UK Accelerator Institutes Seminar Series Autumn 2025 (Session 14)

Report of Contributions

https://indico.cern.ch/e/1600065

Contribution ID: **16** Type: **not specified**

Fusion Commercialization and Fusion Power Stations should not be confused

Thursday, 4 December 2025 16:00 (1 hour)

The 2020s have seen a profound cultural shift in nuclear fusion science and engineering. For decades a global community of publicly-funded scientists worked in one of two types of laboratory. Either these would be defence scientists working in a national laboratory focussed on the needs of ensuring nuclear weapons reliability or more visibly they would be government researchers seeking to develop a low carbon energy source for the future. In most cases that energy source would be based on a large experimental magnetic device known as a tokamak. In recent years, however, numerous private sector enterprises have emerged, each seeking to monetise fusion physics. Usually the proposal is for the production of reliable low carbon electricity largely free of the safety and security risks that accompany conventional nuclear power. In this talk Professor Nuttall will explore the new culture of fusion and examine ways in which fusion commercialisation might develop in the years to come. He will stress that there is more to fusion commercialisation than building fusion power stations.

Presenter: Prof. NUTTALL, William (University of Bristol)

Contribution ID: **17** Type: **not specified**

The Accelerator on a Nanophotonic Chip

Thursday, 16 October 2025 16:00 (1 hour)

The highly successful RF accelerator technology is based on a structured vacuum, fit to the wavelength of the driving RF or microwave fields. The same principle can be used with light. Because the wavelength of light lies around 1 micron, acceleration structures need to be fabricated with a feature size on the sub-micron scale –a standard size for cleanroom-based nanofabrication. We will show that we can now build laser-powered nanophotonic structures that not only accelerate electrons but that also keep them together. For this, we use alternating phase focusing, a well-known scheme also used in RF ion accelerators. We employ it in the nanophotonics realm to keep the injected electrons on track in the 200nm narrow acceleration channel. Based on this, we can now accelerate electrons over 0.5mm and observe substantial energy gains. The current status of on-chip accelerators will be presented, with an outlook on near term goals and far term opportunities.

Presenter: Prof. HOMMELHOFF, Peter (LMU Munich)

Contribution ID: **20** Type: **not specified**

The Diamond II Project

Thursday, 27 November 2025 16:00 (1 hour)

The Diamond-II Project is a coordinated programme of development that combines a major machine upgrade with new beamlines and provides complementary improvements to optics, detectors, computing and supporting infrastructure. This talk will present an overview of the project, concentrating on the key storage ring design features and novel aspects of the operation. The seminar concludes with a status update and outlines the next steps towards commissioning in 2029.

Presenter: MARTIN, Ian Peter Stephen (Diamond Light Source)

Contribution ID: **21** Type: **not specified**

Particle Accelerators for High Energy Physics Based on Proton-Driven Plasma Wakefields

Thursday, 30 October 2025 16:00 (1 hour)

Acceleration of particles in plasma looks promising due to the very high electric fields which can be achieved, bringing prospects for much more compact accelerator facilities. Schemes based on laser- or electron-driven wakes have been under investigation for several decades. Proton-driven plasma wakefield acceleration is a more recent concept, and a demonstration project, AWAKE, is underway at CERN. The basic principles will be introduced and the status of the AWAKE effort described. I will further report on recent developments that provide an exciting outlook for colliders for high-energy particle physics.

Presenter: CALDWELL, Allen (Max-Planck-Institut fur Physik (DE))

Contribution ID: **22** Type: **not specified**

Advanced mechanisms for laser-driven particle acceleration from solid targets

Thursday, 6 November 2025 16:00 (1 hour)

There is growing interest in laser-based, all-optical technologies for particle acceleration, due to their intrinsically compact nature, and to the unique properties of the beams produced through these techniques. The prospect for future clinical application has been a strong motivation for research in acceleration of protons and heavier ions. In particular, the ultrashort nature of the ion pulses makes their application in in-vitro and in-vivo radiobiology particularly interesting, in the context of the current interest in FLASH irradiations at very high dose rates. While the most established acceleration mechanism is via the so-called Target Normal Sheath Acceleration (TNSA), several alternative mechanisms have attracted attention, either due to the capability of acting on bulk ions within the irradiated targets, or to an enhanced acceleration efficiency and faster scaling with increasing laser intensity.

Particularly promising are interactions with ultrathin targets where, depending on the irradiation conditions, the acceleration can be dominated by radiation pressure, or by relativistic transparency effects. A series of experimental campaigns carried out by our group and collaborators on the GEMINI laser system at the Central Laser Facility (RAL) has investigated the acceleration of protons and carbon ions from ultrathin (nm-scale) carbon foils. This work has highlighted strong dependences of the ion energies on target thickness and laser polarization, with particularly noticeable effects on carbon ions. Perspectives for scaling up these results to the multi-PW regimes (e.g. accessible on the ELI and Apollon facilities) will be discussed. The role of target pre-expansion is emerging as particularly important for the acceleration process and simulations indicate the potential for significant acceleration enhancement by exploiting suitable density profiles.

We will also discuss a variant of TNSA acceleration which has recently been proposed, in which the electrons driving the process are accelerated by surface plasma waves excited on extended targets by a laser pulse propagating parallel to the target surface. Recent experiments by our group, also performed on GEMINI have characterized the electron source resulting from this configuration, revealing a strong highly collimated, superponderomotive component, which is an important first step for future extension to ion acceleration.

Presenter: Prof. BORGHESI, Marco

Contribution ID: **23** Type: **not specified**

LEP3: A high luminosity electron-positron Higgs boson factory in the LHC tunnel

Thursday, 13 November 2025 16:00 (1 hour)

The 2020 European Strategy for Particle Physics (ESPP) emphasized the critical importance of completing the High-Luminosity LHC (HL-LHC) upgrade of both the accelerator and experiments in a timely manner, identifying it as a top priority for the field. The strategy also established two key recommendations for future accelerator initiatives: (i) the realization of an electron–positron Higgs factory as the highest-priority next collider, and (ii) the investigation, in collaboration with international partners, of the technical and financial feasibility of a hadron collider at CERN with a centre-of-mass energy of at least 100 TeV, potentially preceded by an electron–positron Higgs and electroweak factory. In alignment with these objectives the Future Circular Collider (FCC) programme—comprising FCC-ee and FCC-hh—represents the preferred path forward for CERN, offering both precision and energy-frontier capabilities.

However, the 2025 ESPP update calls for the identification of prioritized alternative options should the preferred FCC pathway prove unfeasible or non-competitive. In this context, we propose LEP3, an electron–positron collider reusing the existing LHC tunnel, as a strategic backup to FCC-ee. LEP3 would exploit much of the research and development already carried out for FCC-ee, enabling high-precision studies of the Z, W, and Higgs bosons below the top–antitop production threshold. Combining strong physics potential with reduced cost, LEP3 provides performance comparable or superior to other fallback options—such as linear, muon, or LHeC colliders—while maintaining the technological continuity essential for a future energy-frontier collider. Conceived as a contingency, LEP3 complements, rather than competes with, the FCC-ee proposal. This talk will explore the LEP3 option.

Presenter: VIRDEE, Jim (Imperial College (GB))

Contribution ID: **24** Type: **not specified**

LWFA-based light sources and their applications in imaging

Thursday, 20 November 2025 16:00 (1 hour)

Laser wakefield accelerators (LWFAs) are novel drivers of compact ultrafast radiation sources. Two primary emission mechanisms are betatron radiation in the X-ray regime, generated as relativistic electrons oscillate transversely in the plasma cavity, and inverse Compton scattering (ICS), produced when a relativistic electron beam collides with a laser pulse, giving energy to photons up to the X-ray or gamma-ray regimes. In this talk, I will compare the characteristics of these two types of radiation alongside their potential applications. I will provide examples of facilities gearing up for LWFA-radiation sources for everyday research and present the status of the efforts in Cockcroft.

Presenter: APSIMON, Oznur (University of Manchester and the Cockcroft Institute)