



Riccardo Bartolini, DESY

I.FAST 3nd Annual Meeting, Paris, 18.04.2024

Outline

- *Scope of WP7 and Task 7.2*
- *Ultra-low emittance rings network
summary of IFAST activities in Task 7.2
(limited) highlights of technical challenges*
- *Conclusions and ongoing work*

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 prototypes** on cutting edge technological aspects, critical in the construction of new, compact, and sustainable accelerators (**Tasks 7.3-7.4-7.5**) – **see next 3**

Networking in the ultra low emittance rings community

- *The WP7 in Task 7.2 will continue to foster and disseminate the latest development in accelerator technology of ultra low emittance rings serving a large and ever growing community in EU and worldwide: **Workshops + visit and beam tests + reports***

Recent progress:

APS-U (Argonne) has completed the installation of the new ring; booster and transfer line ready; first beam expected very soon

HEPS (Beijing) Linac and Booster tested; SR in commissioning in the next months

SLS-II (130 pm @ 2.7 GeV) under construction: restart in **2025**

ELETTRA 2.0 (212 pm @ 2.4 GeV) under construction: shutdown in 2025, restart in **2027**

Diamond II (160 pm @ 3.5 GeV) approved with 530 M pounds recently: restart in **2027**

Korea-4GLS (58 pm, 4 GeV) funded, restart in **2028**

APS-U and Spring8-II also funded



Summary of activities in Task 7.2

Workshops organized/supported in third year:

- 26th-29th April 2023 (DESY): support for the *Pulse POver for Kicker* System (PulPOKS)
- 1st-2nd June 2023 (DESY): *Resistive magnets* for ultra low emittance rings
- 14-15th November 2023 (Trieste): *Permanent magnet based solution* for low emittance rings (joint with LEAPS)
- 16-19th February 2024 (CERN) : 9th *general workshop* ultra low emittance rings
- 3-6th March 2024 (KIT) : topical workshop on *feedback systems + beam tests*
- 7-8th March 2024 (KIT) : topical workshop on *injectors for ultra low emittance rings*

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

9th General Low Emittance Rings Workshop

(February 13th-16th, CERN)

~ 100 participants (record in person for this series)

~ 60 presentations

(45 Europe + 10 Americas + 4 Asia)

<https://indico.cern.ch/event/1326603/>



Low Emittance Rings workshop 2024

Feb 13 – 16, 2024
CERN
Europe/Zurich timezone

Enter your search term

Overview

Timetable

Contribution List

Registration

Participant List

Videoconference

Accommodation

How to reach CERN

CERN Map

Social events

Visits

Practical Details

How to upload a presentation on Indico

Contact

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The **9th Low Emittance Rings Workshop 2024**, supported by the I.FAST EU project Work Package 7 on High brightness accelerators for light sources, will be held at CERN, Geneva (Switzerland) on **13-16 of February 2024**. The goal of the workshop is to bring together experts from the scientific communities working on low emittance lepton rings, including light source storage rings, damping rings and e+/e-circular colliders.

The workshop sessions will include:

- **Low emittance ring design**
- **Low emittance ring commissioning and operation**
- **Collective effects and beam stability aspects**
- **Associated technologies for low emittance rings**
- **Machine Learning tools for design and operation**

In collaboration with the IFAST WP11 on Sustainable concepts and technologies, a day will be dedicated to presentations and discussions on **Power Consumption, Efficiency and Sustainability**, key aspects for the design and operation of present and future accelerators.

Students are encouraged to participate and present their work. A **prize** will be awarded to the **best student presentation** to allow for participating in a major conference presenting studies related to Low Emittance Rings.

The programme will be organised by the **Scientific Programme Committee**:



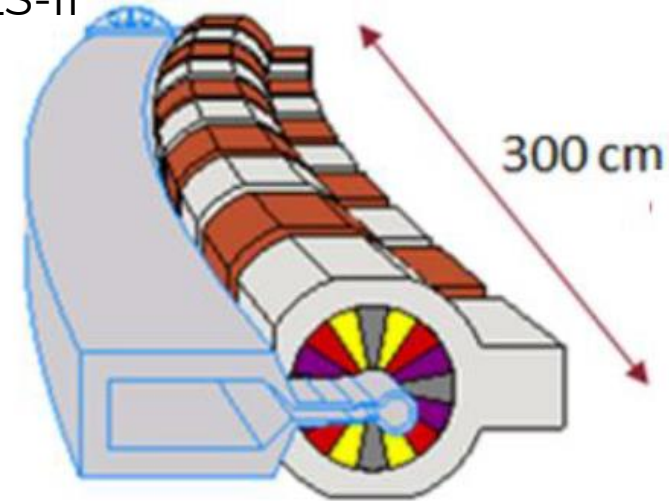
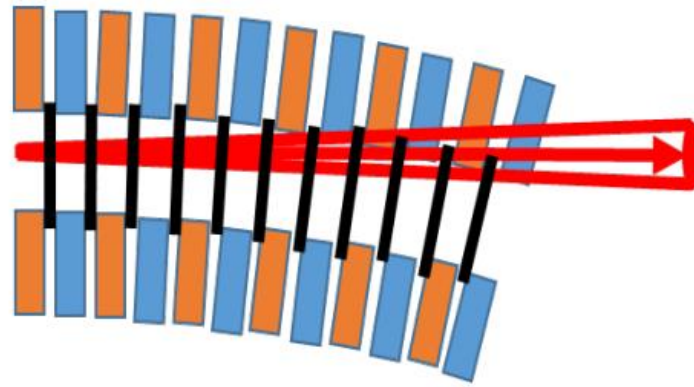
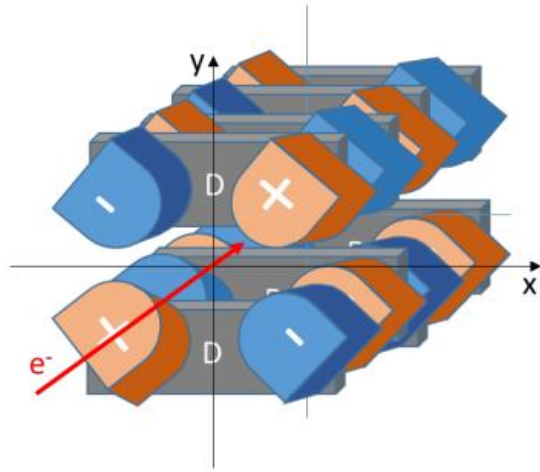
9th General Low Emittance Rings Workshop

(some) highlights

New concepts (lattice: NSLS-upgrade – magnets: VADER see talk by Y. Papaphilippou)

Complex bend concept – T. Shaftan
Strong focusing distributed along a

Complex bend lattice 23 pm @ 3GeV
17% of the power consumption on
NSLS-II



Joint session with WP11 on **sustainable concepts** and technologies
Extensive use of **machine learning** algorithms both in design and
operation of accelerators

Workshop on Injectors for Storage Ring Based Light Sources

(6-8 March 2024, KIT)

- 41 participants, 21 presentations related to
 - **new injectors and modifications to old machines**
 - proposed and future injectors

The 6 GeV LPA injector **drive** PETRA IV

<https://indico.scc.kit.edu/event/3948/>

I.FAST Workshop 2024 on Injectors for Storage Ring Based Light Sources

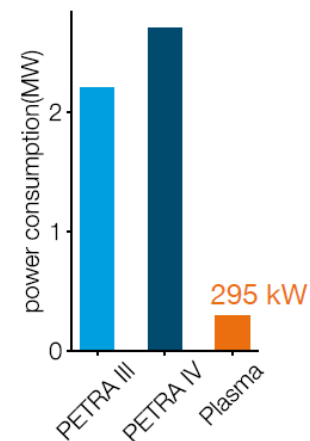
6-8 March 2024
KIT
Europe/Berlin timezone

Overview

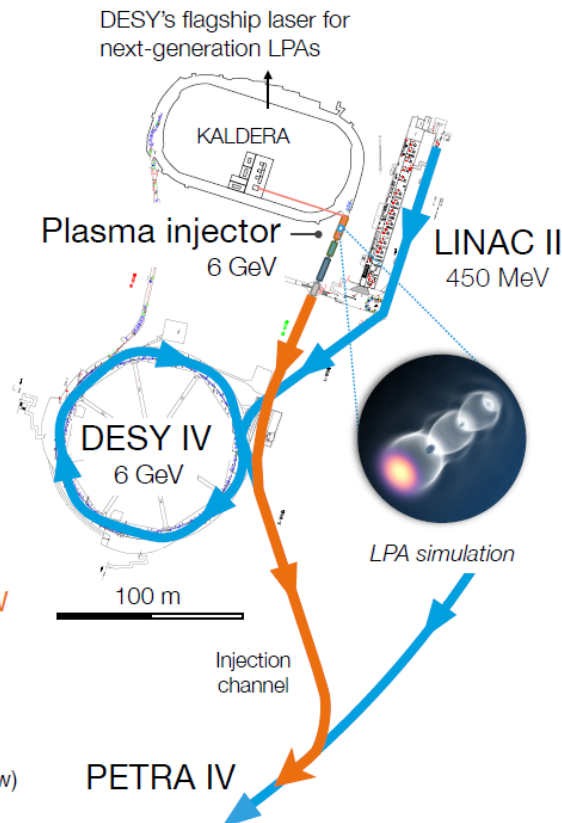
- Call for Abstracts
- Timetable
- Contribution List
- Book of Abstracts
- Registration
- Participant List



Injector power usage (during injection)



(Complex topic: under review)



ial Meeting, Paris, 18/04/2024

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Courtesy A. Mochihashi (KIT)



Workshop on resistive magnets for low emittance rings

(June 1st-2nd, DESY) <https://indico.desy.de/event/39184/>

Hybrid workshop: ~50 participants (EU, US, Asia: ~10 Spring-8)

Challenges and recent trends in the **design, construction and operation of resistive magnets** for ultra low emittance rings

Workshop on permanent magnets for low emittance rings

(November 14th-15th, Trieste) LER-PerMag workshop

42 participants (EU, US, Asia): **Joint workshop with LEAPS**

Review recent trends in the **design, construction and operation of PM based magnets**

Visit to KVMA (special thanks D. Cozzomettante)



magnet design

solutions for Dipoles, DQ, Quads, Sexts, Octupoles, materials (PM, highly saturated magnets)

cross talk

reduction of power consumption (cooling, DT, ...)

magnet construction

tolerance achieved

experience with milling vs wire erosion

Workshop on Bunch-by-Bunch Feedback Systems and Related Beam Dynamics (3-6 March 2024, KIT)

<https://indico.scc.kit.edu/event/3742>

- 43 participants, 18 presentations
 - Beam instrumentation and high power systems
 - Hardware for fast signal processing
 - Related beam dynamics
 - Applications and new ideas/ collaborations
- **Beam tests at KARA**
 - Vertical emittance/beam size control with the BbB feedback system
 - Commissioning methods for BbB feedback system
 - Test of longitudinal BbB feedback system with stripline kicker in KARA booster

I.FAST Workshop 2024 on Bunch-by-Bunch Feedback Systems and Related Beam Dynamics

3-6 March 2024
KIT
Europe/Berlin timezone

Overview

Scientific Programme

Call for Abstracts

Timetable

Contribution List

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Participant List



Participants: R. Nagaoka, G. Rehm, D. Teytelboym, T. Nakamura, M. Dehler, S. Pfeiffer, M. Lanza, et al.

Michele Caporin, I.P.A.S.E. Annual Meeting, Paris, 18/04/2024

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Courtesy A. Mochihashi (KIT)

WP7 Task 7.1 and 7.2: milestones and deliverables

D7.1	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
D7.2	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
D7.3	Longitudinally variable bend prototype fabrication	7.3	CERN	DEM	PU	40	MS27	Prototype acceptance tests	7.3	46	Report
D7.4	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
D7.5	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
D7.6	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										
WP7 High Brightness Accelerators for light sources																																																												
7,1 Coordination and communication																																																D												
7,2 Enabling technologies for ultra-low emittance rings																																																M	D											
7,3 Variable Dipole for the upgrade of the ELETTRA storage ring																								M																		D	M																	
7,4 Very high gradient RF Guns operating in the C-band RF technology																								M																		D	D	M																
7,5 CompactLight Prototype Accelerating Structures																						M	D																			D																		

Other tasks covered in next talks by Y. Papaphilippou, D. Alesini, and G. D'Auria

Conclusions and perspectives

Ultra low emittance ring community is very active with many projects funded (SLS-II, ELETTRA 2.0, Diamond II) and many TDR/CDR programmes ongoing (PETRA IV, SOLEIL-II, ALBA-II, ..)

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

Next workshops under discussion:

- 10Th general low emittance ring workshop (location TBD)
- Topical workshop on technology for ultra low emittance rings (ALERT 14 – ALERT19)
- Longitudinal Electron beam Dynamics for coherent light Sources 2024 (LEDS 2024).
PSI, Bern, September 2024
Scaling, instabilities and other collective effects that impact brightness in FELs and storage rings.

iFAST

Thanks A. Mochihaschi (KIT) and Y.
Papaphilippou (CERN)
Thank you for your attention!



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