

G. Franchetti

improving Accelerator PErformance and new Concepts –APEC (WP6)

Alessandro Drago (INFN-LNF), Giuliano Franchetti (GSI), Johannes Gutleber (CERN), Klaus Höppner (HIT), Florian Hug (JGU), Mauro Migliorati (U. Roma Sapienza), Frank Zimmermann (CERN)

1st APEC steering meeting, CERN, 5 May 2017

APEC in a nutshell

5 scientific tasks with the goals

- to **improve the performance of the next generation of accelerators** (*MESA, FAIR, HL-LHC, ThomX...*) ,
- to **advance the design of the “next next” generation of accelerators** (*FCC, LHeC, ...*) ,
and
- to **investigate and rank accelerator options for the long-term future** (*muons, crystals, nanotubes, gravitational waves,...*)

WP6 APEC tasks

- **Task 1.1. Coordination and Communication**
(F. Zimmermann, CERN; G. Franchetti, GSI)
- **Task 1.2. Beam Quality Control in Hadron Storage Rings and Synchrotrons** (G. Franchetti, GSI; F. Zimmermann, CERN)
- **Task 1.3. Reliability and Availability of Particle Accelerators**
(J. Gutleber, CERN; K. Höppner, HIT Heidelberg)
- **Task 1.4. Improved Beam Stabilization**
(M. Migliorati, La Sapienza/INFN; A. Drago, INFN-LNF)
- **Task 1.5. Beam Quality Control in Linacs and Energy Recovery Linacs** (F. Hug, JGU Mainz)
- **Task 1.6. Far Future Concepts & Feasibility**
(M. Zanetti, Padova/INFN; F. Zimmermann, CERN)

Task 6.1 Coordination and Communication

Coordinators: F. Zimmermann, CERN; G. Franchetti, GSI

- **Coordination** of network tasks, **interface** with other work packages, general public, etc.
- **Dissemination of network results** through public presentations and articles
- **Monitoring task progress.** Adherence to milestones and timely **delivery of results**

Task 6.2 Beam Quality Control in Hadron Storage Rings and Synchrotrons

Coordinators: G. Franchetti, GSI; F. Zimmermann, CERN

- **Compilation and classification of processes** causing performance degradation
- **Ranking of these mechanisms according to their relative importance**
- Identification and prioritization of **mitigation approaches**
- **Interfacing with Technology JRAs** (e-lenses, thin films, etc.)

Task 6.3 Reliability and Availability of Particle Accelerators

Coordinators: J. Gutleber, CERN; K. Höppner, HIT

- Establish **standard body of RAMS knowledge** for particle accelerator application
- **Compile and rank existing RAM standards, methods and practises** in major laboratories
- **Analysis of RAMS characteristics** for particle accelerator technical systems
- Spreading the identified best RAM practices in order to **introduce a common RAM baseline**
- Assess the **feasibility of an Open Data Infrastructure for accelerator reliability**



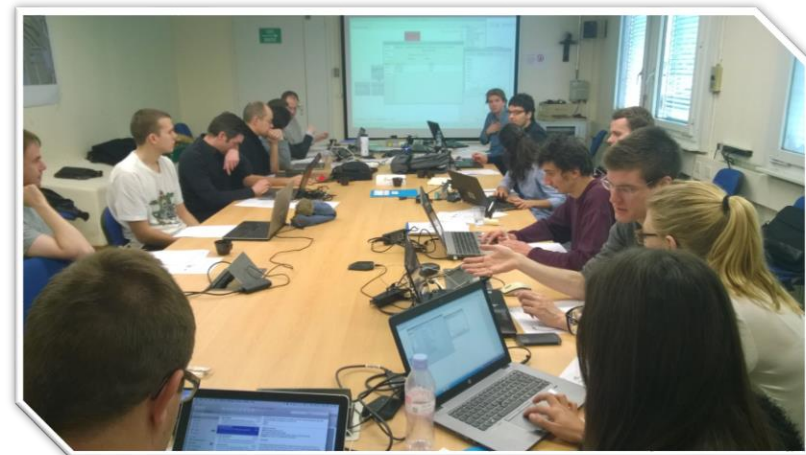
Accelerator Reliability & Availability training

**NEXT SESSION
JUNE 27-30**

- **Regular training, 2 times/year**
- Part of CERN training catalogue
- External participants welcome!
 - Fee: 1'000 Chf
- **Contact: Julie.Hadre@cern.ch**
- <https://indico.cern.ch/event/636757/>

Common terminology and concepts

- Methods: FMEA, FTA, RBD
- Density functions, Weibull modelling, redundancies
- Modelling and simulation with Markov and Monte Carlo method, ELMAS tool
- Real-life examples



Task 6.4 Improved Beam Stabilization

Coordinators: M. Migliorati (Sapienza); A. Drago (INFN Frascati)

- **Review existing strategies & methods** for beam-impedance assessments and impedance models
- Propose and evaluate **novel methods to reduce accelerator impedance**
- Identify or develop **strategies for electron-cloud mitigation** at future accelerators
- Conceptual **design of advanced beam feedback systems** for future machines

Task 6.5 Beam Quality Control in Linacs and Energy Recovery Linacs

Coordinators: F. Hug (JGU Mainz)

- Expand **synergies between** proposed future ERL **projects** and operating or soon-to-be-commissioned linacs/recirculating linacs and ERLs in Europe
- Establish a **parameter database** for the various facilities
- Examine innovative and **alternative “ERL” approaches**
- Work out synergies between **linac developers and source developers** for optimum beam quality
- **Identify outstanding open questions and develop prioritized R&D guidelines**

Task 6.6 Far Future Concepts & Feasibility

Coord's: M. Zanetti (Padova); F. Zimmermann (CERN)

- Analysis of the potential of **crystals** for charged-particle bending or particle acceleration
- Development of advanced **photon colliders**, including gamma-gamma and photon-nucleon colliders
- Assessment of **advanced muon-collider concepts** without ionization cooling
- Assessment of the potential use of large storage rings for **gravitational wave detection or generation**
- **Assessing and ranking a basket of future concepts with regard to “future feasibility” and physics cases**
- **White list of ranked future options**

Deliverables

List of deliverables

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
D6.1	Ranking of performance degrading mechanisms for hadron storage rings and synchrotrons	12 - GSI	Report	Public	28
D6.2	Report on optimal RAMS characteristics for particle accelerators	1 - CERN	Report	Public	36
D6.3	Summary of novel methods to reduce accelerator impedance	21 - INFN	Report	Public	36
D6.4	Report on outstanding open questions and prioritized R&D guidelines for Energy Recovery Linacs	16 - JGU	Report	Public	44
D6.5	White list of ranked far-future accelerator options	21 - INFN	Report	Public	46

Deliverables - description

Description of deliverables

D6.1 : Ranking of performance degrading mechanisms for hadron storage rings and synchrotrons [28]

Compilation and classification of the processes causing performance degradation in past, existing and planned facilities (Task 6.2)

D6.2 : Report on optimal RAMS characteristics for particle accelerators [36]

Compilation of a list of Reliability, Availability, Maintainability and Serviceability (RAMS) methods and practices in different laboratories and definition of optimal RAMS characteristics for particle accelerator systems (Task 6.3)

D6.3 : Summary of novel methods to reduce accelerator impedance [36]

Compilation and review of existing strategies and methods for beam-impedance assessments and impedance models (Task 6.4)

D6.4 : Report on outstanding open questions and prioritized R&D guidelines for Energy Recovery Linacs [44]

Compilation of a parameter database for various facilities including innovative and alternative Energy Recovery Linacs (ERL) approaches. Formulation of guidelines for the design of ERLs (Task 6.5)

D6.5 : White list of ranked far-future accelerator options [46]

Assessment and ranking of several future concepts with regard to “future feasibility” and physics cases, including a summary report (Task 6.6)

Milestones

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS26	Report on 1st Annual workshops of all tasks (Task 6.1)	1 - CERN	12	Agenda, attendance lists on Indico
MS27	Report on 2nd Annual workshops of all tasks (Task 6.1)	1 - CERN	24	Agenda, attendance lists on Indico
MS28	Parameter database for various ERL & Linac facilities (Task 6.5)	16 - JGU	24	Report approved by StCom
MS29	Report on 3rd Annual workshops of all tasks (Task 6.1)	1 - CERN	36	Agenda, attendance lists on Indico
MS30	Strategies for e-cloud mitigation in future accelerators (Task 6.4)	21 - INFN	40	Report approved by StCom
MS31	Identification & prioritization of mitigation approaches (Task 6.2)	12 - GSI	40	Report approved by StCom
MS32	Feasibility of an Open Data Infrastructure for accelerator reliability (Task 6.3)	1 - CERN	44	Report approved by StCom

APEC hiring

tasks 6.3, 6.4, and 6.6

plan and status

upcoming APEC workshops

- Impedance and beam instabilities, Benevento, Italy, 19-22 September (Task 6.4)
- SpaceCharge2017, TU Darmstadt, 4-6 October 2017 (6.2)
- Slow Extraction Workshop 2, CERN, 9-10 November 2017 (6.2)
- Accelerator Reliability Workshop, HIT Heidelberg, November or December 2017 (6.3)
- E-CLOUD'18, La Biodola, Italy, 3-6 June 2018 (6.2,6.4)
- Slow Extraction Workshop 3, FNAL, 2018 (6.2)
- ...
- Materials and Surfaces for Accelerators, 2019 (6.2)
Together with ARIES WPs 15 (thin films) and 17 (new materials)
- APEC ERL workshop #1 (6.5)?
- Advanced Concepts workshop #1 (6.6)?

APEC publications

conference/journal articles should include acknowledgement

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and final versions be sent to Frank, Giuliano and Valerie, to be added to the ARIES database

first APEC publications & presentations

IPAC 2017, Copenhagen , 14-19 May 2017

- G. Guillermo et al., Comparing the behavior of simulated proton synchrotron radiation in the arcs of the LHC with measurements
- F. Zimmermann, Possible Limits of Plasma Linear Colliders
- S. Ogur et al., Preliminary Design of FCC-ee Pre-Injector Complex
- M. A. Valdivia et al., Optimized monochromatization for direct Higgs production in future circular e^+e^- colliders

ICALEPCS 2017, Barcelona 8-13 October 2017

- Klaus Höppner et al., Towards a Common Reliability & Availability Information System for Particle Accelerator Facilities

facilities with APEC participation or links

- SuperKEKB commissioning (KEK)
- IOTA commissioning & studies (FNAL)
- ThomX commissioning (LAL)
- MESA commissioning (JGU)
- PERLE@Orsay (LAL)
- GammaFactory (CERN)
- FAIR, HL-LHC/LIU (GSI, CERN)
- FCC & HE-LHC (CERN)
- ELI-NP (INFN)
- CBETA (Cornell/BNL)
- ...