

WELCOME

AWAKE Collaboration Meeting

Carsten P Welsch



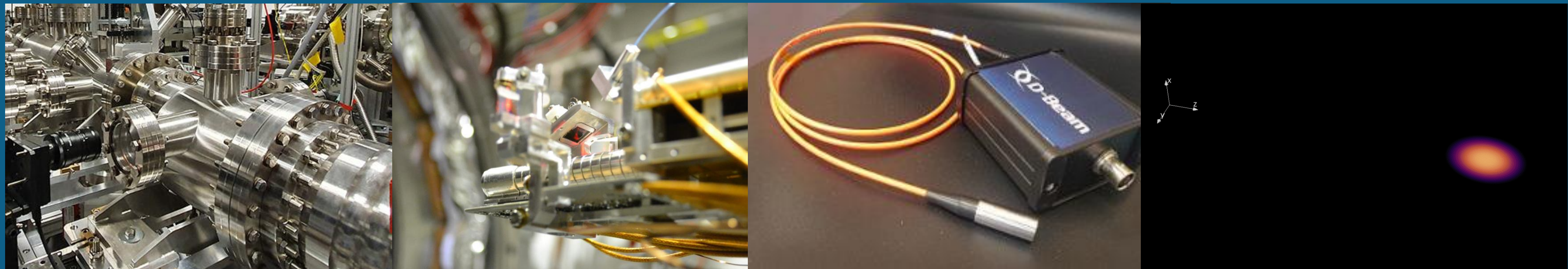
AWAKE

QUASAR Group Research



Working across three strategic areas:

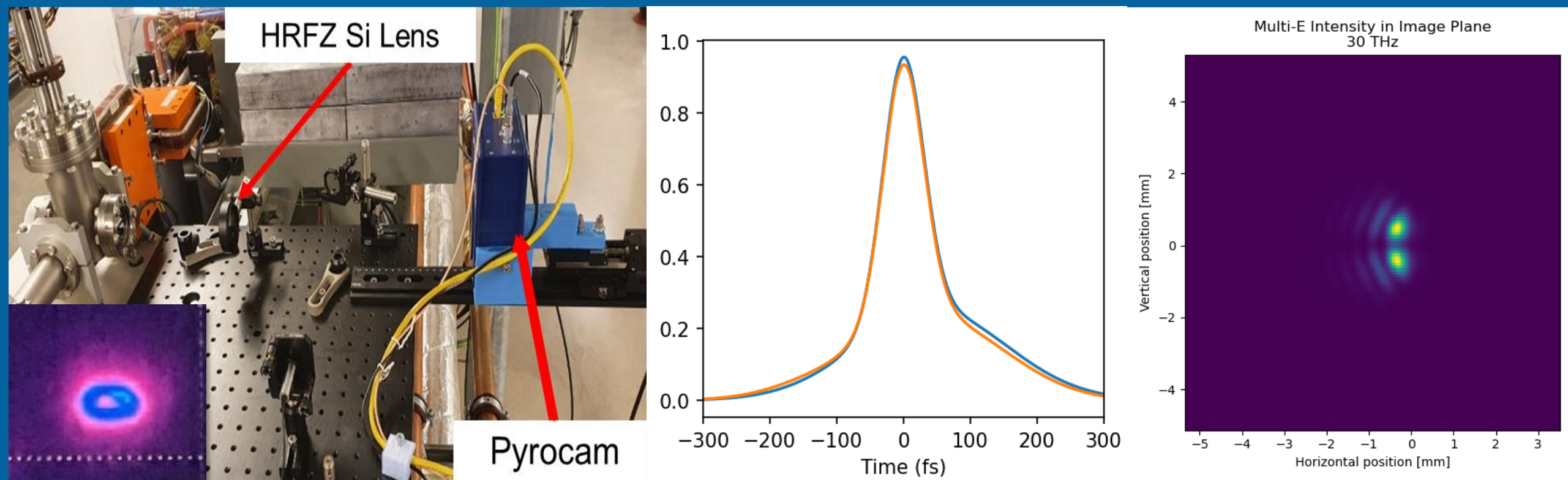
- Frontier Accelerators
- Novel Accelerators
- Accelerator Applications.



All work underpinned by R&D into Data Intensive Science.

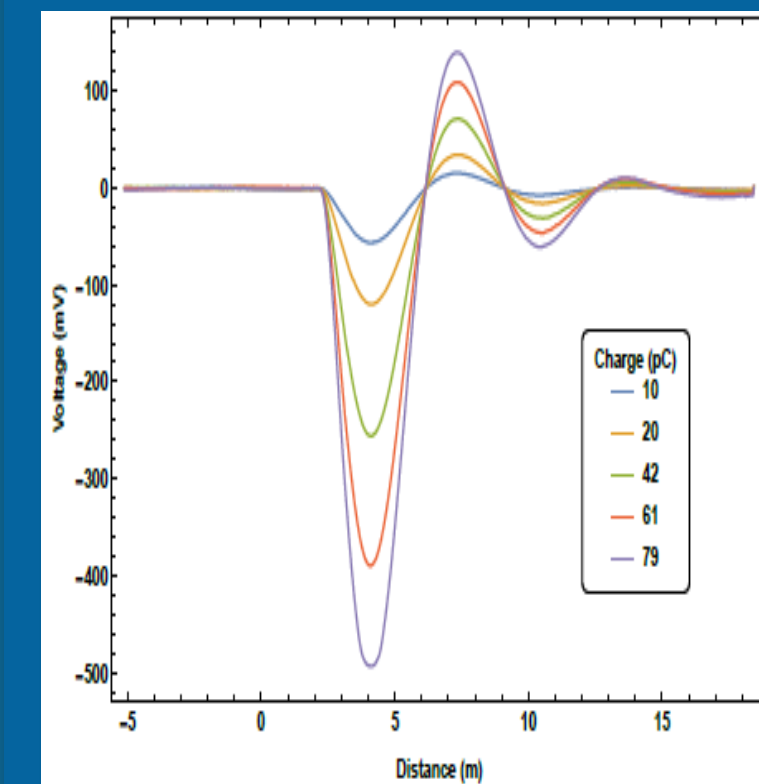
R&D in AWAKE

Longitudinal bunch profile – CTR/CSR Imaging with Machine Learning



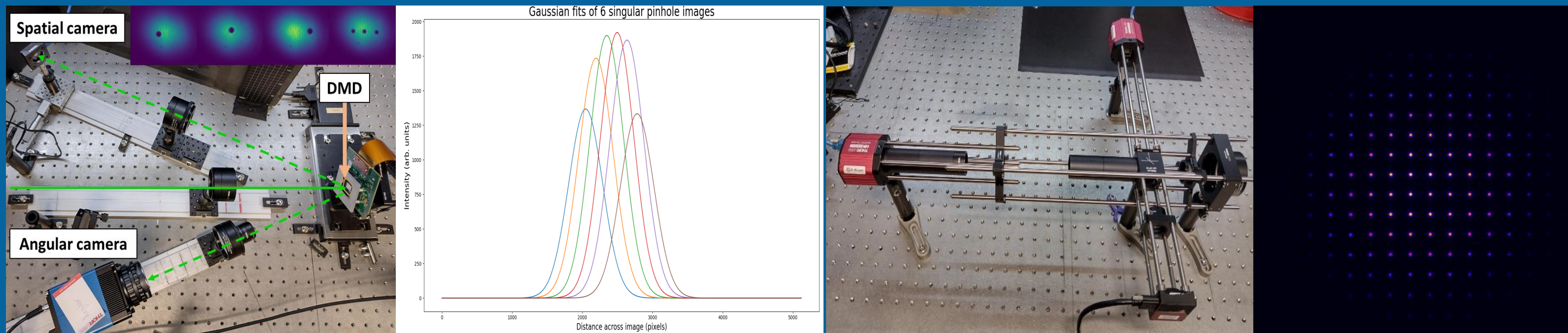
- Pre and post acceleration e^-
- Could use existing/planned TR screens or SR from spectrometer
- Compact breadboard

Optical fibre-based diagnostics



- Loss signals:
- Loss location
 - Beam Alignment
 - Energy/spread

Emittance – DMD(multi-shot)/MLA(single-shot) Optical Pepper-pot



- Both for pre-acceleration e^-
- Existing/planned TR screens
- SR from spectrometer for MLA on post-acceleration e^-
- Compact breadboard
- MLA just requires CMOS interface
- DMD already tested at AWAKE

Future plans

- CTR/CSR imaging with Machine Learning
 - Extract bunch profile from measurements of CTR and CSR at MAX IV as part of existing collaboration
 - Leverage simulation work to apply machine learning analysis to experimental measurements
- DMD/MLA Emittance diagnostics
 - Test of method at CLEAR
 - Full end-to-end simulation
 - Installation and optimisation at CLARA FEBE
- Proton angular distribution imaging with DMD-masking
 - Found potential solution to dispersion, plan to test at AWAKE this year
- Optical fiber beam loss monitor (oBLM)
 - Two PhD students started recently focused solely on oBLM (ERL and SPS/LHC)
 - Test new prototype in research and industrial setting, concentrating on novel applications
- Betatron radiation diagnostics
 - Build on and expand existing collaboration with UCLA and U Manchester, looking at application to AWAKE

LIV. INNO



Data-driven research



- LIV.INNO focuses on innovation in STFC science and industry applications.
- The center is based on LIV.DAT, a previous very successful CDT in Data Science
- Around 40 PhD students will be trained across at least three cohorts
- Accelerator R&D is a core element of both CDTs, including AWAKE
- Wider impact achieved through placements, outreach symposium, and “DataAid”

AWAKE-UK Website

www.awake-uk.org

- Science
- Collaboration
- Publications
- News

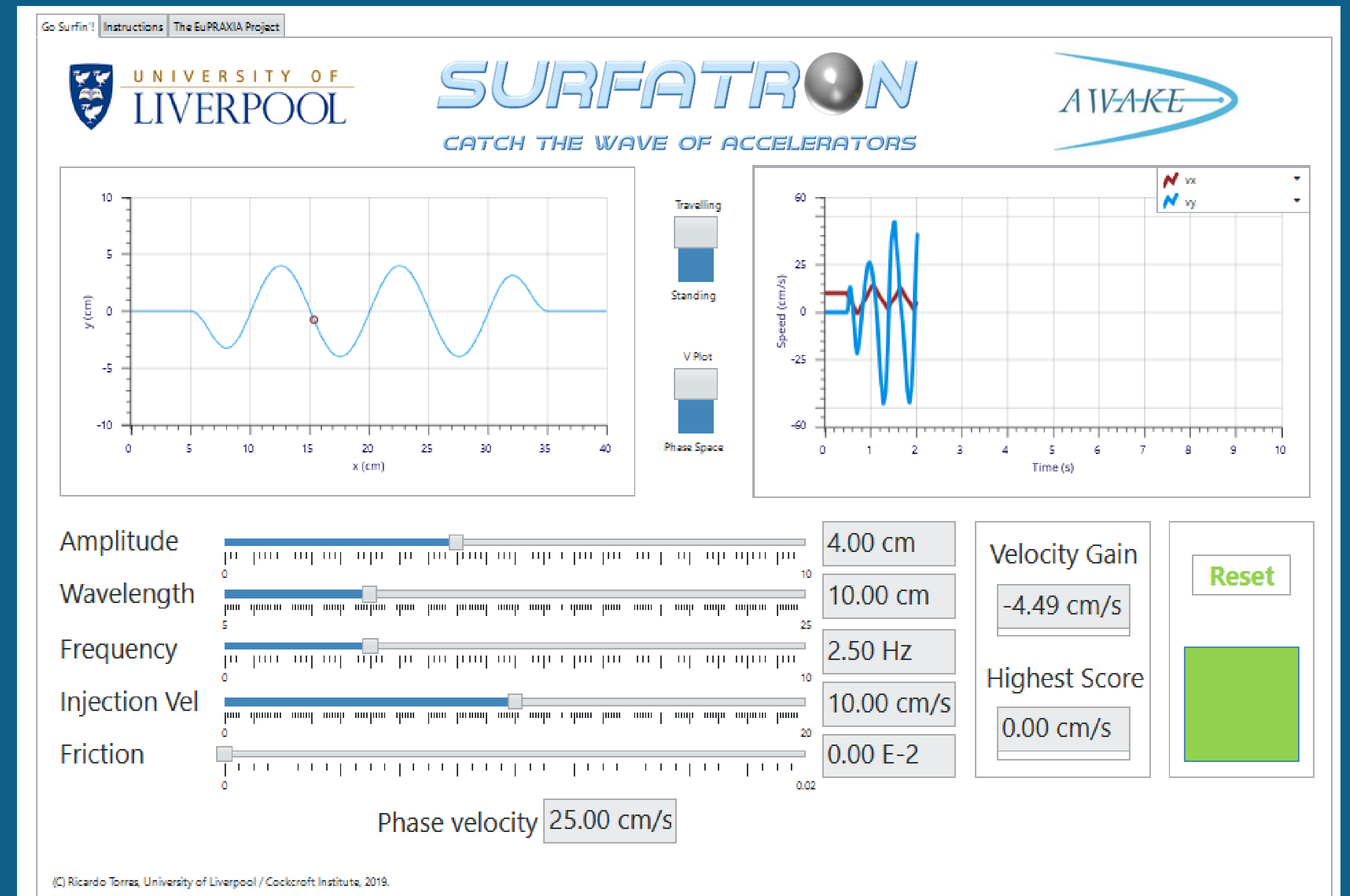
The screenshot shows the AWAKE-UK website homepage. At the top left is the 'AWAKE-UK' logo. To the right is a navigation menu with links for 'News', 'Science', 'Collaboration', 'Publications', and 'Contact'. Below the navigation is the heading 'Latest News, Updates and Events'. The main content area features a grid of ten news articles, each with a thumbnail image, a date, a title, and a short summary.

Date	Title	Summary
Feb 28	Tackling instabilities in a plasma wakefield accelerator	Plasma wakefield accelerators are widely regarded as a promising alternative to conventional RF-based accelerators due ...
Nov 23, 2023	AWAKE-UK members take the pulse on the project	A group of members and associates of the AWAKE-UK collaboration met online on Friday 10 November to discuss the...
Sep 20, 2023	Professor Peter Norreys recognised by the American Nuclear Society	Oxford University's Professor Peter Norreys, a key member of the AWAKE-UK collaboration, has been awarded the...
May 12, 2023	AWAKE Collaboration meets in Uppsala	The Advanced Proton Driven Plasma Wakefield Acceleration Experiment (AWAKE) is proof-of-principle experiment...
Apr 21, 2023	Surfatron brings the physics of plasma accelerators to the classroom	The online game Surfatron, designed by Ricardo Torres has proven a useful tool to convey the challenges of plasma wakefie...
Mar 22, 2023	AWAKE researcher awarded prestigious Ernest Rutherford Fellowship	STFC has awarded an Ernest Rutherford Fellowship to Dr Morgan Hibberd from the University of Manchester, the first to be...
Mar 30, 2023	AWAKE achieves first ever acceleration of electrons in a proton-driven plasma wave	Novel scheme paves way for entirely new range of particle physics experiments In a paper published today in the journal...
Mar 22, 2023	AWAKE-UK Collaboration met in Liverpool	On 17 March 2023, the AWAKE UK collaboration held its bi-annual meeting at Novotel Liverpool Paddington Village to...
Mar 20, 2023	Paving the Way for Next-Generation X-Ray Sources	To build powerful but small particle accelerators, one requires both strong accelerating fields and particles in the rig...
Nov 16, 2022	AWAKE Collaboration Meeting held at CERN	A collaboration meeting of the AWAKE project took place at CERN on 5 – 7 October 2022. These meetings bring...

Surfatron online

www.awake-uk.org


- Plasma wave
- Injection
- Synchronisation
- Dephasing
- Tab with info about AWAKE



Communication & Outreach


Surfatron

- Online game
- Mechanical device
- Demo video
- Demonstrates some of the challenges of wakefield acceleration.
- Communicate the science of AWAKE to wide audience.



Science in School
The European journal for science teachers

ISSUE 62 – April 2023 Topics Engineering | Physics | Resources



Surfatron: catch the wave of accelerators

Ricardo Torres

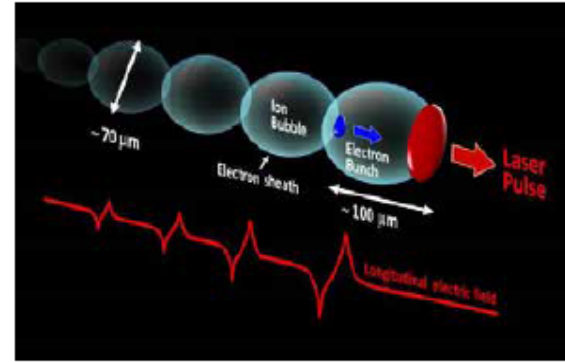
Try your hand at Surfatron, a game that lets students experience the challenges faced by particle accelerator scientists while learning the physics of waves.

Introduction

Accelerator science is a constantly evolving field. New technological advances allow large colliders – like the Large Hadron Collider (LHC) – to reach higher energies and discover new particles. At the same time, particle accelerators that are used in hospitals for cancer treatment may offer a safer, more effective, and more affordable service.

New technology, which could revolutionize the field of accelerators, relies on the ability of scientists to inject a beam of particles with a well-defined energy into a suitable plasma wave to gain energy, much in the same way as a surfer catches a wave at sea to be pushed forward.

Surfatron illustrates the same process, by simulating the motion of a ball on an undulating track. The purpose of the game is to get the ball – the surfer – to gain as much speed as possible by finding the optimum parameters of the wave (amplitude, wavelength, and frequency) and launching the ball at the right time with the appropriate initial speed.



A laser pulse travelling through a gas of ionized atoms creates a wake of plasma waves that can be used to accelerate electrons to a very high energy.
Image courtesy of Ricardo Torres

To play the game, students have to manipulate the amplitude, wavelength, and frequency of a wave, helping them to understand intuitively the properties of waves and the basic working principles of linear particle accelerators, while learning to interpret velocity plots.

www.sciencenschool.org/article/2023/surfatron-catch-the-wave-of-accelerators



CERN Accelerating science

Accelerating NEWS

News | Issue 45

Surfatron – Bringing the science of plasma accelerators to the classroom

Online activity designed at the University of Liverpool proves successful in engaging schoolchildren with the physics of the novel plasma wakefield accelerator being investigated in AWAKE.

25 SEPTEMBER, 2023 | By Ricardo Torres (University of Liverpool)



Communication & Outreach

Exhibitions

- LINAC 2022, IPAC2024
- Daresbury Open Week 2023. More than 5,000 visitors.
- University of Liverpool Open Days

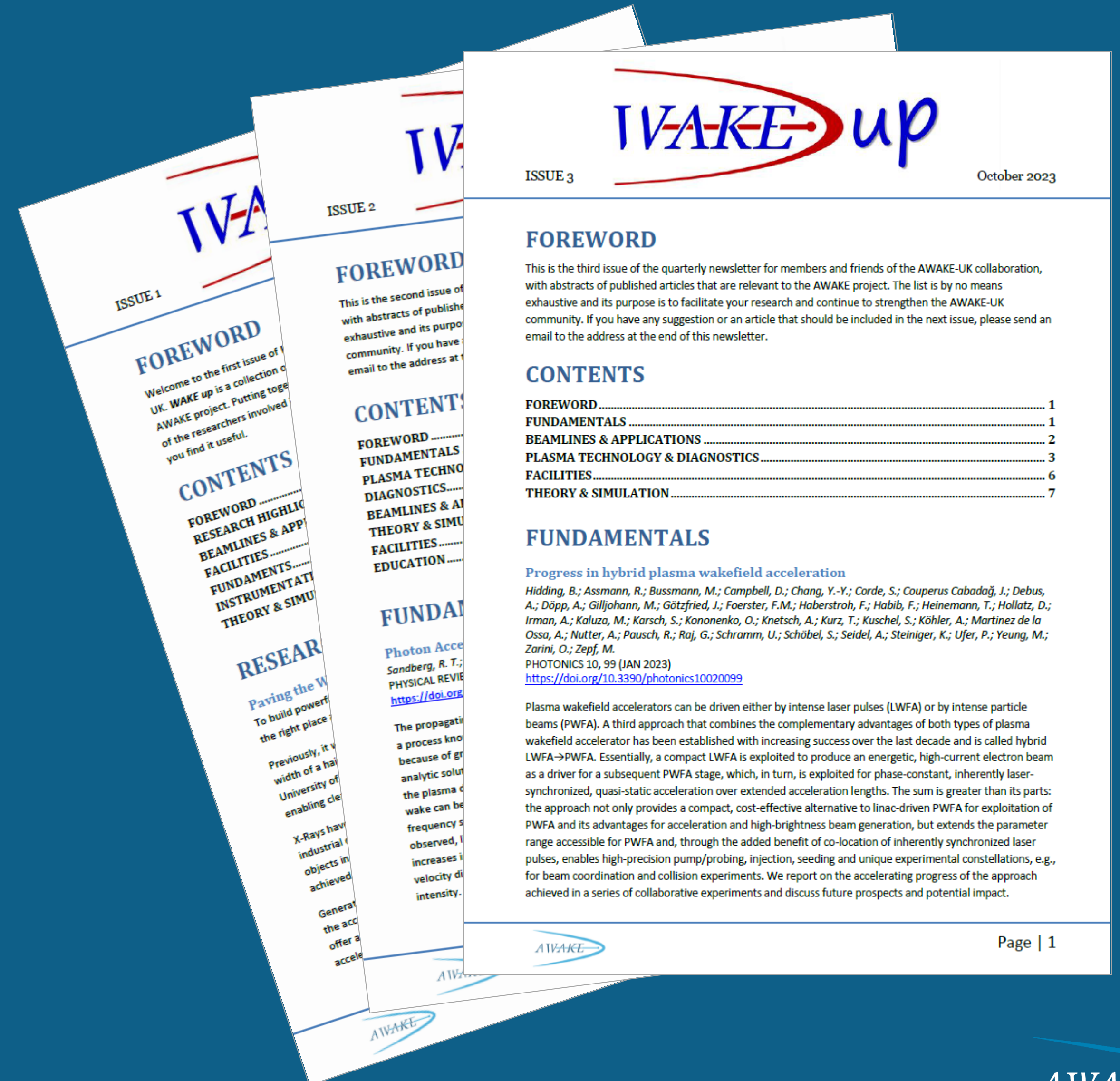
Further outreach

- Lymm summer festival
- Physics of Star Wars at SWCE, IPAC23, APS March meeting 2024



WAKE up

- Three issues circulated.
- Quarterly newsletter for partners of AWAKE-UK.
- Collection of abstracts of published articles that are relevant to AWAKE.
- Facilitate the work of the researchers involved in AWAKE-UK.



AWAKE Collaboration Meeting

- **Welcome** to the UK and to Liverpool!
- **Enjoy** the scientific discussions and the environment at the Spine and at Daresbury Lab on Wednesday.
- **Many thanks** to STFC for their support of the AWAKE-UK project (and this meeting!) and to all who helped organize this event!