

Task 6.2 Plan

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ARIES Ambition

ARIES aims to improve the **present and future performance** of the European particle accelerator infrastructure, thereby strengthening Europe's leading position in this field. The improvement will result from pushing beyond state-of-the-art to a set of **selected ground-breaking technologies with a potentially strong impact on future accelerators**, from collecting a **wider community** around these challenging objectives and from **sharing the test infrastructure** required to develop the new technologies. The technologies developed in ARIES aim to push the traditional frontiers of particle accelerators, energy and intensity or luminosity, integrating cost and sustainability factors as essential elements in the optimisation process. This multi-parameter optimisation requires a **multi-disciplinary approach**, which is the main feature of ARIES.

ARIES Ambition

ARIES
advancing the energy frontier

***Magnetic field
in superconducting dipole magnets***

***Electric field gradient
in accelerating cavities***

***Electric field in novel high-gradient
accelerating structures***

ARIES
advancing the intensity frontier

The intensity/luminosity frontier is particularly complex because it is related to both **technological** and **beam physics** aspects, which in turn are closely related to the specific type of accelerator.

WP6



ARIES Ambition

Intensity/luminosity frontier

State-of-art ¹⁶	Ambition of ARIES	Challenges
<p>Proton collider luminosity: $5 \times 10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$ in the LHC during the 2015 run at 13 TeV</p> <p>HL-LHC goal: 10^{34} with luminosity levelling</p> <p>Heavy ion intensity: 10^{12} ions/pulse, goal of FAIR</p> <p>Stored energy: 362 MJ/beam in LHC¹⁶ (future goals: 700 MJ for HL- LHC, 8 GJ for FCC)</p> <p>Emittances for 3rd generation synchrotron light sources: < 1 nm (0.3 and 0.5 nm for MAX-IV and NSLS-II)</p> <p>Accelerator beam availability: 95% (target for ESS)</p>	<p>Bring to Europe the leadership in space charge compensation based on the generation of a modulated electron beam interacting with the main proton or ion beam (“electron- lens”).</p> <p>Develop materials required for collimation of the large power of the high-intensity beams.</p> <p>Achieve further reduction in the emittance of synchrotron light sources</p> <p>Increase the accelerator reliability and availability.</p>	<p>Build and test (WP16) a modulated electron gun with 20 A current (beyond the state-of-the-art 5 A).</p> <p>New graphite composites (WP14 and 17) will provide electrical conductivity of 2.5 MS/m, factor 10 of normal graphite, and 2.5 times what has been achieved, with robustness to beam impacts ~ 3 MJ.</p> <p>WP7: develop critical components like injection kickers, high gradient magnets, improve vacuum design and beam optimisation, to ensure emittances in the 100–200 ps range</p> <p>Achieve availabilities 95% for large research facilities and >98% for small medical and industrial accelerators (Task 6.3)</p>

Technology	ARIES WP	Present TRL	Objectives (Technological breakthroughs)	Final TRL
Electron beams for space charge compensation	WP16	2	Set-up and beam test of an electron gun with the RF power modulator. Achieve peak e-beam current of 20 A and amplitude modulation with a bandwidth of several MHz with appropriate beam profiles and propagation.	3

Technology	ARIES WP	Present TRL	Objectives (Technological breakthroughs)	Final TRL
Beam quality control in accelerators	WP6	1	Identify and rank performance degrading mechanisms for hadron storage rings and synchrotrons and novel methods to reduce accelerator impedance.	2
Materials for extreme thermal management	WP14 WP17	3	Study and development of graphitic materials and electrically conductive coatings, resisting the impact of high intensity particle beams for electrical conductivity of 2.5MS/m, with robustness to beam impacts ~ 3 MJ and resistance to radiation > fraction of a DPA.	4
Reliability and availability of accelerators	WP6	3	Define optimal design and operational RAMS characteristics for particle accelerators to improve availability beyond 90%.	4
Advanced instrumentation for accelerators	WP8	2/3	Improvement of accelerator operation for high quality beams e.g., position and resolution improvement or operation of feedback loops.	3/4
Injection systems for ultra-low emittance rings	WP7	1, 2	Innovative kicker concepts for beam injection in small apertures rings: nonlinear pulsed kicker magnets for on-axis injection and fast-rise high-stability kickers for swap-out injection.	3



Progress in Networking Activities

The developments required to push forward the frontiers of particle accelerators are often at the cross-roads of several technologies and branches of accelerator science, requiring the combination of various competences. The role of the ARIES Networks will be of a **catalysing nature** to circumvent the natural fragmentation into specialties and domains, to break barriers between traditional communities, and to aggregate a wide community around topics of excellence. In this way, they will foster a culture of co-operation both geographical and between research, academia and industry. The main objective of the Networking activities will be to **identify and promote early stage technologies** and to develop **common tools and strategies** aimed at enhancing the services provided by the research infrastructures.

IMPACT

WP6 will provide **ideas** and **concepts** to improve performance of all accelerators, including those for basic research, for applied research and for medical and industrial applications. A specific task will **develop design and operational strategies to improve availability** of accelerators, impacting all types of accelerators and in particular those operating for medicine and industry.

Plan for Task 6.2

December 2018

- 1) Contact major EU key player GSI/CERN/RAL
- 2) Create a kick-off forum on the state of the art of operational experience
- 3) Involvement of some of the storage rings community (start)
- 4) Goal → forming a core group of people who participates to a periodic series of events targeting the ARIES Ambition
 - Hadron machine will report their main problems
 - New ideas and concepts will be grounded
 - Summarizing the state of the art at global level: there are more events beyond ARIES that need to be accounted to maintain the ARIES IMPACT.
 - Linking WP6 to US significant R&D developments: IOTA

Venue: possibly Frankfurt downtown if cost-wise accessible

Further extension: involve more task of WP6.

Venue for 2019 → Heidelberg



