



# I-FAST 1<sup>st</sup> Annual Meeting

Riccardo Bartolini, DESY

May 5<sup>th</sup>, 2022

# WP7: High brightness accelerators for light sources

**Scope:** WP7 pursues the R&D on new technical solutions for the design and construction of **accelerator-based light sources**, exceeding the performance of present machines. The research embraces both **storage ring based synchrotron light sources** and **free electron laser driven by Linacs**.

Fostering networking activities building on the previous EU networks funded within the ARIES and EuCARD2 projects (**Task 7.2**) Supporting R&D and prototype on cutting edge technological aspects, critical in the construction of new, compact, and sustainable accelerators (**Tasks 7.3-7.4-7.5**).

**Task 7.1:** Coordination and communication (R. Bartolini, DESY)

Beneficiaries: DESY

**Task 7.2:** Enabling technologies for ultralow emittance rings (A. Mochihashi, KIT)

NETWORK

Beneficiaries: DESY, CERN, SOLEIL, DLS, INFN, KIT, PSI, KYMA

**Task 7.3:** Variable dipole for the upgrade of the ELETTRA storage ring (Y. Papaphilippou, CERN)

Beneficiaries: CERN, CIEMAT, ELETTRA, KYMA

**Task 7.4:** Very high gradient RF gun operating in the C-band RF technology (D. Alesini, INFN)

Beneficiaries: INFN, COMEB, PSI, VDL-ETG

**Task 7.5:** CompactLight prototype accelerating structures (G. D'Auria, ELETTRA)

Beneficiaries: ELETTRA, CERN, INFN, VDL-ETG, COMEB, TMD

PROTOTYPE

# Task 7.2: Ultra low emittance rings

## Scope:

Task 7.2 aims at strengthening the **networking activity** in the accelerator community on topics related to the major technological challenges faced in the design, construction and operation of ultra-low emittance rings.

- **Organise general and topical workshops** on the technology enabling the design and construction of future ultra-low emittance rings
- support **exchange of staff** for visits and common experiments
- produce **progress reports** on the status of the R&D in the technology areas of relevance for ultra low emittance rings, most notably magnets, vacuum, injection.

# WP7 Task 7.2: milestones and deliverables

<b>D7.1</b>	Final report on the development of high brightness electron beams for light sources	7.1	UOXF	R	PU	48	MS25	General workshop on Task7.2 activity summary	7.2	42	Indico page
<b>D7.2</b>	Report on enabling technology for ultralow emittance ring	7.2	KIT	R	PU	45	MS26	Magnet specifications based on optics calculations for ELETTRA. Magnetic and mechanical design including fabrication drawings	7.3	24	Report
<b>D7.3</b>	Longitudinally variable bend prototype fabrication	7.3	CERN	DEM	PU	40	MS27	Prototype acceptance tests	7.3	46	Report
<b>D7.4</b>	Mechanical realization and low power RF test of the two RF guns	7.4	INFN	DEM	PU	38	MS28	Electromagnetic and mechanical design of the two guns	7.4	24	Report
<b>D7.5</b>	Construction of the XLS accelerating structure pre-prototype.	7.5	ELETTRA-ST	DEM	PU	24	MS29	High-power test stand setup and final results of the high-power tests	7.4	46	Report
<b>D7.6</b>	Construction of the XLS accelerating structure full prototype.	7.5	ELETTRA-ST	DEM	PU	36	MS30	Construction and RF tests of CompactLight accelerating structure prototype	7.5	21	Prototype in operation

Tasks Description	Year 1												Year 2												Year 3												Year 4															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
<b>WP7 High Brightness Accelerators for light sources</b>																																																				
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7,3 Variable Dipole for the upgrade of the ELETTRA storage ring																									M																									D		
7,4 Very high gradient RF Guns operating in the C-band RF technology																									M													D														
7,5 CompactLight Prototype Accelerating Structures																						M	D																	D												

Other Tasks covered in next talks by Y. Papahilippou, D. Alesini and G. D'Auria



# The networking activities in Task. 7.2 will focus on five sub-tasks

**Novel injection schemes** in small dynamic apertures (PSI, SOLEIL). Fast switches for fast pulsers and fast kickers or stripline. This will target novel injection schemes and the transparent top-up operation. **Strong involvement with industrial partners** is foreseen in pushing the performance of fast pulsers.

**Advanced magnet concepts** (CERN, KYMA) to develop dipoles with longitudinal gradient, permanent magnet (PM) dipole and quadrupole for green facilities with high gradient small apertures magnets, combined PM multipoles (e.g. sextupoles and octupoles) for **space saving and sustainability**.

**Vacuum systems in small apertures** (DLS, SOLEIL, CERN) to develop feasible ultra-vacuum systems based on **small radius pipes, NEG (or other novel) coating and new surface treatments**. This will include the evaluation of the impedance effects of such vessels.

**RF and diagnostics** for beam control of ultra-low emittance rings (INFN) to **develop feedback systems, orbit stability, harmonic cavities design and analysis, and diagnostics for ultra-small beam size**.

**Experimental tests** (KIT, CERN) **on the major technical challenges**: impedance; NEG characterization at dedicated beamlines with tests at SOLEIL, DLS, KIT; injection; beam based alignment of complex combined function magnets

# Activities organised so far

Regular meetings scheduled for Task. 7.2 chaired by A. Mochihashi (KIT)

## Two workshops already organized:

10<sup>th</sup>-11<sup>th</sup> May 2021 (DESY/Virtual): Miniworkshop on girders and alignment ( Virtual / DESY )

<https://indico.desy.de/event/30022/>

~80 participants

25<sup>th</sup>-29<sup>th</sup> April 2022 (KIT): Beam diagnostics and dynamics in low emittance rings

<https://indico.scc.kit.edu/event/2592/overview>

81 registered

## One workshop in preparation:

26<sup>th</sup>-29<sup>th</sup> June 2022 (ALBA): 3<sup>rd</sup> workshop on low emittance ring design

<https://indico.cells.es/event/1072/>

# Mini-workshop on girders and alignment

A mini-workshop on girders and alignment to review the technical solutions for girder design and magnets support and alignment

## Virtual mini-workshop on girders and alignment

10-11 May 2021  
Europe/Berlin timezone

Overview

Participant List

The next generation of light source aims at delivering electron beams with unprecedented brightness and emittance properties. A crucial requirement in these projects is the accuracy in the alignment and positioning control of the magnetic elements on the girder and the girders in the tunnel. While many beam based tools have been developed and successfully tested, the requirement in the mechanical engineering and alignment of such elements is still a major concern and a technology challenge. Different solutions are adopted by different light sources.

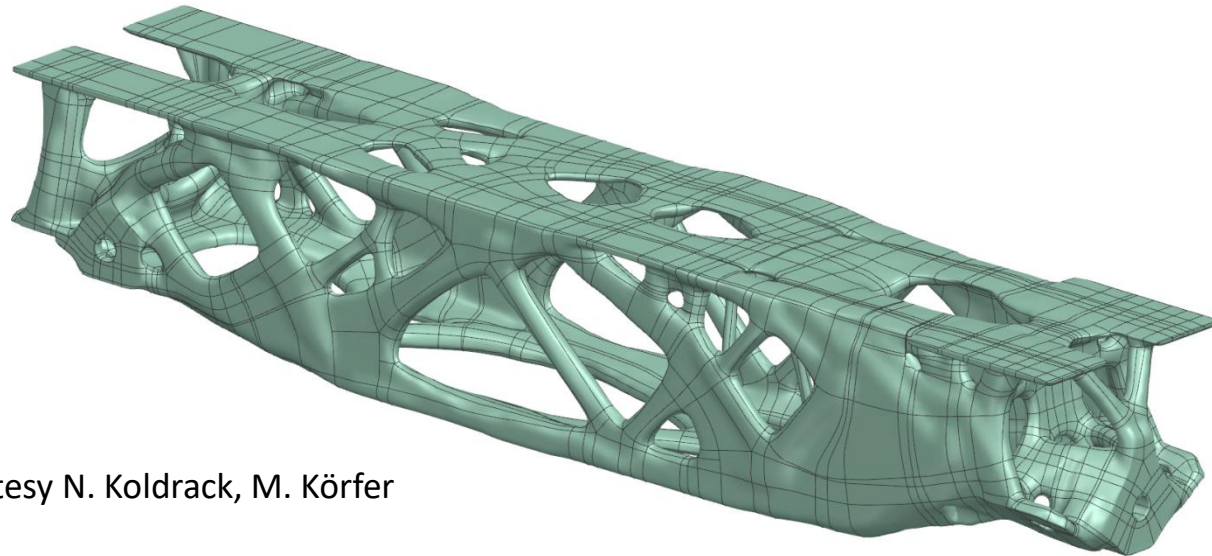
The scope of the dedicated topical mini-workshop is to review the best practices in in the design, construction and alignment of girders and their elements, including aspects related the assembly procedures and logistics.

Presentations from all major projects: ESRF-EBS, PETRA IV, SIRIUS, APS-U, ALS-U, SLS-II, SOLEIL, ELETTRA

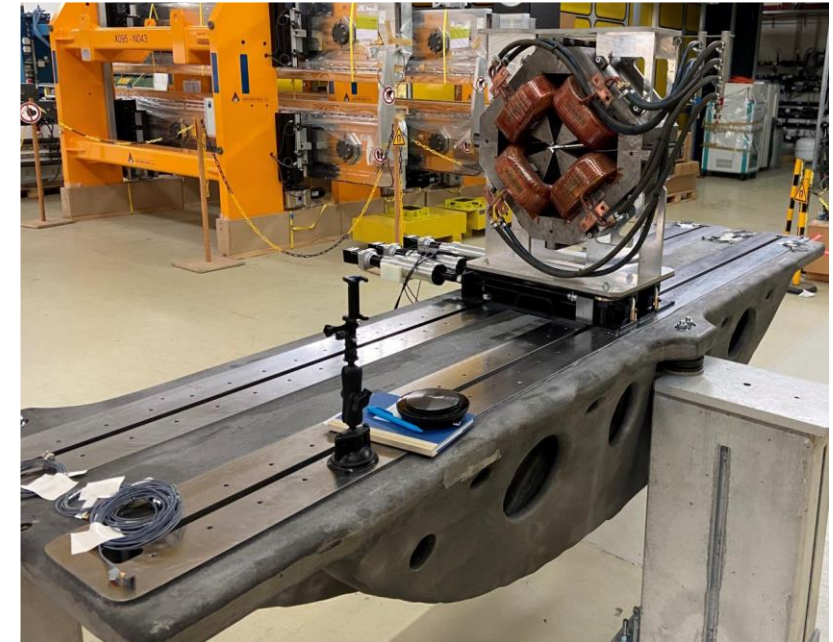
# Mini-workshop on girders and alignment (highlights)

PETRA IV is proposing a new concept for girder structure moving forward the classical welded box structure

The design is based on the topological optimisation of the structure and will be based on cast iron manufacturing process



Courtesy N. Koldrack, M. Körfer



Superior performance to welded design when weight constraints are imposed. Cost of cast iron manufacturing process similar for large series production (288 girders in PETRA IV)



# Workshop on beam diagnostics and dynamics in ultra-low emittance rings

Review recent progress in beam diagnostic for ultralow emittance rings

## I.FAST Workshop 2022: Beam diagnostics and dynamics in ultra-low emittance rings

25-29 April 2022  
Europe/Berlin timezone

### Overview

Scientific Organization Committee

Organization

Timetable

Registration

Contribution List

Participant List

### Contact

✉ office@ibpt.kit.edu



Today, in Europe and the world, several projects for the ring-based synchrotron light source are going on, aiming to generate the high brilliance synchrotron light by the low-emittance beams. One of the critical issues for such a high-quality beam is the beam dynamics that handle the beam optics and realize the low-emittance beam by keeping sufficient beam stability by the optics design. On the other hand, it is also essential to evaluate precisely the beam quality and stability for such a high-quality beam by beam diagnostics. This workshop aims to prepare the opportunity to discuss the beam dynamics and diagnostics for the low-emittance and high-quality beam and share the possibility and requests from both sides. One of the workshop's goals will be to make clear the directions of the beam dynamics and diagnostics for the low-emittance rings.

- On-line workshop organized by KIT
- 20 scientific presentations
- Over 80 registered participants

<https://indico.scc.kit.edu/event/2592/>



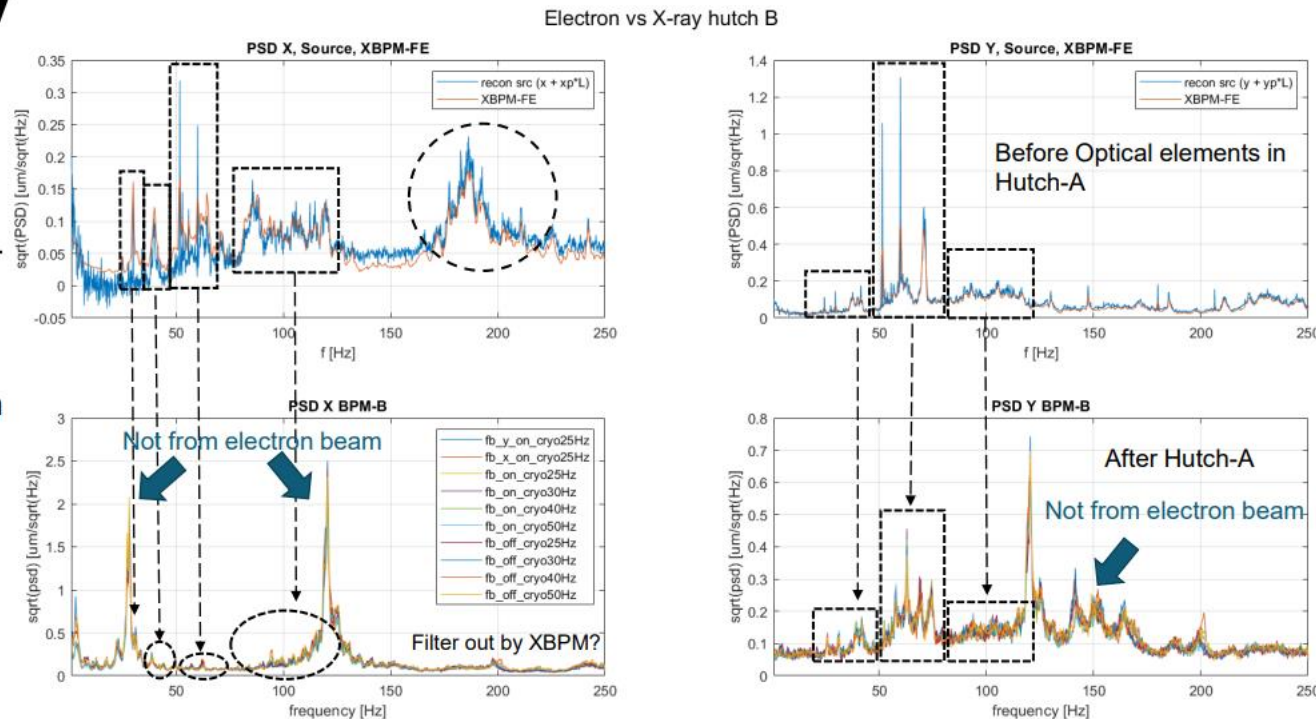
# Workshop on beam diagnostics and dynamics in ultra-low emittance rings (highlight)

Detection of noise sources at e-BPM and X-BPMs and correlations for possible feedback loops

## Impacts of electron beam on X-ray beam stability

S. Kongtawong  
BNL

- 28 Hz and 120 Hz were **not** from the electron beam
- The impact of the electron beam on X-ray beam stability is smaller in the horizontal
- The vertical electron noises' amplitude were comparable to the peaks above 120 Hz

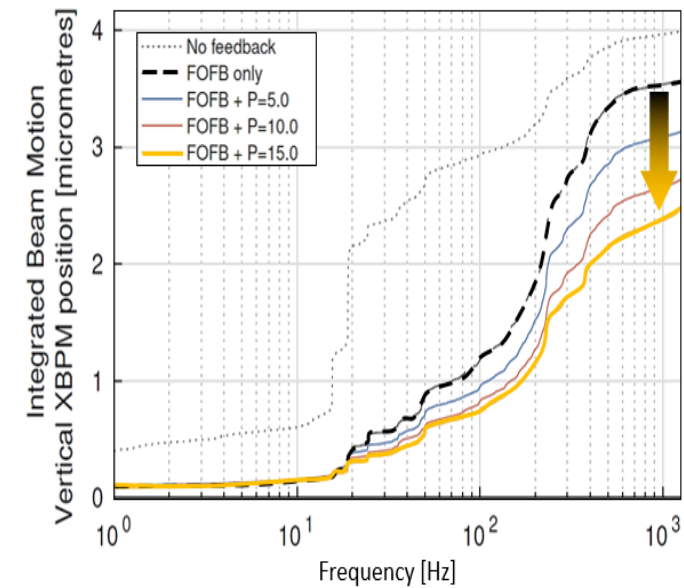
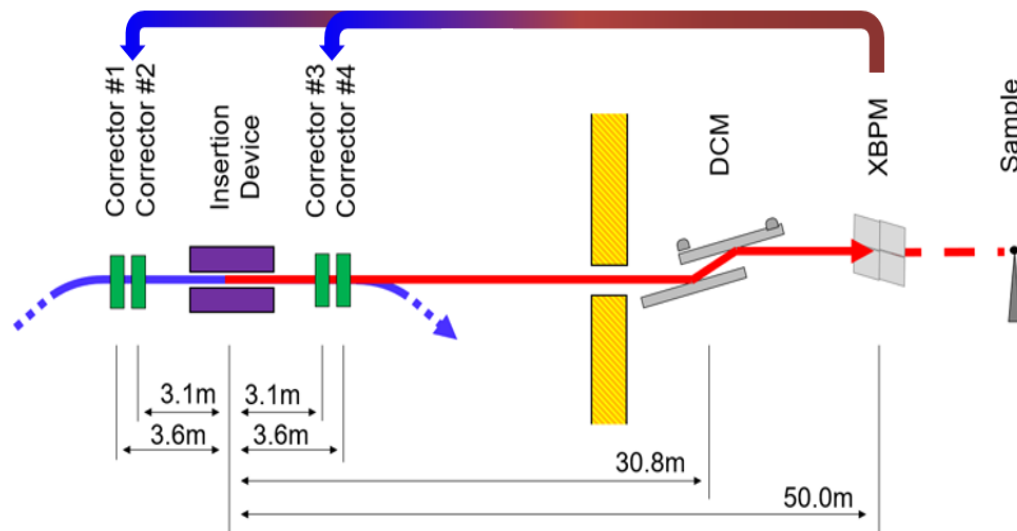


# Workshop on beam diagnostics and dynamics in ultra-low emittance rings (highlight)

Orbit and point source stabilization at the sample (V. Schlott)

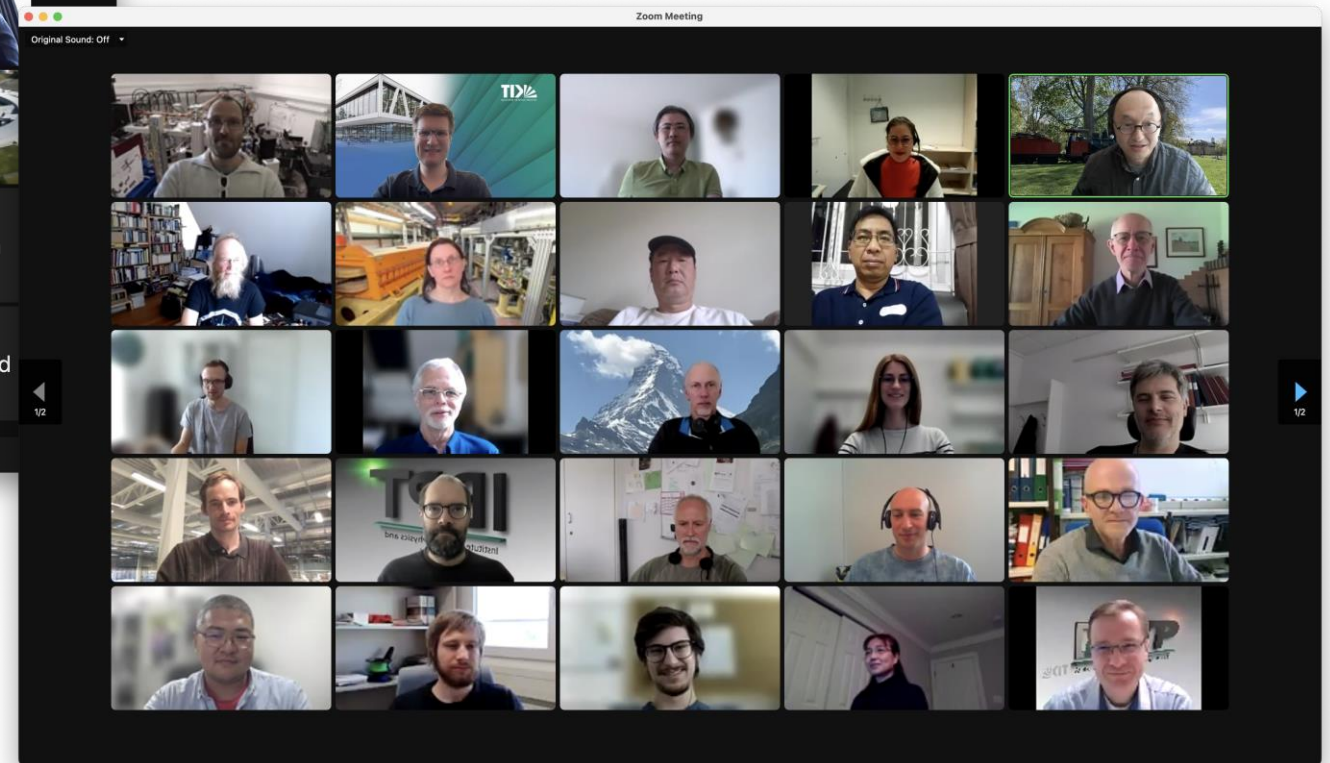
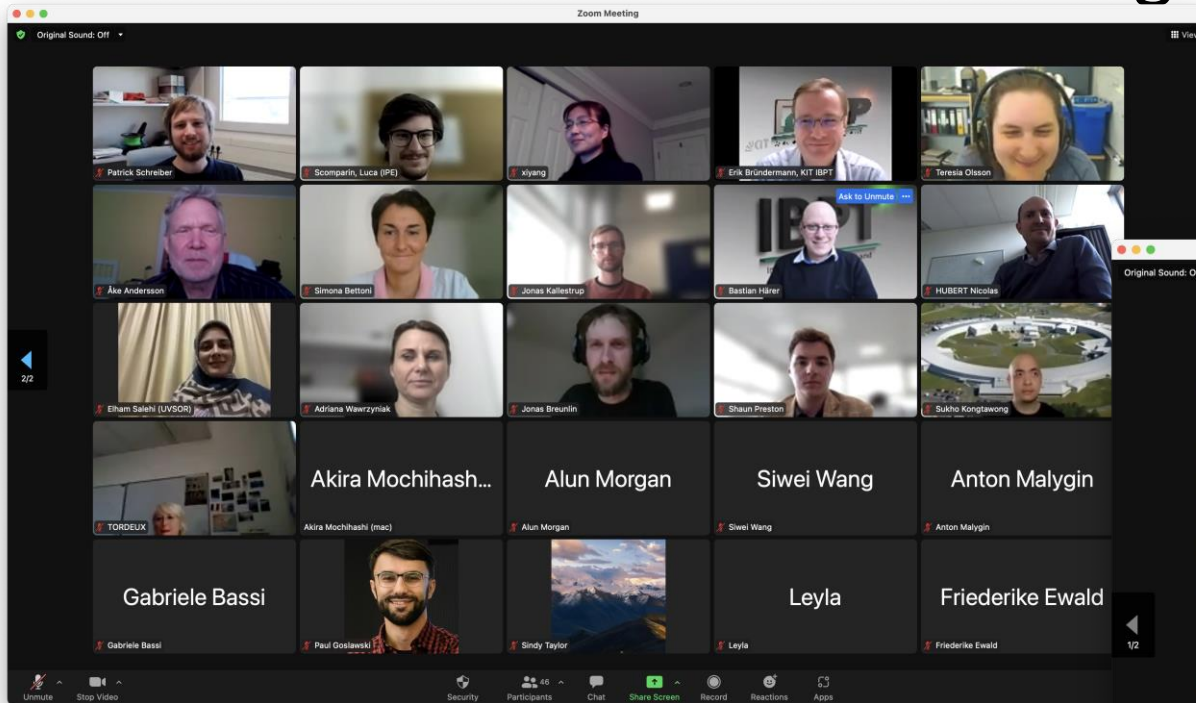
## Example 2: Fast (1 kHz) Feedback using XBPM Reading and Electron Beam Steering at DLS

C. Bloomer, G. Rehm, A. Tipper IBIC 2019



# Workshop on beam diagnostics and dynamics in ultra-low emittance rings (highlight)

Group Photo Session  
at Zoom Meeting Room  
(28. April 2022)



# Workshop on lattice design for ultra-low emittance rings

## LEL 2022 - 3rd Workshop on Low Emittance Lattice Design

26-29 June 2022  
ALBA  
Europe/Madrid timezone

Overview

Preliminary Programme

Registration

Participant List

Practical Information

Committees

Secretariat

✉ [dperez@cells.es](mailto:dperez@cells.es)

The **3rd Workshop on Low Emittance Lattice Design - LEL 2022** will be held from the 26th to the 29th of June 2022, hosted by the ALBA Laboratory, Cerdanyola del Vallès (Barcelona), Spain.

The workshop is organised by [ALBA](#) and supported by the [iFAST](#) project. It is the third one in a series of workshops on this topic.

The goal of this series of LEL workshops is to bring together experts from the scientific community working on low emittance lattice designs for high brightness light sources and colliders.

The workshop will focus on the following topics:

- LEL design concepts
- Design tools / Non-linear optimisation tools / Analysis tools
- Error sensitivity / Alignment strategies / Correction Schemes
- Collective effects in LEL
- Injection / design of injector chain

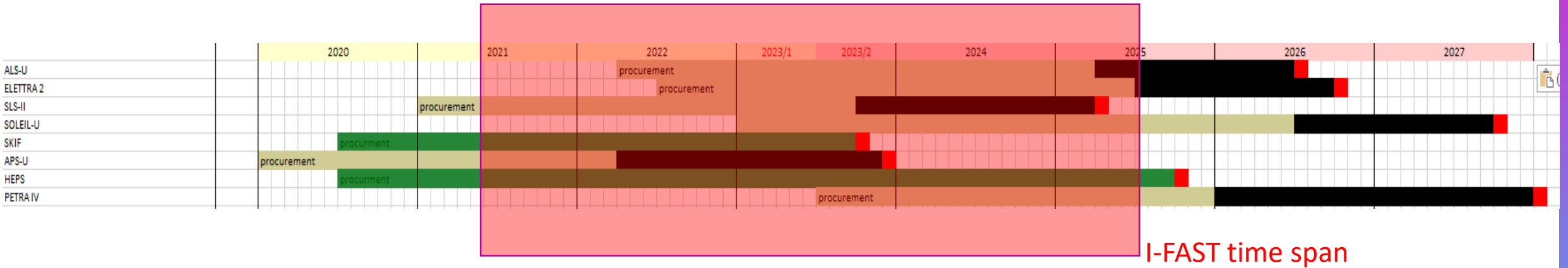
Participants in the workshop are invited to propose contributions to the programme committee.



Riccardo Bartolini – i.FAST 1<sup>st</sup> Annual Meeting May 2022

# Conclusions

Many facilities or upgrades are planned in the coming years



- Green bars: green field projects
- Black bars: dark period
- Red bar: restart of user mode (friendly users in many cases)
- Timeline since official project approval
- In some cases (APS-U) procurement started before official approval

WP7 Task 7.2 will continue to foster interactions in the community of ultralow emittance rings in the coming years



# Continuing a well established tradition of LER workshops

**1<sup>th</sup> Low Emittance Rings Workshop**, 12-15 January 2010 CERN – participants 70

<https://ler2010.web.cern.ch/>

**2<sup>th</sup> Low Emittance Rings Workshop**, 3-5 October 2011 Heraklion, Crete

<https://lowering2011.web.cern.ch/>

**3<sup>th</sup> Low Emittance Rings Workshop** 8-10 July 2013 Oxford University

<https://indico.cern.ch/event/247069/overview> (EuCARD-2) – participants 80

**4<sup>th</sup> Low Emittance Rings Workshop**, 17-19 September 2014, INFN-LNF Frascati

<https://agenda.infn.it/event/7766/> (EuCARD-2) – participants 67

**5<sup>th</sup> Low Emittance Rings Workshop**, 15-17 September 2015 ESRF, Grenoble

<https://indico.cern.ch/event/395487/overview> (EuCARD-2)

**6<sup>th</sup> Low Emittance Rings Workshop**, 26-28 October 2016, Synchrotron SOLEIL

<https://www.synchrotron-soleil.fr/en/events/low-emittance-rings-workshop-2016> (EuCARD-2)

**7<sup>th</sup> LER Workshop**, 15-17 January 2018 CERN (ARIES)

<https://indico.cern.ch/event/671745/>

**8<sup>th</sup> LER Workshop** 26-30 October 2020 INFN-LNF Frascati (held remotely) (ARIES)

<https://agenda.infn.it/event/20813/overview> – participants 160

*Courtesy S. Guiducci*