

# Protons and Ions for Europe



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- High intensity proton and ion drivers are of utmost importance for almost every scientific discipline
  - Neutron and muon sources for material science and medicine
  - High intensity beams, neutrino sources and colliders for fundamental physics
  - Studies of atomic nuclei and nuclear processes
- Major accelerators are moving into delivery phase
  - SPIRAL2
  - ESS
  - DONES
  - Long lead times - now need to look to future plans
- Other facilities are making important plans for next generation facilities
  - ISIS
  - CERN



# Aims

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- Improve performance
  - Limitation from beam intercepting devices (target, foil)
  - Limitation from collective effects
- Improve reliability
  - Loss and damage mechanisms
- Improve cost & sustainability
  - Power efficiency
  - Capital cost and new facility footprint
- Supported by latest techniques
  - Digital Twinning & Machine Learning



# 2026-TECH-01-01

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- Aim of this topic is to deliver innovative scientific instrumentation, tools, digitalisation, methods and solutions
  - Research and development of new scientific instrumentation, tools, digitalisation, and methods for research infrastructures;
  - Technology validation and prototyping;
  - Training of RI staff
  - Potential for industrial exploitation of the solutions
- Minimise the research infrastructures' environmental footprint and increase resilience
- Should include at least two different research infrastructures as beneficiaries
- Should reach TRL3-4 by end of project (validation in lab environment)



# Work Packages

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- Propose 8 work packages
  - 1 Management
  - 2 Linear accelerators
  - 3 Ring accelerators
  - 4 Targets and Moderators
  - 5 Magnets
  - 6 Radiofrequency cavities
  - 7 Beam Instrumentation
  - 8 Computing, Machine Learning and Digital Twins
- Noting that sustainability is an important input that will impact every WP



# WP1: Management

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- Management work package will:
  - Provide overall management of the Research and Innovation Action
  - Support financial and project management
  - Ensure timely release of Deliverables and Milestones
  - Support regular meetings of the team
  - Support equality and gender dimension activities within the project
  - Ensure compliance with EU data management
  - For discussion – cost and sustainability considerations



# WP2: Linear Accelerators

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- Linear Accelerator technology improvement
  - Linac design
  - Ion source development
    - ECR ion sources
    - H+/D+ ion sources
  - Loss mitigation techniques
    - Uncontrolled H- stripping
    - Beam stability
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# WP3: Rings

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- Ring development to deliver novel beams
  - Injection and extraction
    - Including advanced stripping techniques
  - Extreme bunch compression techniques
  - FFAs and beam stacking
  - Mid-pulse length extraction
  - Consideration of requirements and feasibility for instrumentation (joint with WP7)
  - Potentially move to rings:
    - Laser stripping of H<sup>-</sup>
    - Advanced stripping foil development



# WP4: Targets and Moderators

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- Advanced target technologies to deliver the next generation sources:
  - Fluidised Tungsten target
  - Liquid metal target/dump
  - Advanced target wheels
  - Liquid metal neutron reflectors
  - Target instrumentation



# WP5: Magnets

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- Magnet technologies to improve sustainability, reliability and beam performance
  - (Advanced kicker designs)
  - (High aperture permanent magnets)
  - Rapid pulsed normal conducting magnets
  - FFA magnet designs
  - Beam screen between magnets and beam
  - Radiation tolerance of HTS cable



# WP6: RF

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- RF technology to deliver versatile and efficient performance
  - Improved MA and vacuum cavity structures
  - High efficiency klystrons and solid-state power sources
  - Breakdown and cavity degradation phenomena and mitigation
  - Meander kicker



# WP7: Beam Instrumentation

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- Advanced instrumentation techniques
  - Non-linear BPMs for full beam reconstruction, ESS, esDONES, ISIS
  - Gas monitors and advanced vacuum systems, esDONES, ISIS
  - Novel reconstruction tools for ionisation profile monitors, esDONES, ISIS
  - (Laser diagnostics for H- sources)
  - Longitudinal measurement of extreme bunches, ISIS, CERN
  - Beam loss monitors – specifically neutron monitoring esDONES, ISIS
  - Feedback loop for damper, ISIS, CERN
  - Radiation hard electronics e.g. profile monitors and BLMs esDONES, ISIS
  - Fast acquisition systems for pressure sensors esDONES
  - Slow pump systems esDONES



# WP8: Computing

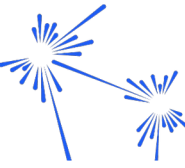
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- Development of computing modelling tools important
  - Machine learning for operational reliability and optimisation
  - Development of precise software tools and models
  - Benchmarking against codes and real machines

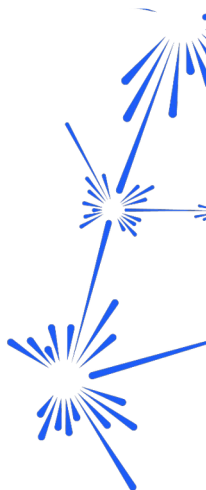


# Timeline

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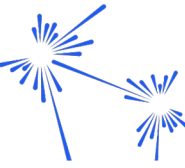


- **February 2025:** First draft resource requirement. Start writing words.
- **March-April 2026:** First draft proposal, distribute. Final draft resource requirement.
- **April-May 2026:** Editing
- **1st June 2026:** Submission
  
- TIARA: 18<sup>th</sup> March 2026
- Call Opens: 10th March 2026
- Submit Deadline: 16th June 2026



# Next Step

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- Bring working groups together for focused discussion
- Propose Tuesday 24<sup>th</sup> February and Friday 27<sup>th</sup> February:
  - See <https://indico.stfc.ac.uk/event/1848/>
  - Please attend WPs in which you are interested (not required to attend all)
- Aim to develop material and resource requirements
- Follow up with WP description

