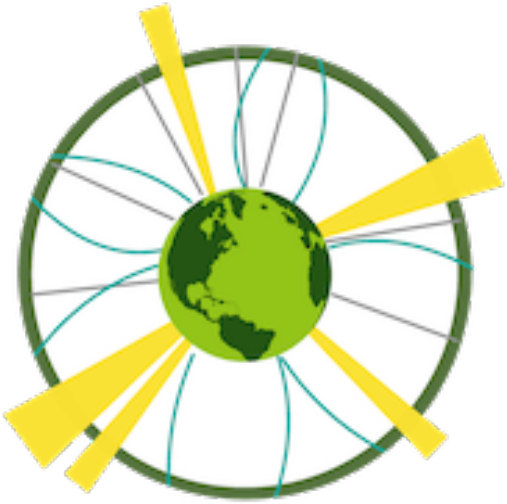
Sustainable HEP 2025 —4th Edition



Report of Contributions

https://indico.global/e/susthep25

Contribution ID: **57** Type: **15 minute talk**

The environmental impact, carbon and sustainability of computing in the ATLAS experiment

Thursday 15 May 2025 12:30 (20 minutes)

ATLAS, one of two general-purpose experiments at the Large Hadron Collider (LHC), operates a large internationally-distributed computing infrastructure, including over 1 EB of managed data on disk and tape and almost one million simultaneously running CPU cores. Upgrades for the High-Luminosity LHC will increase the required computing resources by a factor of 3–4 by the beginning of the 2030s, and by an order of magnitude before the conclusion of data taking at the beginning of the 2040s. These resources are spread over around 100 computing sites worldwide. Efforts are underway within the experiment to evaluate and mitigate various aspects of the environmental impact of the sites, with the additional long-term goal of making recommendations to the sites that will significantly reduce the total expected environmental impact in the HL-LHC era. These efforts take several forms: building awareness in the experiment community, adjusting aspects of the computing policy, and modifications of data center configurations, either in ways that take advantage of particular features of ATLAS work or in generic ways that reduce the environmental impact of the computing. This contribution describes the ongoing investigations and approaches that have already provided useful, and actionable outcomes that can be implemented today.

Author: MARSHALL, Zach (Lawrence Berkeley National Lab. (US))

Presenter: MARSHALL, Zach (Lawrence Berkeley National Lab. (US))

Session Classification: Submitted Talks

Contribution ID: **58** Type: **15 minute talk**

Countering the biodiversity loss using particle physics research sites

Wednesday 14 May 2025 09:15 (15 minutes)

The climate changes, finite amounts of resources and loss in biodiversity are the three major socio-ecological problems faced by humanity. They have been recognized as urgent matters by international bodies, and regular national recommendations or international agreements set scopes to be reached in the next few decades or even years. As these scopes appear as simultaneously insufficient and challenging, there seems to be a consensus on the fact that all activities should work on reducing their greenhouse gases emissions, and their material and biodiversity footprints.

Sustainable development aspects therefore recently received an increasing interest in the high energy physics (HEP) community. But, of the three problems mentioned above, biodiversity appears as the least familiar, and HEP impacts on it have not been studied yet.

After an introduction to what defines biodiversity, to its status and the consequences, I will therefore show why the HEP sites – from small laboratories to accelerator sites – can play a significant role in halting the loss in biodiversity, because of their intrinsic characteristics. I will show examples of situations and projects, which demonstrate that more action is possible on most current HEP sites, and that future sites have a potential to locally halt the biodiversity loss, provided this criterion is taken into account at the earliest step of the project design.

Author: FAIVRE, Julien (Centre National de la Recherche Scientifique (FR))

Presenter: FAIVRE, Julien (Centre National de la Recherche Scientifique (FR))

Session Classification: Submitted Talks

Contribution ID: **59** Type: **15 minute talk**

Sustainable Science: ATLAS Computing Practices in South Africa

Wednesday 14 May 2025 09:30 (15 minutes)

In this presentation, we will summarise the computing practices adapted by ATLAS users in South Africa, based on a survey that was circulated.
While the main focus of the survey was on distributed computing, we obtained useful feedback on other aspects as well, such as about lack of training and resources. We will highlight these challenges faced by the users, and thoughts on how we can address them keeping in mind efficiency, productivity and of course sustainability.

Authors: KAR, Deepak (University of the Witwatersrand (ZA)); MAZINI, Rachid (University of the Witwatersrand (ZA))

Presenter: KAR, Deepak (University of the Witwatersrand (ZA))

Session Classification: Submitted Talks

Contribution ID: **60** Type: **5 minute 'flash' talk**

Life Cycle Assessment of ISIS-II: Challenges and Pathways for Sustainable Accelerator Design

Life Cycle Assessments (LCAs) provide key insights into the broad range of environmental impacts associated with a product or system. By providing both a holistic overview and a detailed breakdown of these impacts, LCAs help identify the most effective opportunities for sustainability improvements. As the demand for sustainable practices grows, LCAs will play an increasingly important role in evaluating the environmental footprint of complex scientific infrastructure, including particle accelerator facilities.

Practically, what do we need as a field to effectively enable these assessments?

In this talk, I will present the LCA conducted for the ISIS-II Neutron and Muon Source. I will outline the methodological challenges encountered, share key findings, and propose practical solutions to support the broader adoption of LCAs in the design, operation and decommissioning of accelerator facilities.

Author: Dr WAKELING, Hannah (John Adams Institute, University of Oxford)

Presenter: Dr WAKELING, Hannah (John Adams Institute, University of Oxford)

Session Classification: Flash Talks

Contribution ID: **61** Type: **15 minute talk**

CEPC development towards a sustainable green Higgs factory

Wednesday 14 May 2025 10:15 (15 minutes)

CEPC is a circular electron positron Higgs factory of 100km circumference.
CEPC TDR has been completed in Dec. 2023 and EDR has been started since 2024. CEPC is planned to start the construction around 2027 and complete around 2035 followed by two years commissioning. A sustainable green CEPC Higgs facory philosophy has been adopted and applied in both the optimization designs on scientific outputs vs CO2 emission, and relevant key technologies' developments, indusrtrial fabrications, operations scheme, green energy utilization, heat recovery, etc. In this talk, the above mentioned aspects are reported.

Author: GAO, Jie

Presenter: GAO, Jie

Session Classification: Submitted Talks

Contribution ID: **62** Type: **15 minute talk**

The future of HEP Work at the DESY data-centre

Wednesday 14 May 2025 10:45 (15 minutes)

Sustainability is becoming an ever-increasing part in the planning, designing and operation of large-scale infrastructures. In HEP this is especially relevant as accelerators that create particle beams and data-centres that analyse data use a lot of energy. Research Facility 2.0 is an EU-funded project with a vision of developing a more sustainable path for the future of research. Its remit covers both of these areas by researching: the design and use of technologies for use at future accelerators; and the approaches we can take to manage energy at support infrastructures. Both have unique challenges in terms of environmental impact. DESY is the only institution on this project looking to develop strategies for the energy and carbon management of "green"data-centres. This is important for HEP as data-centres will be an ongoing resources exploited by current and future experiments for data analysis. This talk shall show the results of some initial investigations in implementing energy management strategies at the DESY computing centre.

Author: Dr SPITERI, Dwayne (DESY)

Presenter: Dr SPITERI, Dwayne (DESY)

Session Classification: Submitted Talks

Contribution ID: **63** Type: **15 minute talk**

Longevity studies with full-scale CMS cathode strip chambers using gas mixtures with reduced CF4 content

Wednesday 14 May 2025 11:00 (15 minutes)

Cathode strip chambers (CSCs) are a key component of the endcap muon system in the CMS experiment at CERN. There are 540 CSCs successfully operating at CMS with a gas mixture of 40% Ar, 50% CO_2, and 10% CF_4. The chamber longevity study is particularly important in anticipation of the upcoming HL-LHC upgrade and the corresponding CMS detector upgrade, which will result in a significant increase of background rates in the forward region. Due to the high global warming potential (GWP) of CF4, the longevity tests also aim to probe CSC operation with a reduced content of this gas.

The longevity of CSCs is being investigated using two production CMS CSCs of type ME1/1 and ME2/1, at the Gamma Irradiation Facility (GIF++) at CERN, where the charge accumulation rate is approximately 30 times higher than the expected HL-LHC conditions. Currently, the accumulated charge in these chambers is approaching three times that expected from the HL-LHC. Throughout the irradiation studies, three gas mixtures—40% Ar + CO_2 with varying CF_4 concentrations of 10%, 5%, and 2%—were evaluated, with no observed degradation in chamber performance.

Author: SONG, Shaowei (Chinese Academy of Sciences (CN))

Presenter: SONG, Shaowei (Chinese Academy of Sciences (CN))

Session Classification: Submitted Talks

Contribution ID: **64** Type: **15 minute talk**

Longevity and eco-gas studies in the CMS cathode strip chamber muon detector

Wednesday 14 May 2025 10:00 (15 minutes)

The cathode strip chambers (CSCs) of the CMS experiment are a type of multi-wire proportional chamber that operates with a mixture of Ar, CO_2, and CF_4 gases. CF_4 is a well known component preventing aging of the anode wires. It has, however, a high global warming potential (GWP), and reducing our reliance on it is critical for improving the ecological sustainability of the experiment. As one of the prompt solutions, CMS CSCs use recuperated CF_4 while studies on possible reduction and or gas substitution are performed in parallel. One such investigation, presented here, uses small prototype CSCs, known as miniCSCs, which have only two layers. Detector performance and longevity are evaluated across a wide range of experimental conditions and gas mixtures. These chambers undergo accelerated aging using highly active ^{90}Sr sources, while performance is continuously monitored for signs of degradation.

Author: ARBOUR, Collin (Rice University (US))

Presenter: ARBOUR, Collin (Rice University (US))

Session Classification: Submitted Talks

Contribution ID: **65** Type: **15 minute talk**

Sustainability Studies for Future Linear Colliders

Wednesday 14 May 2025 12:30 (15 minutes)

Sustainability has become a prioritized goal in the design, planning and implementation of future accelerators; approaches to improved sustainability include overall system design, optimisation of subsystems, and operational concepts. A direct quantification of the ecological footprint, is currently performed only sporadically, with Lifecycle Assessments (LCA) emerging as a more comprehensive approach.
Several large electron-positron linear colliders are currently being studied as potential future Higgs-factories, ILC in Japan and CLIC and a ILC-based Linear Collider Facility at CERN. These projects are closely collaborating on methods to reduce the power consumption of accelerator components and systems, and smart integration of future accelerator infrastructure with the surrounding site and society. In a recent, common study an LCA of the civil construction as well as the accelerator and detector components of both projects was conducted.
This contribution will present this and other current results and future activities.

Authors: TITOV, Maxim (CEA Saclay); DOEBERT, Steffen (CERN); STAPNES, Steinar (CERN); Dr SCHÖRNER-SADENIUS, Thomas (DESY)

Presenter: Dr LIST, Benno (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Submitted Talks

Contribution ID: **66** Type: **15 minute talk**

Resource-aware Research on Universe and Matter in Germany

Wednesday 14 May 2025 12:15 (15 minutes)

Scientists in Germany working on the digitization of research at accelerators and telescopes met at a workshop supported by the Federal Ministry for Education and Research, BMBF, in 2023 to discuss sustainability aspects of their research. The outcome was a white paper that is a call to action and describes a portfolio of measures with time scales required for their implementation. To follow up, two online events were organized in 2024 and a further in person workshop is planned for summer 2025. In this talk the white paper and the progress since then are presented.

Authors: STAHL, Achim (Rheinisch Westfaelische Tech. Hoch. (DE)); BRUERS, Ben (Deutsches Elektronen-Synchrotron (DE)); MURPHY, Bridget; WALTHER, Cyrus; SPITERI, Dwayne (University of Glasgow); ERDMANN, Johannes (RWTH Aachen University); REINDL, Judith; SCHWARZ, Kilian; SCHUMACHER, Markus; ERDMANN, Martin (Rheinisch Westfaelische Tech. Hoch. (DE)); Mr GASTHUBER, Martin (DESY); KUHR, Thomas (Ludwig Maximilians Universitat (DE)); ENSSLIN, Torsten (MPI f. Astrophysics)

Presenter: KUHR, Thomas (Ludwig Maximilians Universitat (DE))

Session Classification: Submitted Talks

Contribution ID: **67** Type: **15 minute talk**

Enhancing the light and weakly coupled new physics program at FCC with sustainable alternatives

Thursday 15 May 2025 12:50 (15 minutes)

To maximize the potential of dedicated detectors for long-lived particles (LLPs), they must be placed in locations that are optimal for our physics goals. We propose an innovative concept: a dedicated transverse detector for LLPs, called DELIGHT, with its positioning and size optimized for both FCC-ee and FCC-hh. This unique approach would enable the FCC to enhance resource utilization and promote sustainability in high-energy physics (HEP). Moreover, we believe that utilizing pile-up (PU) as an additional resource is also a step towards sustainability. While the high levels of PU in FCC-hh are anticipated to present significant challenges in searches for light new physics, we offer a different perspective. Instead of viewing PU merely as an obstacle, we emphasize its potential advantages in the search for light LLPs arising from B or D hadron decays at future hadron colliders. This alternative perspective might increase our chances of discovering light new physics sooner, thereby reducing the overall run time of future colliders.

Authors: BHATTACHERJEE, BIPLOB (Indian Institute of Science); BOSE, Camellia; DREINER, Herbi; Dr GHOSH, NIVEDITA (Indian Institute of Science); MUKHERJEE, Swagata (Indian Institute of Technology, Kanpur); Dr MATSUMOTO, Shigeki (Kavli IPMU); SENGUPTA, Rhitaja (BCTP and Physikalisches Institut der Universität Bonn, Germany); Mr SHARMA, Anand (Indian Institute of Science, Bengaluru)

Presenter: SENGUPTA, Rhitaja (BCTP and Physikalisches Institut der Universität Bonn, Germany)

Session Classification: Submitted Talks

Contribution ID: **68** Type: **15 minute talk**

Computing at the Exascale, CERN IT's Approach to Sustainability

Wednesday 14 May 2025 10:30 (15 minutes)

The CERN IT department operates the computing, storage and networking infrastructure for most of the services at CERN. The core task is to provide storage, processing and networking for the four LHC experiments. Long term storage is provided in the form of tape libraries with a total capacity of one exabyte, disk storage at the same scale. The 450000 CPU cores are mostly used through IT's batch system. As the WLCG-T0 CERN covers roughly 20% of the computing needs of the experiments.
These resources are hosted in the 4.1 MW Meyrin Data Centre and the 2 MW Prevessin Data Centre.
We will present the current and planned activities of CERN IT to understand and improve the environmental sustainability of computing at our site and within the WLCG community.
In addition, an overview of CERN's general approach to environmental sustainability will be given.

Author: SCHULZ, Markus (CERN)

Presenter: SCHULZ, Markus (CERN)

Session Classification: Submitted Talks

Contribution ID: **69** Type: **15 minute talk**

Sustainability studies of big data processing in real time for HEP

Thursday 15 May 2025 11:15 (15 minutes)

The LHCb collaboration is currently using a pioneer system of data filtering in the trigger system, based on real time particle reconstruction in Graphics Processing Units (GPUs). This corresponds to processing 5 TB/s of information and has required a huge amount of hardware and software developments. Among them, the corresponding power consumption and sustainability is an imperative matter in view of the next high luminosity era for the LHC collider, which will largely increase the output data rate. In the context of the High-Low project at IFIC in Valencia, several studies have been performed to understand how to optimize the energy usage in terms of the computing architectures and the efficiency of the algorithms which are running on them. In addition, a strategy is designed to evaluate the potential impact of quantum computing as it begins to enter in the field.

Authors: VALERO BIOT, Alberto (Univ. of Valencia and CSIC (ES)); FERNANDEZ CASANI, Alvaro (Univ. of Valencia and CSIC (ES)); DE OYANGUREN CAMPOS, Arantza (Univ. of Valencia and CSIC (ES)); ZHUO, Jiahui (Univ. of Valencia and CSIC (ES)); FIORINI, Luca (Univ. of Valencia and CSIC (ES)); LUCIO MARTINEZ, Miriam (Univ. of Valencia and CSIC (ES)); KHOLOIMOV, Valerii (Instituto de Física Corpuscular (Univ. of Valencia)); SVINTOZELSKYI, Volodymyr (Univ. of Valencia and CSIC (ES))

Presenter: SVINTOZELSKYI, Volodymyr (Univ. of Valencia and CSIC (ES))

Session Classification: Submitted Talks

Contribution ID: **70** Type: **15 minute talk**

Green Cherenkov gas radiators

Thursday 15 May 2025 13:20 (15 minutes)

Saturated fluorocarbons (SFCs:C_nF_(2n+2)) are chosen for their optical properties as Cherenkov radiators, with C_4F_10 and CF_4 used in the COMPASS and LHCb RICH detectors. Non-conductivity, non-flammability and radiation resistance also make SFCs ideal coolants: C_6F_14 liquid cooling is used in all LHC experiments, while C3F8 is used for the evaporative cooling in TOTEM and the ATLAS silicon tracker. These fluids, however, have high GWPs (5000–10000*CO_2), and represented around 37% of CERN's CO_2-equivalent emissions in 2022. There is thus an impetus to reduce their use and losses through improved monitoring and circulation system design.
Spur-oxygenated fluoro-ketones, with C_nF_2nO structures can offer similar performance to SFCs with but with very low, or zero GWP. Although these fluids do not yet exist in large quantities over the full CnF2n "matrix"the radiation tolerance and thermal performance of C_6F_12O was initially promising enough to be chosen as a C_6F_14 replacement for cooling silicon photomultipliers. Additionally, subject to optical testing, C_5F_10O could (if blended with nitrogen) replace both C_4F_10 and CF_4 in Cherenkov detectors. Lighter molecules (for example C_2F_4O, with similar thermodynamics to C_2F_6) - if and when available in industrial quantities—might allow lower temperature operation than evaporative CO_2 in future silicon trackers operated at very high luminosity.
Ultrasonic gas mixture analysis is very sensitive to concentration changes of a heavy vapour in a light carrier, and is used - in the only such fluorocarbon coolant leak monitoring system operating at LHC - for real-time monitoring of C_3F_8 coolant leaks from the ATLAS pixel and SCT silicon trackers into their nitrogen-flushed environmental volumes. A typical C_3F_8 sensitivity of better than 10ˆ−5 is achieved.
Advanced new ultrasonic algorithms allow measurement of the concentrations of a pair of gases of particular interest on top of a varying known baseline of other gases. The technique is thus of considerable value in leak monitoring and could be used to blend fluoro-ketones with nitrogen or argon to reduce the GWP "load"of large volume atmospheric pressure gas Cherenkov radiators without the recourse to higher-pressure, flammable or expensive noble gas approaches.
An approach is outlined to GWP reduction with fluoro-ketone fluids and the blending of heritage SFCs or fluoro-ketones with lighter gases using ultrasonic monitoring and control. Possible avenues for the use of fluoro-ketones in liquid phase and evaporative cooling of silicon trackers are discussed.

Author: HALLEWELL, Gregory (Centre National de la Recherche Scientifique (FR))

Presenter: HALLEWELL, Gregory (Centre National de la Recherche Scientifique (FR))

Session Classification: Submitted Talks

Contribution ID: **71** Type: **15 minute talk**

Eco-Friendly Resistive Plate Chamber detectors for HEP

Thursday 15 May 2025 11:00 (15 minutes)

Resistive Plate Chamber detectors are largely used in High Energy Physics experiments given their excellent time and space resolution. They are typically operated in avalanche mode with a high-performance gas mixture based on Tetrafluoroethane (C2H2F4) and Sulphur Hexafluoride (SF6), both fluorinated high Global Warming Potential greenhouse gases.
The RPC EcoGas@GIF++ Collaboration has pursued an intensive R&D activity searching for new gas mixtures with low environmental impact while preserving high detector performance, as needed at LHC and for future applications.
In this talk, results obtained with new eco-friendly gas mixtures based on Tetrafluoropropene and carbon dioxide even under high-irradiation conditions will be presented. Long term ageing tests carried out at the CERN Gamma Irradiation Facility will be discussed together with their possible limits and future perspectives.

Author: COLLABORATION, RPC EcoGas@GIF++

Co-authors: PASTORE, Alessandra (Universita e INFN, Bari (IT)); PICCOLO, Davide (INFN e Laboratori Nazionali di Frascati (IT))

Presenter: PASTORE, Alessandra (Universita e INFN, Bari (IT))

Session Classification: Submitted Talks

Contribution ID: **72** Type: **15 minute talk**

Green software in HEP: benchmarks and studies on MC generators

Thursday 15 May 2025 11:30 (15 minutes)

In this talk, we will describe the studies undertaken at the University of Manchester to estimate and improve the energy efficiency of computing hardware and software used by students and researchers.

The goal of these studies is to build an understanding of the environmental impact of particle physics research focusing on two fronts:
1) the carbon cost of the hardware uses for high power computing hardware and the local computing cluster
2) the energy efficiency of data analysis software and machine learning models in "big data"-related scientific fields including as high-energy particle physics.

The focus of this contribution will be the energy efficiency of scientific software algorithms and MC generation packages, taking Herwig, ML data compression and top tagging algorithms as examples. We will discuss different tools and benchmarks and review their methodologies.

We will then describe our plans towards a lifecycle analysis for computing hardware, and work undergoing to estimate the power consumption of our local cluster more precisely.

Author: VILLAR, Luis (University of Manchester)

Co-authors: DOGLIONI, Caterina (The University of Manchester (GB)); SMITH, James (The University of Manchester (GB)); SPARKS, Michael (University of Manchester); SULE, Siddharth (The University of Manchester (GB)); FITSCHEN, Tobias (The University of Manchester (GB))

Presenter: VILLAR, Luis (University of Manchester)

Session Classification: Submitted Talks

Contribution ID: **73** Type: **15 minute talk**

Efficient Computing with the ALICE Event Processing Nodes GPU farm

Thursday 15 May 2025 11:45 (18 minutes)

\section{Introduction}

The Large Hadron Collider (LHC) at CERN resumed operation in 2022, achieving 13.6 TeV proton–proton collisions.
During the 2019–2021 shutdown, the \mbox{ALICE} detector was upgraded to handle a 50 kHz interaction rate for Pb–Pb collisions,
increasing data volume tenfold compared to previous data-taking periods.
The ALICE Run 3 and 4 computing model, called O2 (Online-Offline), enables continuous readout of sub-detectors,
allowing for synchronous processing of raw data during data taking.
Run˜3 and Run˜4 workflows involve continuous readout from detector front-end electronics, with FPGA boards performing Zero Suppression (ZS).
The TPC outputs 3.3˜TB/s of raw data, reduced by ZS for processing in the EPN farm via an InfiniBand network,
with compressed results transferred to CERN's central IT data center.

\subsection{Efficient data distribution, processing and compression with the EPN farm}

This approach unifies online and offline data processing relying on a single data structure, the Time Frame (TF), which contains all information from the sub-detectors for a given time interval.
TFs are built and compressed on the \mbox{ALICE} Event Processing Nodes (EPN) farm composed of 350 servers and 2800 GPUs achieving compressed data rates up to 4 PB/day,
while the average during Pb–Pb data taking in 2024 with the full LHC orbit was around 2.5 PB/day (comparable with the high rate Pb–Pb period of 2023).
The EPNs are also able to perform the first data calibration pass online. Calibration tasks are split between global calibrations,
which run on CPU-only nodes of the EPN farm, and detector-specific calibrations, which are executed directly on the readout nodes at each LHC fill.
The use of GPU hardware accelerators, with high intrinsic parallelism, reduces costs and energy usage, requiring eight times fewer servers than CPUs for equivalent performance.
The EPN farm is designed for high throughput and low latency, with a focus on energy efficiency and cost-effectiveness.
The data is distributed to the EPN farm by an EPN software module managing the generation of partial TFs containing data from only one detector, directly from the readout nodes.
This module also handles the scheduling and aggregation of the partial TFs into complete TFs at the EPN farm level.
The overall computing efficiency heavily relies on data compression using lossy methods, such as ZS, to reduce data size, while lossless techniques optimize storage.
The TFs from each sub-detector are processed using subsystem-specific algorithms: the resulting integer arrays are compressed using rANS entropy coding,
which efficiently encodes symbols based on their probability distribution, achieving compression ratios close to the entropy limit.
Compared to Huffman coding, rANS reduces the TF sizes by 3\% and outperforms standard compression libraries by up to 15\%.
ALICE's vectorized rANS implementation, using AVX2 instructions, achieves compression speeds of 3200 MB/s for 32-bit symbols,
doubling the performance of standard CPU implementations (Lettrich, M., Fast entropy coding for ALICE Run 3. Proceedings of Science, 2021, https://arxiv.org/abs/2102.09649).

\subsection{Energy-efficiency of the EPN IT infrastructure}

The EPN farm data center, located at the LHC Point 2, uses modular IT containers for scalability with adiabatic cooling to ensures effective energy use. The containers are air-cooled, and each container has a dedicated Air Handling Unit (AHU) which provides the necessary air flow to cool the servers with a temperature set point of 27 ℃.
The cooling units are designed to operate in adiabatic mode when the temperature of the outside air is too high to be used directly
to maintain the set point temperature of the cold aisle inside the containers.
The adiabatic system uses purified water (produced on-site by the ancillary reverse osmosis plant) to irrigate the cooling units heat
exchanges whenever the air-to-air heat exchange alone is not sufficient to maintain the set point temperature of supply air to the racks.
The adiabatic cooling system is designed to operate in a closed loop, with the sprayed water being recuperated to the unit water tanks.
However, periodic water flush cycles are needed to keep the bacteria that accumulate in the water circuit to an acceptable level.
Additionally, annual shock treatment with biocides is performed to ensure a deeper cleanliness the water circuits.
The reverse osmosis plant does not use any chemical products to purify the water apart from the salt consumption needed to soften the incoming raw water.
The EPN IT infrastructure can operate at a Power Usage Effectiveness (PUE) lower then 1.10, significantly reducing energy consumption compared to pure mechanical cooling techniques with PUE values around 1.5.
To limit the salt and water consumption, the adiabatic cooling usage is limited to the months of May to September, when the outside temperature exceeds the
capacity of the air-to-air heat exchangers to keep the chosen set point temperature.

\subsection{Topic of the contribution}

The talk will focus on the use of GPUs in the \mbox{ALICE} EPN farm, highlighting their role in data processing and calibration and the energy efficiency of its IT infrastructure.
Performance metrics from the 2023 and 2024 heavy ion running periods will be presented, including the achieved data rates and compression ratios.
Differences between synchronous and asynchronous processing will be discussed, including resource sharing between the two modes.
Comparisons with CPU-only processing will be made, emphasizing the advantages of GPU-based computing in terms of performance and energy efficiency.
Considerations on the GPU effectiveness, compactness, and favorable
cost-benefit ratio will be done, along with the evaluation of benefits of using GPUs in high-energy physics domain,
including the other major LHC experiments.
Details of the EPN farm's energy-efficient infrastructure will be provided, including the adiabatic cooling system and its impact on PUE.
Considerations on the EPN farm's modular design, scalability and adaptability in view of future upgrades, will be also discussed.
The talk will also address the challenges and lessons learned from the EPN farm's implementation, and provide and overview of the unique expertise gained by the \mbox{ALICE} collaboration in the field of GPU-based computing since 2010,
when the first GPU-based High-Level Trigger farm was deployed and successfully used in the Run 1 and Run 2 periods.

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Co-author: ERBA, Giada (CERN)

Presenter: RONCHETTI, Federico (CERN)

Session Classification: Submitted Talks

Contribution ID: **74** Type: **5 minute 'flash' talk**

Monitoring soil moisture and chemical composition using cosmic ray neutrons

Monday 12 May 2025 19:30 (5 minutes)

This work studies the interaction of cosmic rays, extraterrestrial particles with energies ranging from 10^6 eV to 10^{20} eV, which produce secondary particles, including neutrons, when they collide with atmospheric molecules. These neutrons can be used to non-invasively estimate soil moisture through cosmic ray neutron sensors (CRNS), opening the possibility of using this technology in precision agriculture monitoring systems to optimize the use of water and other agricultural resources. To calibrate CRNS, the MEIGA framework was developed to simulate neutron transport from the top of the atmosphere to 2 km altitude over different observation levels, ranging from sea level to 5000 m a.s.l. The resulting neutron and gamma-ray spectra at ground level were obtained. The results show that the cosmic neutron flux increases with altitude and that the photon spectrum generated by ground interactions can be observed over an area of 1.68 ha. With the capability to calculate the surface neutron flux based on the geographical position (altitude, latitude and longitude), the MEIGA framework facilitates the implementation of CRNS in different regions of the world. This type of technology contributes to more efficient water management in agriculture and supports climate change adaptation strategies.

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Presenter: MIRANDA LEURO, Luigui Joel

Session Classification: Flash Talks

Contribution ID: **75** Type: **EITHER 15 minute talk or 5 minute 'flash' talk**

Research organisations as a paradigm for a novel form of economic stakeholder

Wednesday 14 May 2025 13:15 (15 minutes)

In the field of natural science, there is a customary reluctance to engage in deliberations on economic systems, particularly with regard to the historical debate on capitalism versus communism. Nevertheless, the paper posits that the scientific community can exert influence on the political system by emulating their own organisational and action models within the economic system.

Typically, the development and production of industrial goods and international services such as mobile phones, cars, AI services and social media platforms is carried out by competing, profit-oriented international groups. The success of these endeavours frequently results in the accumulation of significant financial and political influence within our societies. However, from an ecological sustainability perspective, not all products that are produced for profit are desired by society, and not all urgently needed products that would enhance sustainability are available as consumer goods due to a lack of profitability in comparison to competing products. The pressing need for rapid transformation within global industries is underscored by the imminent risks posed by climate change. Nevertheless, the free global market exhibits significant inertia on a global scale, constraining the potential for political initiatives to affect a transition in the short term.

International centres of fundamental research, such as CERN, typically function as non-profit entities funded by member states and disseminate their scientific findings to the global community. These institutions are structured to adhere to democratic principles in their management. Research aims are subject to periodic re-evaluation, with decisions distributed across various levels of expert boards that span the scientific, economic, technical and political requirements and boundary conditions. To avoid unnecessary repetitions and to enable the combination and complementation of efforts by different centres, scientists from competing organisations are included in the evaluation boards.

The concept of **democratic capitalism** is predicated on the notion of transferring the scientific method to the economic realm. It encompasses international non-profit organisations that specialise in the production of sustainable products or services utilising cutting-edge technology. These organisations are linked to member states in a manner analogous to that of CERN, and sell their products on the global market to consumers or governments. The revenues obtained are utilised for the purpose of remunerating employees and management fairly, and for the distribution of profits to member states in accordance with clearly defined rules. Capital is provided by member states (e.g. using government bonds), and the decisions regarding production, including what is produced, how it is produced, and what the salaries and production sites are, are negotiated in different levels of elected committees. These committees are constituted by the amalgamation of the experiential knowledge of businessmen, political stakeholders, and scientific experts. It is anticipated that this democratic capitalism, founded upon the established constitutions of non-profit organisations, will possess the capacity to respond expeditiously to the demands posed by climate change, thereby diminishing the exploitation and corruption that is pervasive within the economic-political complex.

Author: Prof. DUEREN, Michael (Justus-Liebig-University Giessen (DE))

Presenter: Prof. DUEREN, Michael (Justus-Liebig-University Giessen (DE))

Session Classification: Submitted Talks

Contribution ID: **76** Type: **15 minute talk**

Innovative Approaches to Methane Capture: From CERN's Greenhouse Gas Reduction Strategies to Sustainable Livestock Emissions Management

Thursday 15 May 2025 12:03 (15 minutes)

In recent years, CERN has implemented various strategies to minimize the usage of greenhouse gases (GHG) and prevent their release into the atmosphere. Among these gases, CF_4 plays a not-negligible role, as it is responsible for approximately 20% of the CERN direct GHG emissions. Different strategies have been adopted, such as the research for more environmentally friendly gas mixtures to be used in the detectors and the development of gas recirculation and recuperation systems, which are designed to allow the reuse of exhaust gas. Building on this solid experience, the CH_4 Livestock Emission (CH4rLiE) project aims at developing a prototype for methane emissions capture in a barn environment. In comparison to CO_2, methane has a higher global warming potential (GWP), and human-produced methane emissions account for roughly 23% of global warming. Since a single cow can release roughly 110 kg of methane annually, emissions from livestock farms are not insignificant. Several initiatives have attempted to address the issue by addressing animal feed; CH4rLiE, on the other hand, suggests utilizing a specialized recovery system derived from CMS Cathode Strip Chambers CF_4 recovery systems to address the methane that has already been produced and dispersed in the atmosphere. Therefore, the study of gas adsorption by porous materials and the creation of a methane capture prototype system that will be installed in an actual barn are the main objectives of the project. An initial phase of gas diffusion simulations and a campaign of gas concentration measurements in various barn areas are supporting this study. Additionally, CH4rLiE will offer a chance to investigate, for the first time, the viability of recovering methane from the farm environment without compromising the living or feeding conditions of the animals. The social benefits are particularly intriguing when it comes to creating and executing low-impact farming production methods as well as recycling costly or environmentally harmful gases.

Author: VAI, Ilaria (Pavia University and INFN (IT))

Co-authors: BRAGHIERI, Alessandro (INFN Pavia); TAMIGIO, Alessandro (INFN Pavia); MANDELLI, Beatrice (CERN); AIMÈ, Chiara (Università & INFN Pisa); RICCARDI, Cristina (Università & INFN Pavia); DONDI, Daniele (Università & INFN Pavia); BIAGINI, Davide (Università & INFN Torino); VADIVEL, Dhanalakshmi (Università di Pavia); DINUCCIO, Elio (Università & INFN Torino); ANGIULLI, Francesco Alessandro (Università & INFN Pavia); FINCO, Linda (INFN Torino (IT)); ARENA, Maria Cristina (Pavia University and INFN (IT)); BRUNOLDI, Matteo (Università & INFN Pavia); KAMESWARAN, Nithish Kumar (Università di Pavia); SALVINI, Paola (INFN Pavia); MONTAGNA, Paolo (Università & INFN Pavia); VITULO, Paolo (Università & INFN Pavia); VERNA, Riccardo (INFN Torino); GUIDA, Roberto (CERN); CALZAFERRI, Simone (Università & INFN Pavia)

Presenter: VAI, Ilaria (Pavia University and INFN (IT))

Session Classification: Submitted Talks

Contribution ID: **77** Type: **15 minute talk**

Sustainability Assessment of future large research infrastructures

Wednesday 14 May 2025 12:45 (15 minutes)

The Large Particle Physics Laboratory Directors Group (LDG) established the Working Group on the Sustainability Assessment of Future Accelerators (SWG) in 2024, with the mandate to develop guidelines and a list of key parameters for the assessment of the sustainability of future colliders. The development and continuous update of such a framework is intended to enable coherent communication amongst scientists and adequately convey the information to a broader set of stakeholders.
The SWG report will be available in June 2025 at: https://ldg.web.cern.ch/working-groups/sustainability-assessment-of-accelerators. A 10-pages summary of the report was submitted as input to the Europeans Strategy process for particle physics.
We present highlights of the report to gather feedback for upcoming guidelines on sustainability assessment of large research infrastructures.

Authors: BLOISE, Caterina (INFN- Frascati); TITOV, Maxim (CEA- Saclay)

Presenter: BLOISE, Caterina (INFN- Frascati)

Session Classification: Submitted Talks

Contribution ID: **78** Type: **15 minute talk**

Electron identification using eco-friendly gas mixture for the future ALICE 3 bRICH detector at LHC

Wednesday 14 May 2025 12:00 (15 minutes)

The ALICE collaboration is proposing a new apparatus, ALICE 3, to investigate the Quark Gluon Plasma (QGP) properties in heavy-ion collisions beyond current limits for the LHC Runs 5 and beyond. Precision multi-differential measurements of dielectrons are required to access the time evolution of the QGP medium and chiral symmetry restoration mechanisms. A key ALICE 3 subsystem for dielectron measurements is a proximity-focusing Ring-Imaging Cherenkov (RICH) detector covering the barrel region ($|\eta < 2|$) and using aerogel (n = 1.03 at λ = 400 nm) as Cherenkov radiator and a layer of Silicon Photomultipliers (SiPMs) for the photon detection. The state-of-the-art detector concept ensures a better than 3σ e/π separation up to approximately 2 GeV/c. To further extend the e/π separation capabilities above 4 GeV/c, we are investigating the possibility of filling the RICH expansion gap with a gas mixture having a refractive index of about 1.0006, acting as an additional radiator for threshold-based discrimination. Since the use of gases having large Global Warming Potential, such as fluorocarbons, should be limited, we are studying the possibility to achieve the required optical properties using mixtures of very small fractions of heavy gases with almost inert gases to ensure environmental sustainability. In this contribution the detector concept and simulation studies on the impact of the proposed implementation on dielectron measurements will be presented.

Author: NICASSIO, Nicola (Universita e INFN, Bari (IT))

Presenter: NICASSIO, Nicola (Universita e INFN, Bari (IT))

Session Classification: Submitted Talks

Contribution ID: **79** Type: **15 minute talk**

HALHF - A hybrid, asymmetric, linear Higgs factory based on plasma-wakefield and radio-frequency acceleration

Wednesday 14 May 2025 13:00 (15 minutes)

The construction of an electron–positron collider 'Higgs factory' has been stalled for a decade, not because of feasibility but because of the cost of radio-frequency (RF) acceleration. Plasma-wakefield acceleration promises to alleviate this problem due to its orders-of-magnitude higher accelerating gradients, which result in a significant cost reduction based on a sizeable reduction in footprint. However, plasma-based acceleration of positrons is much more difficult than for electrons. We propose a collider scheme that avoids positron acceleration in plasma, using a mixture of beam-driven plasma-wakefield acceleration to high energy for the electrons and conventional RF acceleration to low energy for the positrons. Here we emphasise the benefits of HALHF with regards to sustainability via a sizeable reduction in carbon emissions during construction - due to the reduced footprint - and possibly also during operation - due to the in-principle higher energy-transfer efficiencies compared to RF.

Authors: FOSTER, Brian (University of Oxford (GB)); Dr LINDSTRØM, Carl A. (University of Oslo (NO)); D'ARCY, Richard (University of Oxford)

Presenter: D'ARCY, Richard (University of Oxford)

Session Classification: Submitted Talks

Contribution ID: **80** Type: **EITHER 15 minute talk or 5 minute 'flash' talk**

Sustainability in the LZ collaboration

Wednesday 14 May 2025 11:30 (8 minutes)

Within the LUX-ZEPLIN (LZ) collaboration, a dedicated sustainability working group began operation in late-2024 with the goal of identifying and mitigating green house gas emissions from operating and analysing the data of the LZ experiment.
We will report the preliminary emissions for dedicated LZ travel activity and the on-site power consumption, then our best vectors and plans for mitigation.

Author: ERIKSEN, Sam (University of Bristol (GB))

Presenter: ERIKSEN, Sam (University of Bristol (GB))

Session Classification: Flash Talks

Contribution ID: **81** Type: **15 minute talk**

Recuperation plants for fluorinated gas at the CERN LHC Experiments

Thursday 15 May 2025 13:05 (15 minutes)

In the context of particle physics, different families of gaseous detectors are operated with fluorinated gases for different purposes at the Large Hadron Collider (LHC) at CERN. The main gases used in these detectors are tetrafluoromethane (CF4), tetrafluoroethane (C2H2F4), sulphur hexafluoride (SF6), perfluorobutane (C4F10). Given their high Global Warming Potential (GWP) and the increasingly stringent European regulations regarding the use and trade of these gases, different approaches have been adopted for reducing the GHG emissions. One of the strategies, currently operating at the LHC Experiments, is the use of gas recuperation systems.
There are four operational recovery systems: two for the CF4, one for the R134a (C2H2F4), and one for the C4F10. These are industrial-scale systems, each of which relies on different principles of gas separation and purification. This is because, in most cases, fluorinated gases are used within gas mixtures where other components have lower Global Warming Potential (GWP).
The separation of fluorinated gases is carried out through membranes, absorbers, and distillation. The recovery system efficiencies are approximately 70% for the CF4, 80% for the R134a, and 90% for the C4F10.
The goal is to reuse the purified gases within gas mixtures sent to detectors in variable fresh/recovered fractions, depending on the purity of the obtained gas (usually between 90% and 98%).
The various stages of the recovery processes are monitored through gas chromatographic analyses, GC/MS (Gas Chromatography/Mass Spectrometry), and infrared (IR) analyses.
The use of these recovery systems in recent years has led to significant savings both in economic and emissions terms. In 2023, 950 kg of recovered CF4 were utilized out of a total of 1400 kg, and 1200 kg of R134a were used out of a total of xxx kg. It's worth noting that the R134a system is still under test and it was operational only for some weeks starting from September 2023 onward.
The development and construction of two new recovery systems for SF6 and C4F10 are still ongoing, and they are expected to be operational by the end of 2024.

Authors: BOUZAIENE, Amin; MANDELLI, Beatrice (CERN); GALASSI, Damiano; RIGOLETTI, Gianluca (CERN); ARENA, Maria Cristina (Pavia University and INFN (IT)); GUIDA, Roberto (CERN)

Presenter: ARENA, Maria Cristina (Pavia University and INFN (IT))

Session Classification: Submitted Talks

Contribution ID: **82** Type: **EITHER 15 minute talk or 5 minute 'flash' talk**

A Methodology for Calculating the CO2 Emissions from the Construction of an LHC Detector Upgrade Using Full Simulation

Monday 12 May 2025 20:00 (5 minutes)

The construction of detectors for the Large Hadron Collider (LHC) have substantial resource demands. As a case study, we examine LHCb Upgrade II, a major replacement of the LHCb detector planned for the 2030s. LHCb estimated Scope I and II carbon emissions for its Framework Technical Design Report, a first of its kind study. A brief overview of these results is given.
In this work, we propose a methodology for determining the Scope III emissions for this project and other future systems. Assessing the Scope III emissions of large detector systems, namely the impact of raw materials, presents greater challenges due to complex supply chains and indirect impacts. With around ten individual bespoke large subdetector systems, contributions from more than twenty countries and over a thousand scientists, an approach that tracks individual procurement orders is not realistic. Instead, we propose utilising the full simulation description of the detector to make an initial estimate, combined with the standard approach of Life Cycle Assessment (LCA). Outside High Energy Physics such a detailed simulation is often referred to as a "digital twin". We extract an inventory of post-processing materials from particle simulations, and implement automated cradle-to-gate impact calculations using the popular database software OpenLCA.
The process is based on the LHCb simulation, which uses GDML data, as part of the standard DD4HEP software framework. This is a widely used geometry markup language, and the main concepts are transferable to alternative geometry descriptions of other detector systems. This simulation serves as the input to our framework for a complete profile of LCA results for LHCb Upgrade II. This allows straightforward identification of materials and components with the most dominant contributions. We investigate limitations on the accuracy of the LCA, its applicability to alternative scenarios, and outline steps to improve the quality of the results.

Author: Mr GRAHAM, Dominic (University of Manchester)

Presenter: Mr GRAHAM, Dominic (University of Manchester)

Session Classification: Flash Talks

Contribution ID: **84** Type: **EITHER 15 minute talk or 5 minute 'flash' talk**

Sustainable Practice & Research Knowledge (SPARK) Hub - Supporting Sustainable Research

Wednesday 14 May 2025 11:42 (12 minutes)

UKRI is supporting the development of a resource to support sustainable research practices. The aim of the hub is to provide a central location for all guidance, certification, emissions quantification, and training regarding a broad set of research activities. UKRI is developing this with the aim that it will be collaboratively supported by multiple European research funders. We are engaging funders with an aspiration of aligning how they promote environmental sustainability long-term. This hub will support both research groups and institutions knowledge share and gain certification for addressing complex problems in an open-access and collaborative manner

In this session, we will review what resources exist, and which we're trying to align. We will also review the rationale and background of this effort, how it could work, and seek input from participants on this model."

Author: FARLEY, Martin (UKRI)

Presenter: FARLEY, Martin (UKRI)

Session Classification: Flash Talks

Contribution ID: **85** Type: **5 minute 'flash' talk**

FlexRICAN (Flexibility in research infrastructures for global carbon neutrality)

Monday 12 May 2025 19:40 (5 minutes)

FlexRICAN (Flexibility in research infrastructures for global carbon neutrality) is a cooperation among three major research infrastructures, each with distinct energy demands i.e., the European Spallation Source ERIC (ESS) in Sweden, the Extreme Light Infrastructure ERIC (ELI), with two running facilities (Czech Republic and Hungary) and the European Magnetic Field Laboratory AISBL (EMFL), with facilities in Grenoble and Nijmegen for DC fields and Dresden and Toulouse for pulsed fields (CNRS, RU, HZDR).

By combining their expertise, the participating research infrastructures (RIs) and industry partners will work to optimize both current and future energy projects. The goal is to showcase how RIs, as major energy consumers, can play a strategic role in advancing energy efficiency. This includes enhancing energy flexibility to support the European power grid and leveraging Waste Heat Recovery solutions to contribute to local heating networks. This seminar will focus on ESS in three main areas:

1- Renewable energy sources
2- Energy storage
3- Waste heat recovery

An analysis is being done on how renewable energy (RE) generation technologies can be implemented at ESS and how much power can be generated by different multi-energy configurations.

The goal is to develop modelling tools that predict and optimize the performance of RE systems (solar, wind, storage, etc.) for the specific conditions of ESS, or any given RI. Alongside these tools, further improvement of current technologies is aimed for; for example, a prototype PV panel will be designed to study how the cooling of solar panels could improve their performance.
These infrastructures are intensive energy consumers, generating a considerable amount of heat per year. Particularly at ESS, a good portion of this waste heat is recovered and transferred to be used in the district heating system. Two main topics are of interest regarding waste heat at ESS. First, the possibility of increasing the working temperature of the klystrons'collectors is being investigated. RF systems, and particularly the klystrons are among the top energy consumers at ESS as they are key parts of the Linac. The possibility of increasing the temperature of the cooling water exiting the collectors will provide a higher grade waste heat. However, the impact of such modification on the lifetime of the devices should be investigated as well.

Second, intermittency is a major issue when it comes to waste heat recovery and ESS is not an exemption. This issue is more serious on hot days in summer when there is less need for heating residential areas and therefore the district heating system will have problems with accepting all the waste heat ESS offers them. Therefore, an investigation is being conducted into the potential solutions to either store or consume the excess waste heat.

Authors: Mr HERRERA RUIZ, Diego (European Spallation Source ERIC (ESS)); Dr OLAD, Peyman (European Spallation Source ERIC (ESS))

Presenter: Mr HERRERA RUIZ, Diego (European Spallation Source ERIC (ESS))

Session Classification: Flash Talks

Contribution ID: **86** Type: **5 minute 'flash' talk**

Sustainability-Driven Energy and Environmental Optimization in High-Power Laser Facilities: ELI ERIC's Approach

Monday 12 May 2025 19:50 (5 minutes)

In response to evolving European and global climate commitments, including the EU Green Deal and related environmental accountability frameworks, ELI ERIC is actively advancing sustainability-focused measures across its operations. The organization is currently developing an ESG roadmap to systematically integrate sustainability into both its operational and technological planning.
A cornerstone of this effort is ELI ERIC's participation in the Horizon Europe-funded FlexRICAN project, which aims to demonstrate scalable energy flexibility solutions for electro-intensive research infrastructures. ELI leads the development of integrated frameworks focused on intelligent building management systems (BMS), precise environmental condition maintenance and battery array optimization—enabling adaptive energy behavior and grid-interoperable operations.
To ensure environmental stability within high-power laser zones—where even minor thermal or humidity deviations can compromise performance—ELI Beamlines is in a process of deploying a dedicated digital twin (DT) architecture. This system supports real-time facility modeling and predictive control using a suite of advanced tools: Mixed-Integer Linear Programming (MILP) via OMEGAlpes for energy dispatch, machine learning for anomaly detection, Gaussian process regression for uncertainty quantification, and greedy algorithms for local load optimization.
These capabilities enable precise environmental regulation while supporting real-time energy responsiveness. With an annual demand of 15 GWh (11 GWh electricity, 4 GWh gas), energy use represents the primary contributor to the facility's carbon footprint.
To address this, ELI Beamlines has invested in renewable energy systems. A 530 kW combined heat and power (CHP) unit with 630 kW thermal output has reduced energy consumption by 7,600 GJ annually, avoiding 1,550 tCO_2e. Complementing this, a 312.8 kWp photovoltaic plant composed of 665 panels contributes an additional 125 tCO_2e in yearly savings.
By integrating digital control systems, advanced energy modeling, and local renewables, ELI ERIC exemplifies how scientific facilities can actively support Europe's green transition. The long-term vision is to align frontier laser science with environmental responsibility—achieving operational excellence that is both technologically and ecologically resilient.

Authors: PECELI, Davorin (ELI Beamlines); BUGANOVA, Patricia (ELI Beamlines)

Co-authors: URBAN, Jakub (ELI Beamlines); CHRAST, Lukas (ELI Beamlines); KOUPIL, Pavel (ELI Beamlines); BERNASEK, Vaclav (ELI Beamlines)

Presenters: PECELI, Davorin (ELI Beamlines); BUGANOVA, Patricia (ELI Beamlines)

Session Classification: Flash Talks

Contribution ID: **87** Type: **not specified**

Living Well Within Limits: is it possible? And what will it take?

Wednesday 14 May 2025 08:15 (1 hour)

The Living Well Within Limits project investigates the energy requirements of well-being, from quantitative, participatory and provisioning systems perspectives. In this presentation, I will communicate individual and cross-cutting findings from the project, and their implications. In particular, I will share our results on the international distribution of energy footprints by country, consumption category, and income classes, as well as modelling the minimum energy demand that would provide decent living standards for everyone on earth by 2050. I will show that achieving low-carbon well-being, both from the beneficiary ("consumer") and supply-chain (producer) sides, involves strong distributional and political elements. Political economy research is thus necessary to diagnose reasons for poor outcomes, and identify the most promising avenues for positive change. I thus argue for the active (as in activist) engagement of the research community.

Presenter: Prof. STEINBERGER, Julia

Session Classification: Invited Talk

Contribution ID: **88** Type: **not specified**

How to do particle physics in a climate emergency

Tuesday 13 May 2025 17:15 (1 hour)

The pursuit of particle physics, or any kind of discovery-driven research, requires a stable and prosperous society. Today, our society is increasingly threatened by global climate change. Human-influenced climate change has already impacted weather patterns, and global warming will only increase unless deep reductions in emissions of CO2 and other greenhouse gases are achieved. Current and future activities in particle physics need to be considered in this context, either on the moral ground that we have a responsibility to leave a habitable planet to future generations, or on the more practical ground that, because of their scale, particle physics projects and activities will be under scrutiny for their impact on the climate. I will discuss several contexts in which particle physics has an impact on greenhouse gas emissions, with a particular focus on future collider projects, and how our field can contribute to a more sustainable future.

Presenter: BLOOM, Kenneth (University of Nebraska Lincoln (US))

Session Classification: Invited Talk

Contribution ID: **89** Type: **not specified**

Keynote speech on climate change

Monday 12 May 2025 17:15 (1 hour)

This talk will explore global climate targets and where we're at in relation to them; key sectors needing to mitigate; key climate impacts and risks arising from failure to mitigate.

Presenter: Prof. WOOD, Ruth

Session Classification: Invited Talk

Contribution ID: **90** Type: **not specified**

Towards a sustainable design of future colliders

Monday 12 May 2025 18:15 (30 minutes)

Particle physics is entering an era where the environmental impact of large-scale facilities must be evaluated, alongside their cost and physics output. In this talk, we explore the carbon footprint of proposed future collider projects, focusing on strategies to mitigate emissions without compromising physics goals. Using recent studies as a case study, we outline a methodology to quantify and compare the environmental cost of future e+e- proposals—accounting for both construction and operation. This approach offers a framework for integrating environmental responsibility into the design and evaluation of next-generation particle physics experiments.

Presenter: VERNIERI, Caterina (SLAC National Accelerator Laboratory (US))

Session Classification: Invited Talk

Contribution ID: **91** Type: **not specified**

Sufficiency: Toward a Physics-Inspired Economics

Monday 12 May 2025 18:45 (30 minutes)

This work explores the interdisciplinary concept of sufficiency leading us to reimagining economic theory through the lens of physics, with a particular focus on sufficiency corridors. Drawing inspiration from thermodynamics and systems theory, it proposes a shift away from traditional scarcity-driven models toward a paradigm grounded in balance and Earth system constraints. Sufficiency emerges as a guiding principle—offering a counterpoint to infinite growth models and redirecting attention from individual behaviour to collective social norms and practices. This presentation lays the groundwork for a physics-inspired economics that is both analytically rigorous and ecologically attuned

Presenter: Prof. SAHEB, Yamina

Session Classification: Invited Talk

Contribution ID: **92** Type: **not specified**

Fathoming Research Sustainability Through Art

Thursday 15 May 2025 08:15 (1 hour)

In an era where scientific advancements are crucial for addressing global challenges, the environmental impact of scientific research itself often goes unnoticed. Laboratories worldwide generate significant amounts of plastic waste, non-renewable resources such as helium gas are rapidly consumed, and vast amounts of energy are expended in our efforts to make the world a better place. Mitigation strategies are known, but it is often difficult to convince people working in the science industry that it is worth their time to do their part to address the climate crisis.

This workshop explores a unique intersection of art and science as well as its power to raise awareness and inspire actionable change. Attendees will not only learn about the importance of art in promoting sustainable research but also have the chance to participate in the creation of a collaborative community art piece!

Session Classification: Invited Talk

Contribution ID: **93** Type: **not specified**

Prof. Dave Newbold (STFC Rutherford Appleton Laboratory (GB)), Denise Voelker, Thomas Planche (TRIUMF)

Tuesday 13 May 2025 18:15 (1h 30m)

Presenters: Prof. NEWBOLD, Dave (STFC Rutherford Appleton Laboratory (GB)); VOELKER, Denise; PLANCHE, Thomas (TRIUMF)

Session Classification: Panel

Contribution ID: **94** Type: **not specified**

Jie Gao (CEPC), Marumi Kado (Max Planck Society (DE)), Sonja Kleiner (CERN), Takayuki Saeki (KEK)

Thursday 15 May 2025 09:15 (1h 30m)

Presenters: GAO, Jie (CEPC); KADO, Marumi (Max Planck Society (DE)); KLEINER, Sonja (CERN); SAEKI, Takayuki (KEK)

Session Classification: Panel

Contribution ID: **95** Type: **5 minute 'flash' talk**

The High Energy Physics, Cosmology, Astroparticle Physics, and Hadron and Nuclear Physics (HECAP+) Initiative

Monday 12 May 2025 20:10 (5 minutes)

Presenter: MILLINGTON, Peter (University of Manchester)

Session Classification: Flash Talks