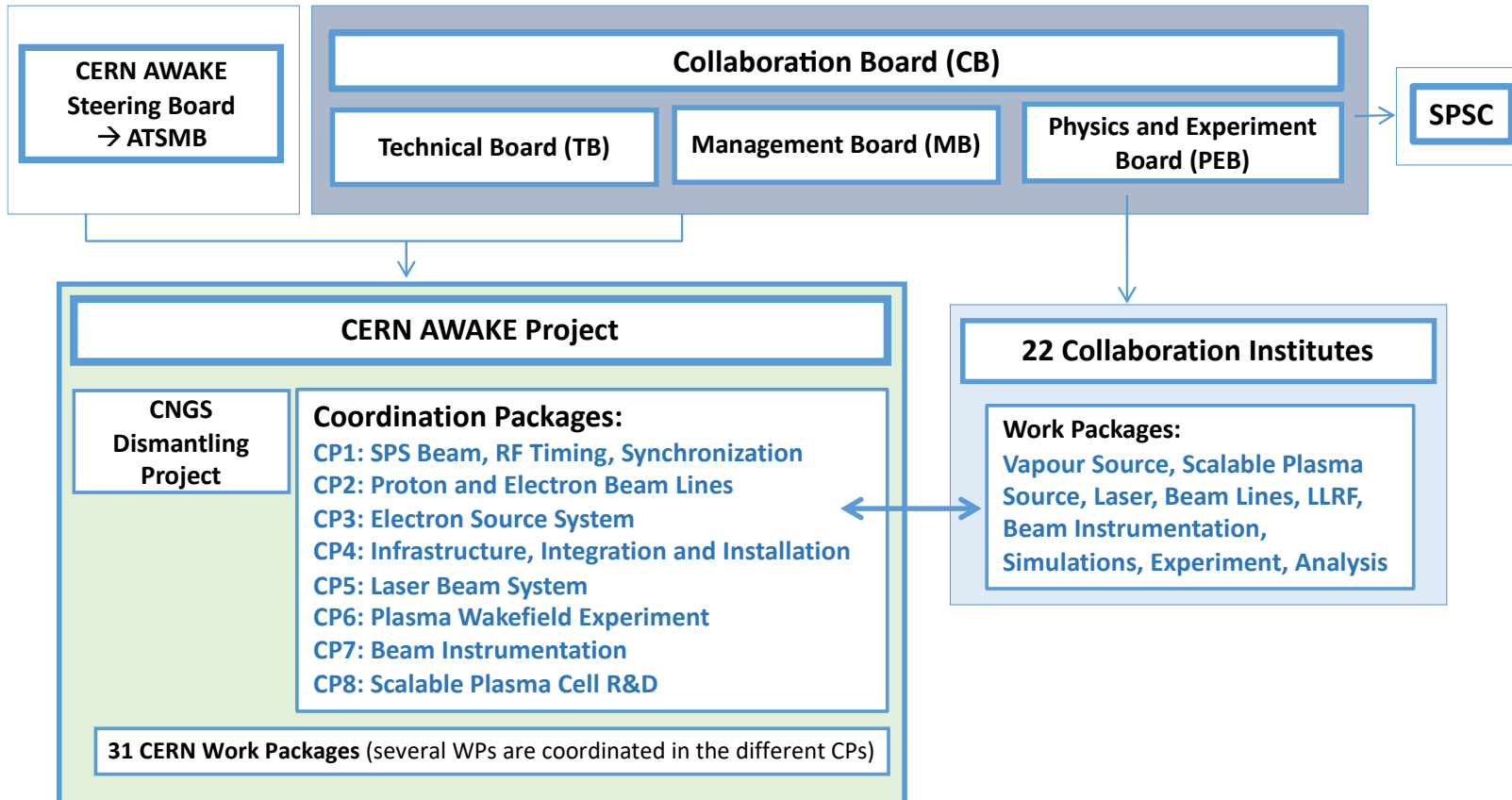
AWAKE is an International Collaboration



Strong Commitment from 22 Institutes



AWAKE Organizational Structure



Spokesperson: Patric Muggli
Deputy: Matthew Wing
Collaboration Board Chair: Allen Caldwell
Technical Coordinator: Edda Gschwendtner
CERN AWAKE Project Leader: Edda Gschwendtner
Physics and Experiment Coordinator: Patric Muggli
Simulation Coordinator: Alexander Pukhov
CNGS Dismantling Project Leader: Ans Pardons
Run Coordinator: Michele Bergamaschi

Publication and Speakers Committee

AWAKE MoU: between CERN and Institutes → in-kind contributions
Addendum to MoU for any new institute, PJAS, new work program

CERN AWAKE Project Organization

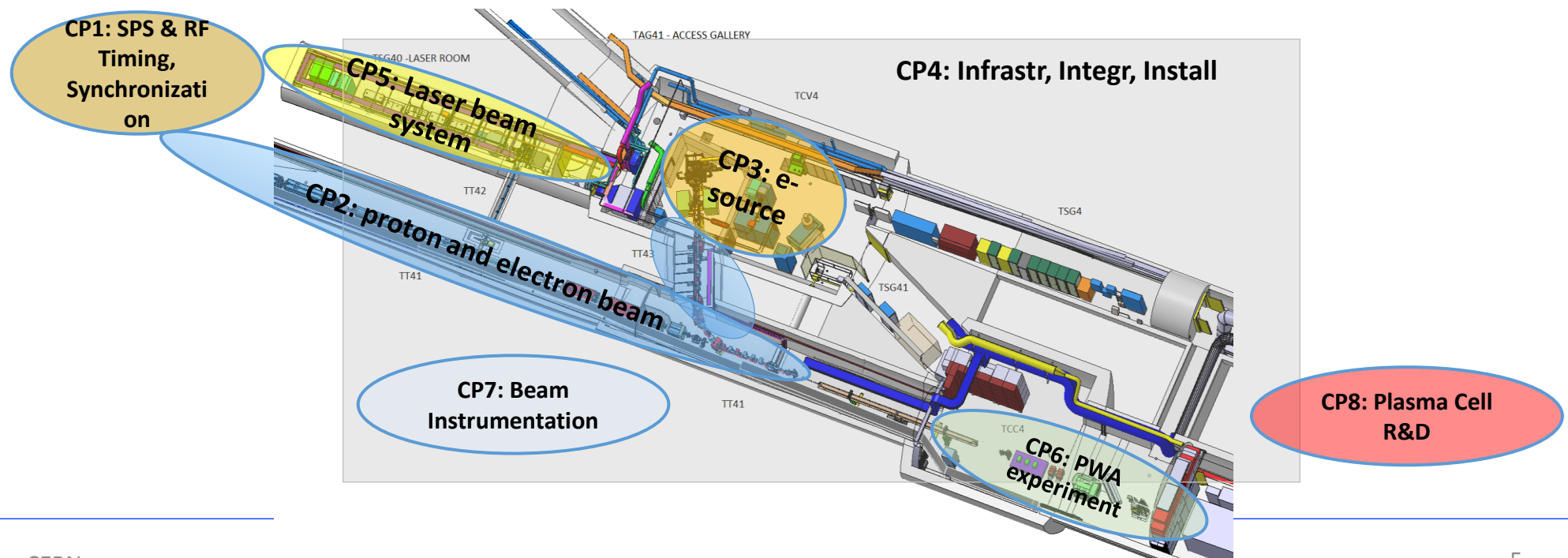
CERN AWAKE Project Team

Coordination Package:

- CP1: SPS Beam, RF Timing, Synchronization, Benjamin Woolley, SY
- CP2: Proton and Electron Beam Lines, Vittorio Bencini, SY
- CP3: Electron Source System, Steffen Doebert, SY
- CP4: Infrastructure, Global Integration and Installation, Ans Pardons, EN
- CP5: Laser Beam System, Eduardo Granados, SY
- CP6: Plasma Wakefield Experiment, Marlene Turner, BE
- CP7: Beam Instrumentation, Stefano Mazzoni, SY
- CP8: Scalable Plasma Cell R&D, Alban Sublet, TE

Coordination Package Leaders:

- Coordinate Work Packages that are associated to the areas and systems of the CP
- Coordinate the institutes' Work Packages
- Regular meetings, EDMS, indico
- Report in project team meetings



WP	WP Name	CERN	WP Leader	Group
WP1	SPS Beam		Heiko Damerau	SY-RF
WP2	Synchronous Clock Distribution and Fast Timing		Ben Woolley	SY-RF
WP3	Laser Synchronisation		Ben Woolley	SY-RF
WP4	Electron LLRF		Ben Woolley	SY-RF
WP5	Proton Line		Vittorio Bencini	SY-ABT
WP6	Electron Line		Vittorio Bencini	SY-ABT
WP7	Electron Source and High Power System		Steffen Doebert	SY-RF
WP8	Shielding, Dumps		Ans Pardons	EN-ACE
WP9	Supports		Ans Pardons	EN-ACE
WP10	Laser Beam Line		Eduardo Granados	SY-STI
WP11	UV laser for e-source		Eduardo Granados	SY-STI
WP12	DAQ		Edda Gschwendtner	BE-ABP
WP13	Beam instrumentation		Stefano Mazzoni	SY-BI
WP14	Helicon Plasma Cell @ CERN		Alban Sublet	TE-VSC
WP15	Discharge Plasma Cell @ CERN		Alban Sublet	TE-VSC
WP16	Simulations		John Farmer	BE-ABP
WP17	Magnets		Philip Schwarz	TE-MSC
WP18	Power Converteres		Gilles Le Godec	SY-EPC
WP19	Vacuum		Jose Ferreira Somoza	TE-VSC
WP20	Interlock		Richard Mompou	TE-MPE
WP21	Mechanical Design		Nicolas Chritin	EN-MME
WP22	Civil Engineering		Alejandro Martinez Selles	SCE-DOD
WP23	Cooling and Ventilation		Michele Battistin	EN-CV
WP23.1	Cooling and Ventilation: Design		Alejandro Rodriguez	EN-CV
WP23.1	Cooling and Ventilation: Operation		Jani Lehtinen	EN-CV
WP24	Electrical Services		Mickael Lonjon	EN-EL
WP24.1	Electrical Services: Electrical Systems		Mickael Lonjon	EN-EL
WP24.2	Electrical Services: Cabling		Guillaume Gros	EN-EL
WP24.3	Electrical Services: Decabling		Christian Bernard	EN-LE
WP25	Transport and Handling		Caterina Bertone, Jean-Louis Grenard	EN-HE
WP26	Access		Didier Vaxelaire	EN-AA
WP27	Fire and Gas		Silvia Grau, Denis Raffourt	EN-AA
WP28	Survey		Jean-Frederic Fuchs	BE-GM
WP29	Ethernet, Wifi, GSM, TETRA		Maryse da Costa	IT-CS
WP30	Control		Marine Gourber-Pace	BE-CO
WP31	Radiation Protection		Claudia Ahdida	HSE-RP
WP31.1	Radiation Protection: Simulations		Claudia Ahdida	HSE-RP
WP31.2	Radiation Protection: RP Monitoring		Christelle Saury, Claudia Ahdida	HSE-RP
WP32	DAQ	Edda Gschwendtner, CERN	Marlene Turner, Michele Bergamaschi	BE-ABP

Collaboration Institutes

WPs/Tasks	Institutes
Vapour Source	MPP, Uni Marburg
Helicon Plasma Source	IPP Greifswald, SPC-EPFL, Univ. of Wisconsin
Discharge Plasma Source	IST, Imperial College, Oxford
Laser	MPP, Wigner Institute
Electron-source, LLRF	Univ. of Uppsala, Univ. of Lancaster
Beam Diagnostics	UCL, MPP, Univ. of Manchester, Univ. of Liverpool, TRIUMF, JAI
Simulations	Budker INP, NSU, IST Lisbon, HHU Duesseldorf, UNIST, IPP Munich, UK
Experiment, Analysis	MPP, Wigner, UK

AWAKE – Program

AWAKE has a Well-Defined Program



→ To date AWAKE has achieved all milestones!



AWAKE Run 1 (2016 - 2018): Proof-of-Concept:

- ✓ Demonstrated seeded self-modulation of the proton bunch and drive strong wakefields
- ✓ Accelerate externally injected electrons to 2 GeV

AWAKE Run 2 (2021 – 2033): Towards an Accelerator:

- Accelerate an **electron beam to high energies (gradient of 0.5-1GV/m)**
- while controlling the **electron beam quality (~10 mm-mrad emittance, 10% energy spread)**
- demonstrate **scalable plasma source technology.**

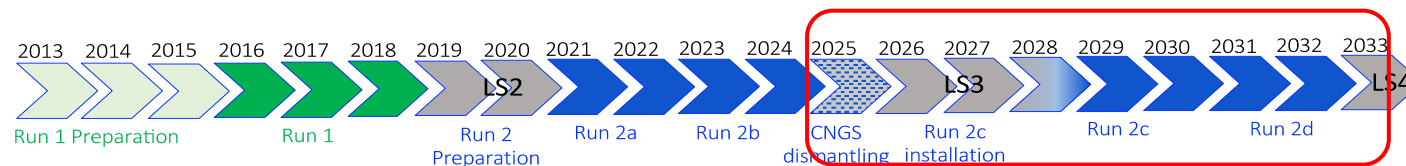
Once AWAKE Run 2 is demonstrated: Possibility for first application of the AWAKE-like technology.

- *develop physics case for particle physics experiments*

**AWAKE Run 2c/d has been approved in this year's MTP!
(CNGS dismantling was approved in 2022)**

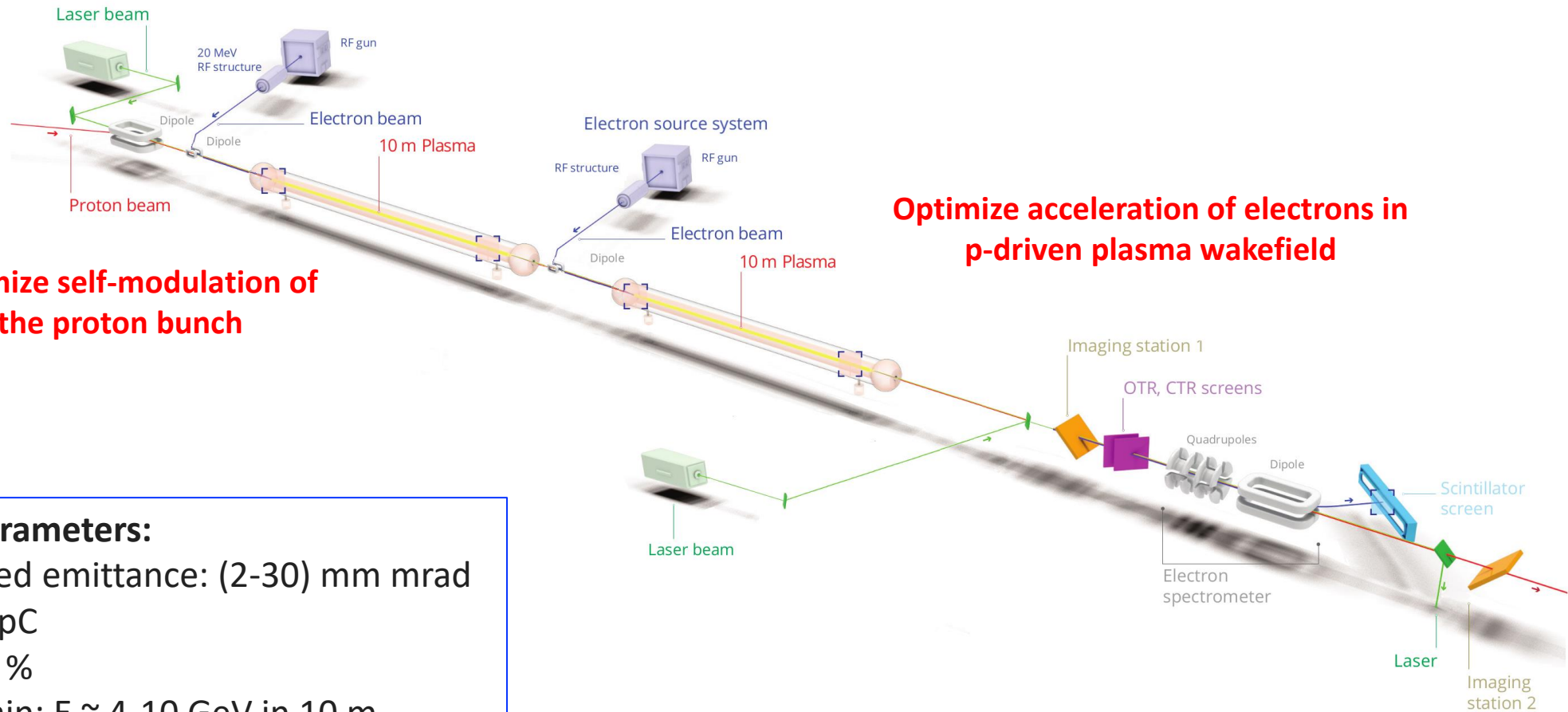
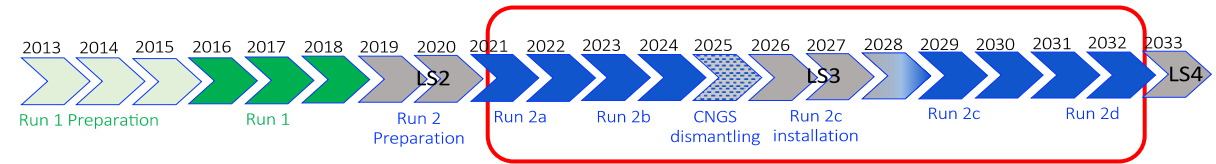
An amount of 10 MCHF is allocated in addition to **AWAKE** for the construction, during LS3, of the necessary hardware (e.g. second electron line) to be deployed in Runs 2c and 2d. Additional funds may be necessary for these runs.

“Dynamic allocation”



AWAKE Run 2

Accelerate an electron beam to **high energies**, while controlling the electron **beam quality** and demonstrate **scalable plasma source** technology.



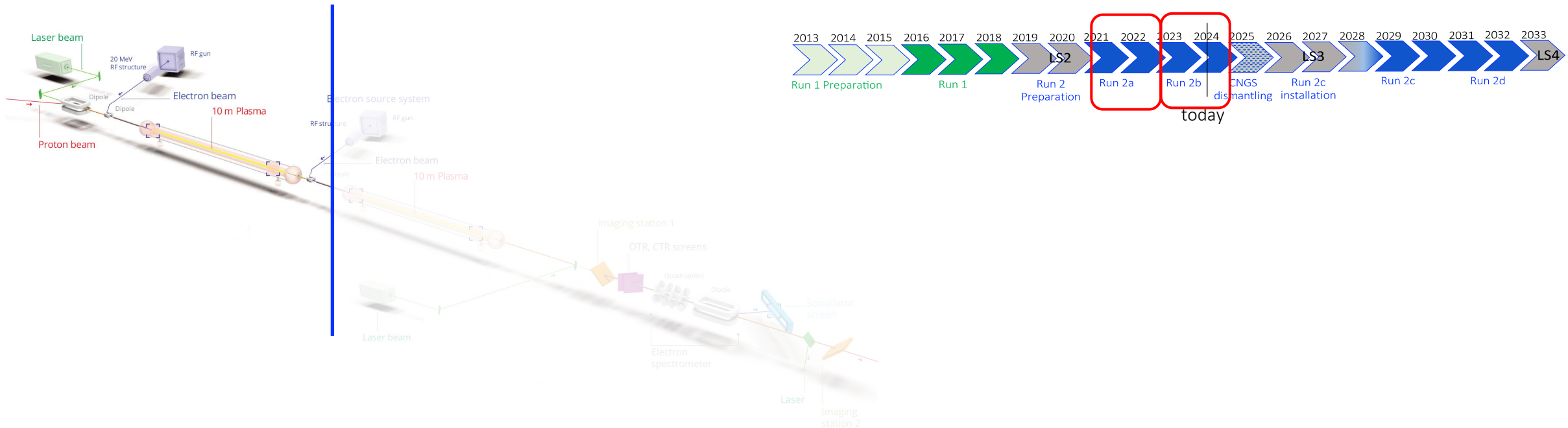
Optimize self-modulation of the proton bunch

Optimize acceleration of electrons in p-driven plasma wakefield

Expected parameters:

- Normalized emittance: (2-30) mm mrad
- $Q_e = 100$ pC
- dE/E : 5-8 %
- Energy gain: $E \sim 4-10$ GeV in 10 m

AWAKE Run 2 Well-Defined Scientific Roadmap – Milestones

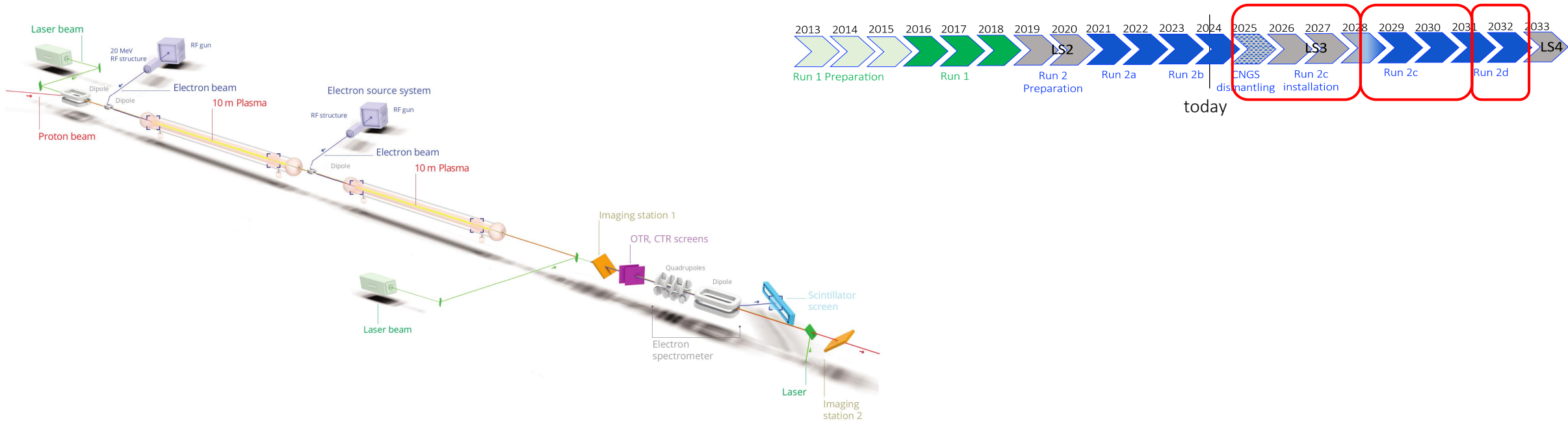


✓ Run 2a (2021-2022): **CONTROL**: demonstrate the seeding of the self-modulation of the entire proton bunch with an electron bunch

now → Run 2b (2023-2024): **STABILIZATION**: maintain large wakefield amplitudes over long plasma distances by introducing a step in the plasma density



AWAKE Run 2 Well-Defined Scientific Roadmap – Milestones



✓ **Run 2a (2021-2022): CONTROL:** demonstrate the *seeding of the self-modulation of the entire proton bunch with an electron bunch*

now → **Run 2b (2023-2024): STABILIZATION:** *maintain large wakefield amplitudes* over long plasma distances by introducing a step in the plasma density

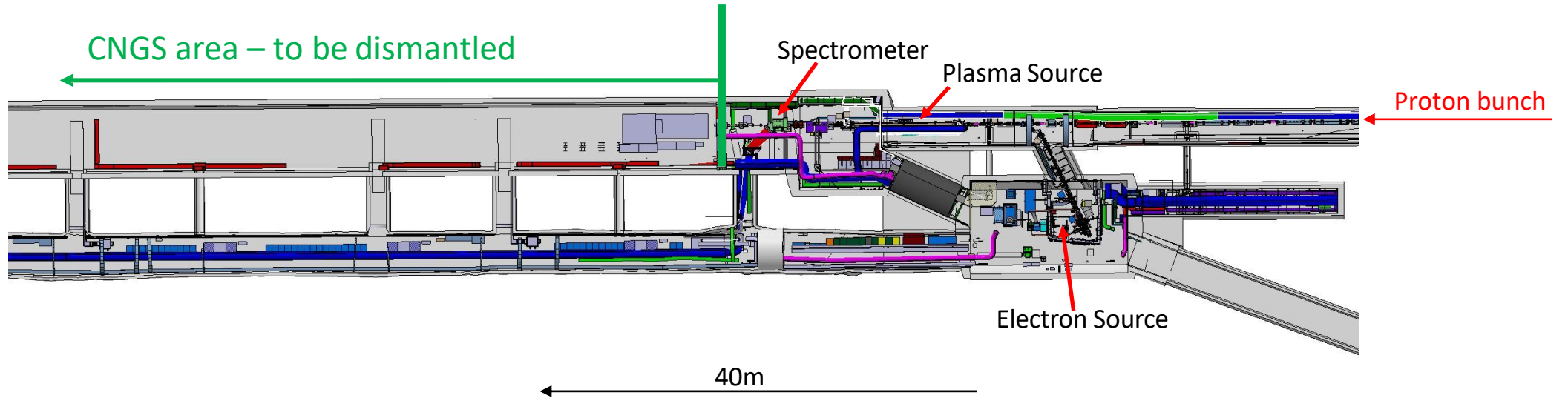
→ (2025-2027): *CNGS dismantling, CERN Long Shutdown LS3, installation of Run 2c*

→ **Run 2c (2028-2031): QUALITY:** demonstrate *electron acceleration and emittance control of externally injected electrons*.

→ **Run 2d (2032- LS4): SCALABILITY:** *development of scalable plasma sources with sub-% level plasma density uniformity*.

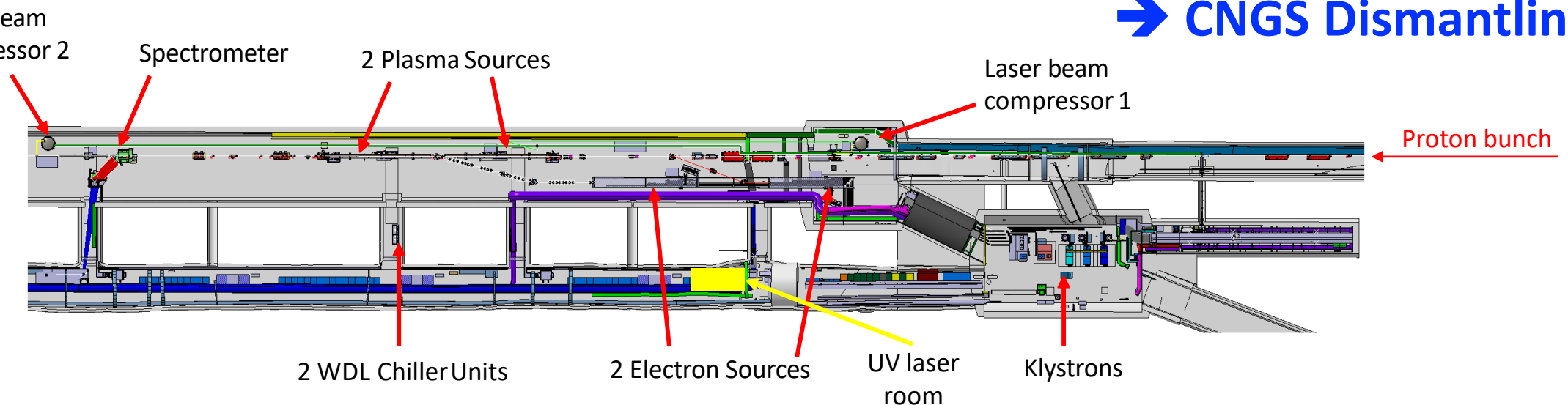
AWAKE Run 2 – Integration

Run1,
Run 2a/b

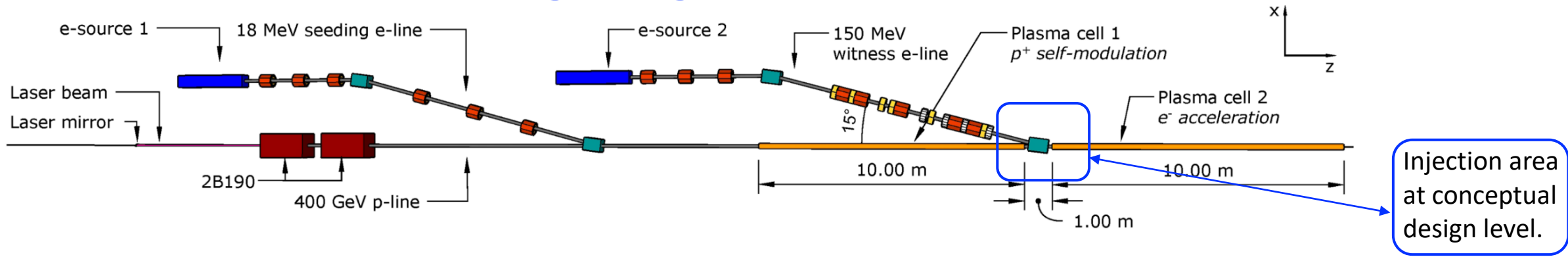


Run 2c/d

➔ CNGS Dismantling!

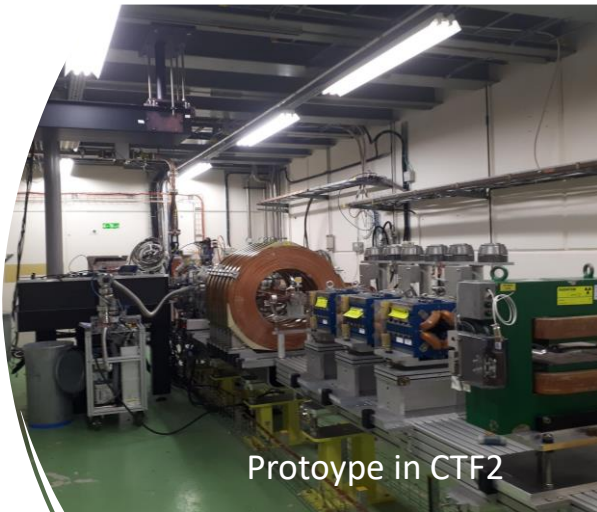


AWAKE Run 2c – Ongoing Studies



➔ Studies, design and prototyping already advancing well for several experimental elements of Run 2c

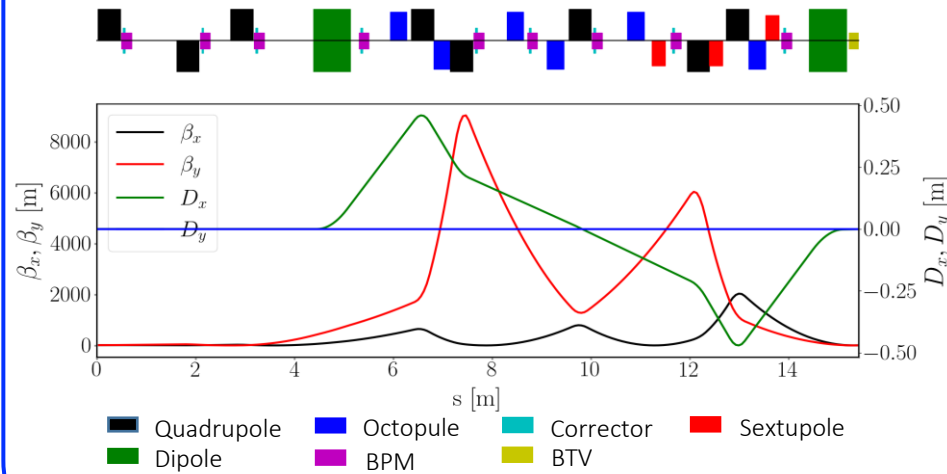
Run 2c electron source prototype



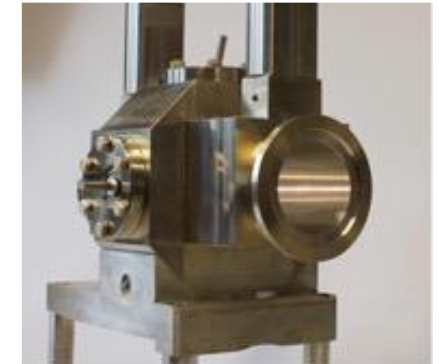
Protoype in CTF2

S-band e-gun (INFN) with X-band accelerator (CLIC/CLEAR)

150 MeV beamline



Beam instrumentation

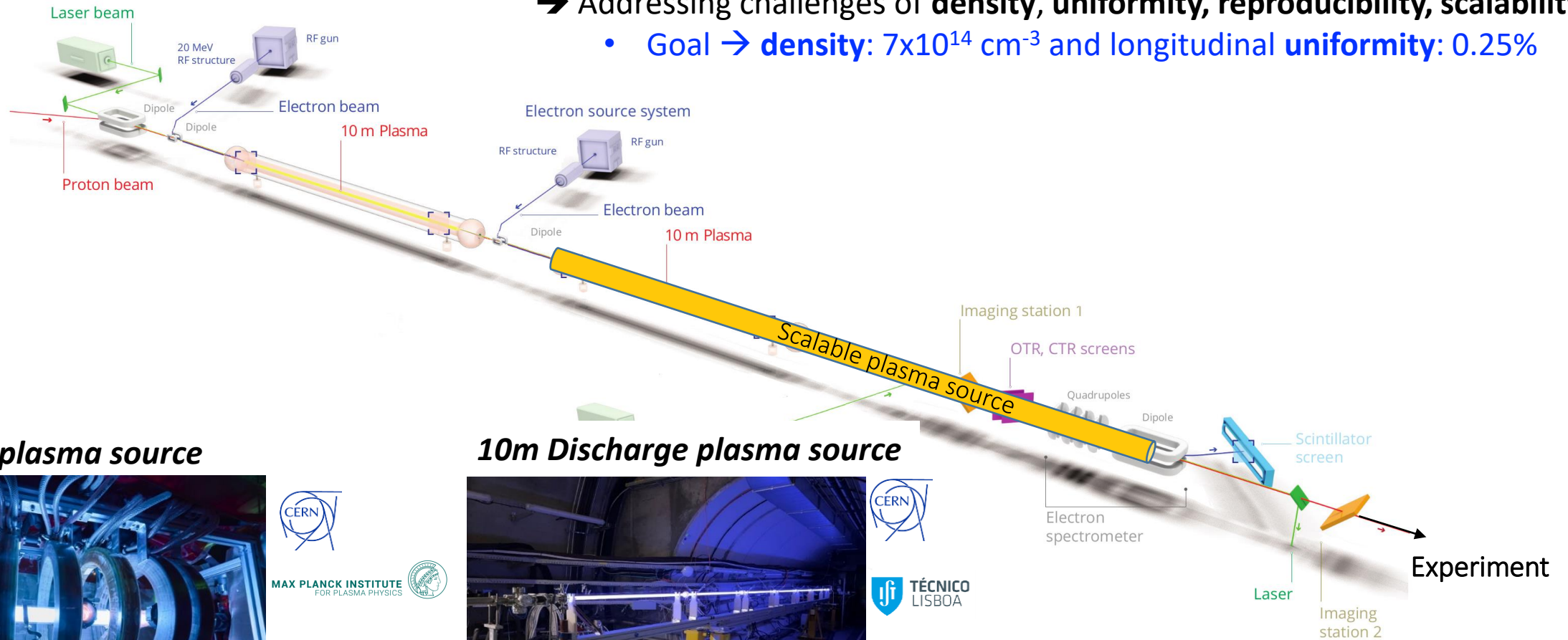


BPMs 10 μm resolution

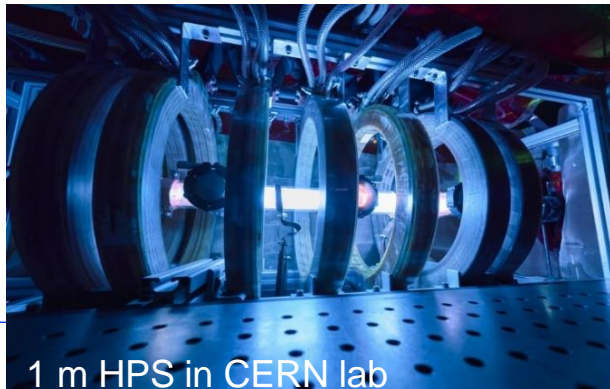
AWAKE Run 2d: Demonstrate Scalable Plasma Sources

Scalable plasma source R&D program:

- ➔ Dedicated plasma source labs at CERN
- ➔ 5 collaborating institutes
- ➔ Addressing challenges of **density, uniformity, reproducibility, scalability**
 - Goal ➔ **density: $7 \times 10^{14} \text{ cm}^{-3}$** and **longitudinal uniformity: 0.25%**



1m Helicon plasma source



1 m HPS in CERN lab



10m Discharge plasma source

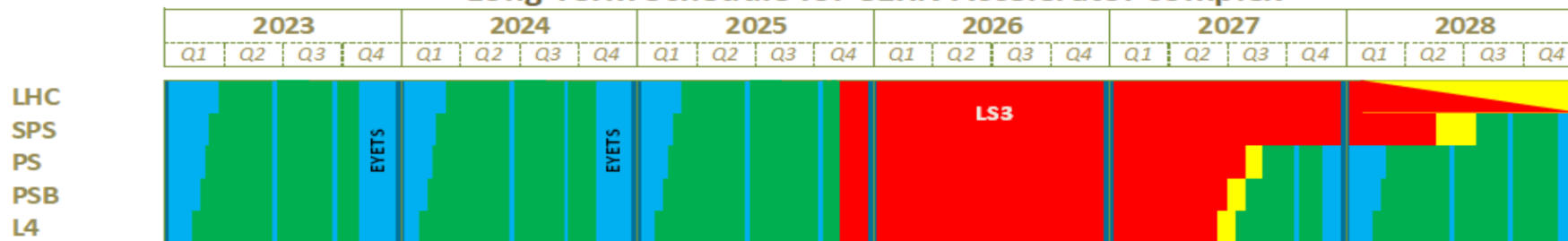


10 m DPS run May 2023



AWAKE – Planning

Long Term Schedule for CERN Accelerator complex



	2024				2025				2026				2027				2028				
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Injector schedule (SPS)	EYETS				EYETS							LS3									
Shed dismantling																					
Creation of new storage area																					
CNGS surface building main works																					
Run 2b dismantling and decabling																					
CNGS & AWAKE dismantling																					
Run 2c - Installation services, cables, equipment																					
Run 2c - Hardware commissioning																					
Run 2c - Commissioning with beam & operation																					

→ In case LS3 is shifted by one year, also CNGS dismantling would shift by 1 year, ie proton run in 2025!

- AWAKE Run 2c,d has been approved in MTP!
 → Start full-swing with preparations for Run 2c!
- Decision about delay of LS3 required in September 2024!
- With CERN's approval, funding requests of collaborating institutes can go ahead.