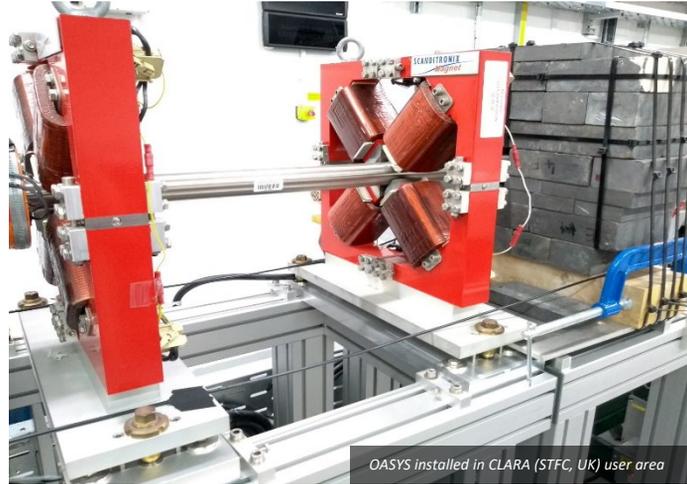


## CASE STUDY

# Optical-fibre based machine protection system for particle accelerators



OASYS installed in CLARA (STFC, UK) user area

Beam loss in particle accelerator structures can be dangerous and costly. Structures could be superconducting elements, which are easily damaged, or detectors, which are susceptible to the increased noise level. In an industrial setting these losses can lead directly to additional maintenance costs and downtime. It is critical that losses are characterised and monitored in as great a detail as the beam itself. Despite this, beam loss monitoring instrumentation is often limited in resolution and in coverage. The majority of current techniques are based on measuring absolute losses, via ionisation or scintillation, at discrete locations.

### The QUASAR Group

The QUASAR Group at the University of Liverpool in collaboration with the spinout company D-Beam Ltd, built upon existing research outcomes to develop and commercialise a new beam loss monitoring device, the optical-fibre beam loss monitor (oBLM) sensor.

STFC funding supported the oBLM project by enabling a series of test

measurements to take place. These measurements were integral to the development process of the oBLM, allowing the sensor to be fully characterised. The novel machine protection system is capable of detecting and characterising what would otherwise be critical beam losses. It can also sense irregularities in accelerator performance and thus help reduce maintenance costs and down time at a particle accelerator facility. This helps maximise operational capacity.

### Future developments

The QUASAR Group built upon the technical knowledge, expertise and development achievements of the oBLM sensor by winning additional STFC funding. The award was a key enabler for the oBLM work to be taken to its next technology stage by developing the optical-fibre analysis system (OASYS). OASYS aimed to provide facility operators with the means to take remedial action ahead of current systems, reducing the impact of beam loss and RF breakdown on a facility's resources. This system can also potentially provide the means of conducting large scale RF

conditioning for manufacturers in the industrial sector.

The OASYS monitor leveraged on the QUASAR Group's links with the STFC-funded Liverpool Centre for Doctoral Training in Data Intensive Science, LIV.DAT, to investigate turning reactive measurements into proactive interventions through novel applications of machine learning techniques.

Using the outcomes of OASYS as a foundation, work will soon commence on further improvements to the monitor and new application ideas. These will initially be in the framework of a new project focusing on beam loss monitoring and machine protection in energy recovery linear accelerators, before starting to apply the technology more widely. The focus will next be on turning the device into a turn-key product, with intuitive user controls, software and investigating novel industrial-scale applications.

*"The OASYS system has allowed us to extend the functionality and applicability of an exciting and emerging technology. Applying this advanced sensor at accelerators and light sources around the world shows exciting prospects for a wide range of applications."*

- Professor Carsten P Welsch,  
QUASAR Group Leader

### About us

The Quantum Systems and advanced Accelerator Research (QUASAR) Group is an internationally structured research group. We are amongst the world-leaders in beam instrumentations development, beam dynamics studies for accelerators and light sources. If you would like to find out more about our work on next generation particle accelerator diagnostics, please get in touch with Prof Carsten P Welsch: [c.p.welsch@liverpool.ac.uk](mailto:c.p.welsch@liverpool.ac.uk)