I-FAST steering committee: 16th November 2021

Riccardo Bartolini, DESY

WP7: High brightness accelerator 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**.

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

Task 7.2: Enabling technologies for ultralow emittance rings (A. Mochihashi, KIT)
Beneficiaries: DESY, CERN, SOLEIL, DLS, INFN, KIT, PSI, KYMA

NETWORK

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

WP7: Milestones and deliverables

D7.1	Final report on the development of high brightness electron beams for light sources	7.1	UOXF	R	PU	48
D7.2	Report on enabling technology for ultralow emittance ring	7.2	KIT	R	PU	45
D7.3	Longitudinally variable bend prototype fabrication	7.3	CERN	DEM	PU	40
D7.4	Mechanical realization and low power RF test of the two RF guns	7.4	INFN	DEM	PU	38
D7.5	Construction of the XLS accelerating structure pre-prototype.	7.5	ELETTRA-ST	DEM	PU	24
D7.6	Construction of the XLS accelerating structure full prototype.	7.5	ELETTRA-ST	DEM	PU	36

MS25	General workshop on Task7.2 activity summary	7.2	42	Indico page
MS26	Magnet specifications based on optics calculations for ELETTRA. Magnetic and mechanical design including fabrication drawings	7.3	24	Report
MS27	Prototype acceptance tests	7.3	46	Report
MS28	Electromagnetic and mechanical design of the two guns	7.4	24	Report
MS29	High-power test stand setup and final results of the high-power tests	7.4	46	Report
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																																																		
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7,5	CompactLight Prototype Accelerating Structures																					M		D												D													

Task 7.2: Enabling technologies for ultra low emittance rings (A. Mochihaschi, KIT)

Scope:

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.

- Monthly regular meetings via zoom (update from facilities, share info, organization of activities). Regular attendance from CERN, DESY, DLS, INFN, KIT, KYMA, PSI, SOLEIL
- 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 and produce progress reports
- first workshop partially supported by I-FAST – 99 delegates !

Task 7.2: Ultra low emittance rings

- **<u>Networking and knowledge sharing within Task 7.2 :</u>**

  Online presentations and discussions:

  - Chris Burrows (Diamond), *Introduction to the R&D Beamline and activities at Diamond* (11.June 2021)
  - Ian Martin (Diamond), *Preparation for Diamond-II relevant to IFAST WP7.2* (11.June 2021)
  - Laurant Nadolski (SOLEIL), *About ongoing studies on the machine with a multipole injection kicker* (15.July 2021)
  - Giovanni Franzini (INFN), *An overview of the bunch by bunch feedback at DAFNE* (13.October 2021)

- **<u>Plan for experimental tests:</u>**

  - Discussion about the possibility of
    experimental tests for the XBPM system at KARA – multibunch feedback system at DAFNE

Task 7.2: Ultra low emittance rings

- **<u>Workshop planning (working title):</u>**
  1. Beam diagnostics and dynamics in ultra-low emittance rings
     - Expansion of our strong network dealing with ultra-low emittance rings, with a focus on beam diagnostics (e.g. on the hardware side) and beam dynamics (e.g. on the software side).
     - Planned venue and date: KIT (Karlsruhe, Germany), May 2022
  2. Permanent magnet technologies and beam dynamics
     - exchanging and sharing knowledge for permanent magnet and related technologies (e. g., mechanical structures, girders etc.) and beam dynamics related to the ultra-low emittance rings. Link to Task 11.3. Potential cooperation with PERMALIC in LEAPS
     - Planned venue and date: CERN (Geneva, Switzerland), July 2022

Task 7.2: Ultra low emittance rings

- **<u>Workshop planning (continue):</u>**
  3. NEG coating vacuum systems
     - Exchanging and sharing knowledge and information about NEG coating vacuum systems, which are now part of the mainstream of vacuum systems for the ultra-low emittance rings.
     - This topic is strongly related to beam dynamics because of the impedance problem. Therefore, we are considering a joint event with the workshop with beam dynamics (possible joint event of Task 7.2 and Task 10.5 is currently being discussed).
  4. Beam dynamics for ultra-low emittance rings
     - Review of latest ultra-low emittance lattice design developments.
     - Optimisation tools, experimental tests of optimization. Model vs Machine studies.
     - Discussion at ALBA: G. Benedetti. (virtual / in person – 2022)

Task 7.2: Ultra low emittance rings

- **<u>Workshop planning (continue):</u>**
  5. General workshop for the ultra-low emittance rings
     - Sharing a wide range of topics on ultra-low emittance rings, allowing us all to further strengthen our ULER network.
     - Planned venue: TBD, date: after October 2022.

Mainitaing the tradition of the General Workshop for Ultralow Emittance Rings

started with the CLIC/ILC collaboration in 2010 and supported by EuCARD2, ARIES and now IFAST

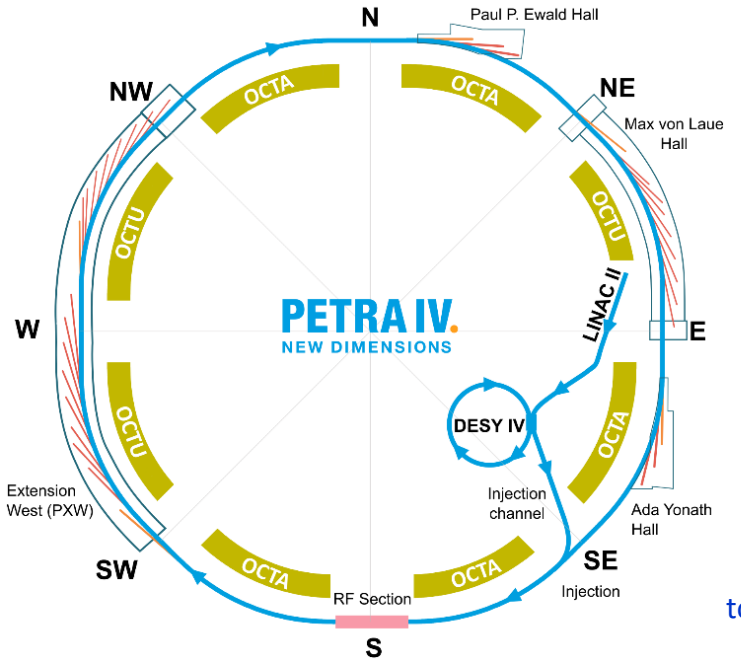
Task 7.2: new lattice at PETRA-IV

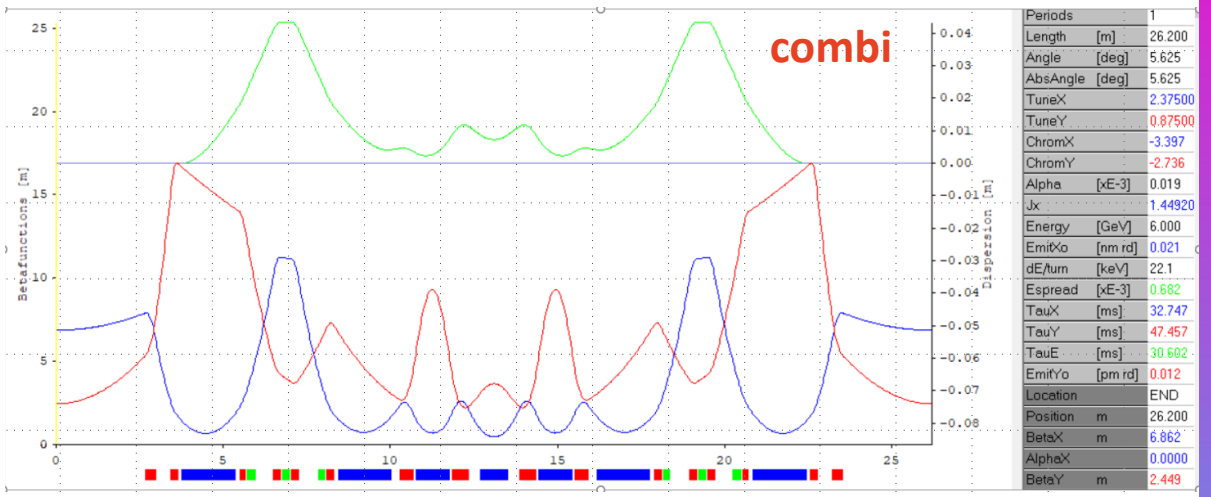
New H6BA cell:

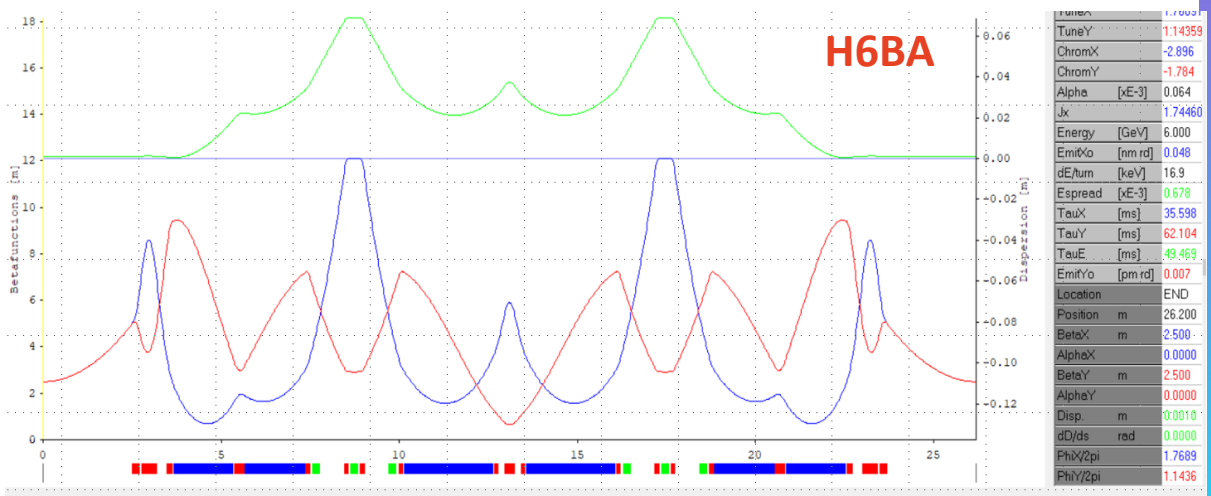
- 4 DLs and 3 central DQs substituted with
- 2 DLQs and 4 PM DQs

Relaxed emittance in the arcs 43 pm and extensive use of damping wigglers in 5 octants (OCTA) for emittance damping to 20 pm and control. Undulator beamlines in 3 octants (OCTU)

DA and MA for bare lattice are remarkably larger.



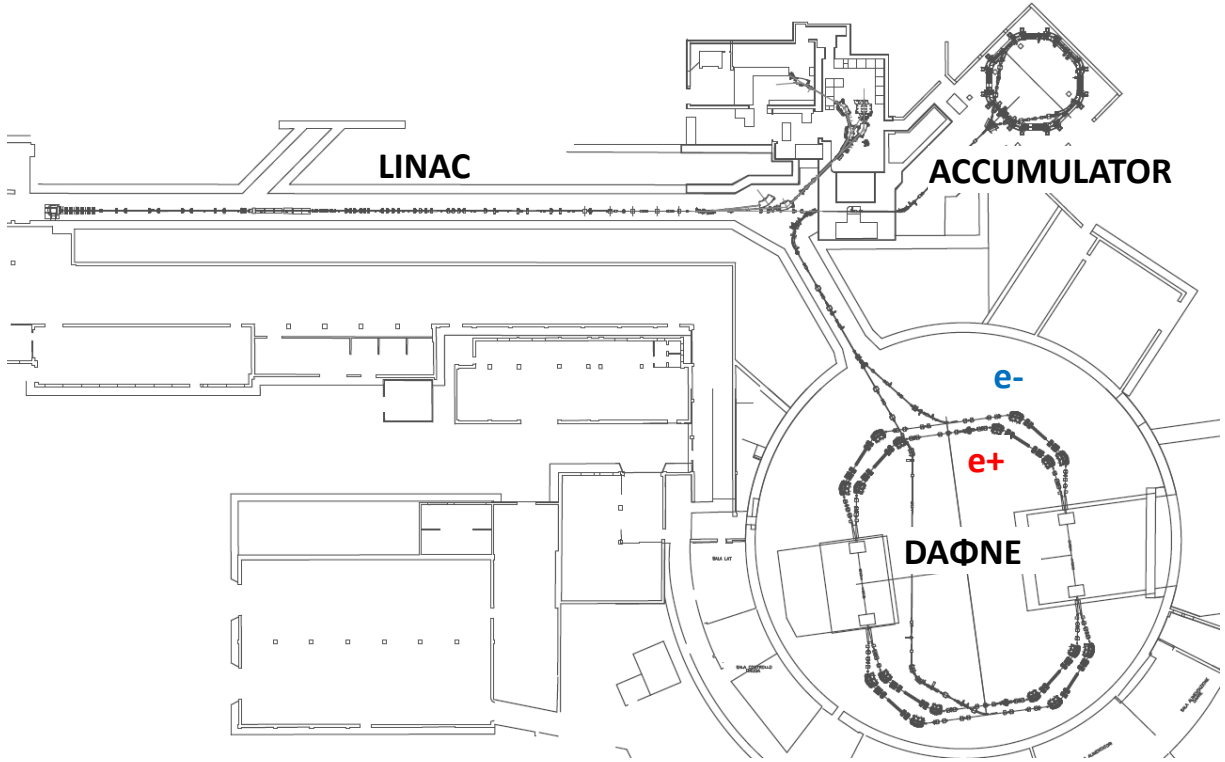




Task 7.2: diagnostics and feedback (INFN-LNF G. Franzini)

Contribution to Task 7.2 at INFN-LNF is the sharing of measurement results and ideas for possible upgrades for the bunch by bunch feedback system of DAΦNE

- **DAΦNE** is an electron-positron collider in operation at INFN-LNF for physics experiments since 1999.
- It operates with (usually) **90 bunches at 510 MeV**, with a **time interval of 2.71 ns** between each other. Typical **stored currents** are in the range of **1 A / 2 A**
- **Bunch-by-bunch longitudinal and transverse feedback** systems were installed in each DAΦNE ring and became operational since 1999.
- **An extensive review on the system is ongoing**. Measurement campaign in order to evaluate and **minimize any possible source of noise** and interferences, and **to find better solutions for the analog /digital treatments** of the signals involved in the system. Extension to ultralow emittance rings



Summary

- Activities in Task 7.2 have started: several workshops under planning
- No issues (…so far)
- Looking forward to progress with upcoming activities, milestone and deliverables