

Protons and Ions for Europe

2026-02-26, 09:00 CET – 13:00 CET by Zoom

We had discussion on the following WPs:

- WP5 Magnets
- WP6 RF
- WP7 Beam Instrumentation
- WP8 Computing

WP5 Magnets

We discussed the following topics:

- High efficiency pulsed magnets – there is interest at CERN and ISIS to develop pulsed magnets to reduce power consumption. Potential for industrial partnerships
- Beam screens – Interest at CERN and ISIS in beam screen design. In ISIS we have experienced mechanical degradation and eventually destruction, possibly due to beam-induced vibrations of the screens. Also interest in screening for kickers, but here the interaction of the screen, kicker and beam is important owing to the rapid pulsed nature of the kickers (on MHz time scale)
- FFA scaled down magnet exists. Interest to develop prototype nested spiral coils to test manufacturing tolerances. Cost scale likely to be 25 kEUR for two or three full-scale coils. Good potential for industrial partners (existing contacts).
- HTS magnets are likely to be important for next-generation facilities. Radiation hardness of this coil technology is a big unknown but will certainly be important for future facility design. An interesting avenue would be the potential to characterise radiation hardness of HTS samples.

We also discussed the possibility for improved kicker design, in particular low impedance kicker design; although there did not seem to be a strong call for development of this technology.

WP6 RF

Two main topics were discussed under RF.

- Solid State Power Amplifiers look interesting for many colleagues. We had a nice discussion of some of the issues surrounding SSPAs and possible avenues for R&D. CERN and esDONES have SSPAs deployed but face issues surrounding reliability which can be addressed.

- Meander kickers also look interesting e.g. for SPIRAL2 and ISIS. Heating is a serious concern that needs a dedicated prototype.

We also considered high efficiency RF structure development for linacs and RF breakdown studies

WP7 Beam Instrumentation

We discussed a broad spectrum of instrumentation techniques. We noted that in the context of bunch compression (as discussed in WP3 Rings), there may be challenges addressing dynamic range; both in terms of frequency response and signal amplitude. We noted also that short bunches at low beta may be challenging to measure. It was pointed out that the frequency response is important for e.g. damper/feedback systems which may be of interest for WP3 Rings.

esDONES highlighted a particular issue around the delivery of longitudinal profile measurements using residual gas analysers. There was discussion of longitudinal and transverse profile measurements and calibration/analysis by looking at collection of electrons and different residual gas ion species. Study of reconstruction algorithms including for example in the context of space charge looks like an interesting avenue to pursue.

Vacuum systems and instrumentation are also important and deserve to be studied. We felt that they may fit in this WP.

We discussed Beam Loss Monitors. Two issues were identified; neutron detection can be challenging depending on the neutron energy and may be important particularly in high radiation areas. Radiation hardness in the readout electronics is also important. It was noted that radiation hardness can be a cross-cutting theme that can impact several tasks.

Non-linear BPMs are also an area of interest for many institutes particularly near to the target.

WP8 Computing Digitalisation

We discussed the importance of computing. Very good modelling codes are now available although the accelerator model must be implemented to a high standard in order to fully characterise machine. It was felt that a Digital operational layer is an important next step, for example integrating the huge array of signals (both beam and non-beam)

Suggested structure:

1. Benchmarking and model readiness
2. Standardised mid-layer between controls and models
3. Virtual diagnostics using 1,2 (digital twin etc)
4. Model based operational assistance (human in the loop) - ML / LLMs etc, even agentic systems
5. Sustainable and efficient computation/use of digital tools

The aim would be to increase uptime and increase quality of delivered beam (e.g. current on target). The codes and models in this framework would become a part of the control system.

There was some discussion of the overall benefit of the work, for example in the context of machine stability and other sorts of effects, and the necessity to have a crisp set of goals.

Summary

We have discussed a compelling set of studies that can deliver important enhancements to the development of existing and future European facilities, maintaining European excellence in these vital machines.

Some dates:

- In 2.5 weeks – March 18th – we have to defend the proposal at TIARA meeting at CERN. It would be good to have refined the task list by that point.
- The proposal must be delivered by June.