

Sustainable HEP - 2nd edition

Monday, 5 September 2022 - Wednesday, 7 September 2022

CERN

Book of Abstracts

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Welcome / 1

Opening remarks and workshop introduction

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Input and Discussion / 3

Striving towards environmental sustainability in High Energy Physics, Cosmology and Astroparticle Physics (HECAP): a grassroots initiative

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This talk will present the current state of the document ‘Striving towards Environmental Sustainability in HECAP’. This work in progress is a grassroots effort emerging from the first workshop on Sustainability in HEP, with the aim of reflecting on the role that our community can play in limiting environmental impacts. We envision it as a prelude to a more widespread engagement of the HECAP community with issues of environmental sustainability, leading eventually to assessment of, reporting on, and target-setting on GHG emissions and other environmental measures at all levels of organization, from individuals, research groups and experimental collaborations, to institutions, funding bodies and policy makers. We urge the audience to contribute to this effort and help shape this document into a useful and complete reference for our community.

I understand that submitted abstracts will only be considered from registered participants.:

Input and Discussion / 7

Sustainability for whom?

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Courtesy of the pandemic, online conferences took over massively. The success of many of these events has made many members of our community think that organizing conferences online or in multiple regional hubs in parallel, could be our contribution to the carbon footprint of conference travel. Being this probably positive, it would also have a negative side. It will contribute to further enhance the already unbalanced research distribution between “South” and “North”.

We all know that physics suffers a severe representation problem, other fields as well. It is not a secret that the work of researchers from the North is published significantly more often and on more prominent platforms than the work of researchers from the South. Major international conferences

and workshop have been for years the chance that scientist from the South have to take part in forums where the state-of-the-art science is discussed, where connections are established and where networking takes place.

Moving to a system of online conferences will have a negative impact on the dire need of more cultural/geographic diversity that Physics has. It is true that hypermobility of scholars in the North must now be reconsidered, but not at the price of isolating the rest of the world and intensifying global inequalities. As scientists born and educated in the South, but with a scientific career developed in the North, we would like to open a discussion about this and present our personal perspective of what measures can be taken to ensure sustainability in our field but at the same time make sure that our community does not left scientist from the South behind.

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Yes, I have already registered.

Impulse talk / 9

Sustainability, Lancium, and HEP

Author: Andrew Grimshaw¹

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Wind and solar are now the least expensive way to produce electricity at scale. Tens of gigawatts of new capacity are coming on-line every year. In Texas alone 6-7 GWs come on-line every year. There are two significant challenges to using them: they are intermittent, and they are often located far away from population centers and their electrical load. What is needed are industries that can control their load and locate near the energy sources. Computation is just such an industry. Computation, particularly computations that can be paused, can play a significant role in accelerating the deployment of renewable energy. By building controllable-load data centers in proximity to the source, we eliminate the line “congestion” bottleneck and the need to move the energy to population centers. Lancium is building controllable load data centers with direct access to gigawatts of power in west Texas. The first 500MW will be available in Q1 2023. In this talk I begin with some electrical grid basics, stability, primary frequency response, ancillary services, and the Texas CREZ line. I then show how computation can be used as a variable and controllable load to stabilize the grid, consuming energy when it is inexpensive, and dropping load and releasing electricity back to the grid (i.e. humans) when energy prices are high. Further, buying TWhs of otherwise unused energy causes renewable energy generation to become more profitable by providing a stable base load, spurring further renewable energy projects.

I conclude with a discussion of short- and long-term options available to the High Energy Physics community at Lancium Clean Campuses. Specifically, we will introduce our HTC PaaS that has already been demonstrated to work for CMS jobs, and introduce options for customer-designed and operated clean energy data centers.

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Yes, I will register before the Call for Abstracts deadline.

Input and Discussion / 10

Sustainable Software Training Delivery at the HEP Software Foundation

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Modern HEP experiments are heavily reliant on software, but the traditional model of software training has relied on air travel to in-person training events (often associated with workshops or conferences). The HEP Software Foundation has developed a software training program to respond to the above challenge and the long-term sustainability of the HEP research software ecosystem. The open source and introductory HEP software curriculum and several software modules on techniques and methods for computing and data science have enabled users to jump start research and contributions to the field. Though initially motivated by the COVID pandemic, a shift in introductory training delivery from primarily in-person to virtual has allowed us to train over 1500 learners in the past 4 years. This shift to scalable virtual learning, which we intend to maintain for the introductory curriculum, has resulted in both an environmental and societal impact. By avoiding the need for air travel to training sites, we have reduced our carbon footprint and enabled learners to attend who otherwise would not have the local funds to travel. In addition, organized software training for HEP field brings efficiency and avoids duplication efforts, again saving related cost of energy and resources.

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Yes, I have already registered.

Future directions and workshop close / 12

Sustainability Platform needs humanpower and ideas

Author: Claire David¹

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Following the first Sustainable HEP workshop held online in June 2021, follow-up discussions centred around potential initiatives. These included the development of an online platform, focussed on environmental sustainability in our fields. The fledgling webpage (sustainable-hecap.github.io/) was made live recently to provide a platform to host the current draft of the reflective document “Striving towards Environmental Sustainability in High Energy Physics, Cosmology and Astroparticle Physics (HECAP).” However, we want this platform to grow ...sustainably! And potentially add features. We thus send a call via this talk to ask for volunteers to take over this project. We invite discussions on how to broaden the scope of this website and on future initiatives that could be hosted, e.g., additional content to help us educate ourselves and the public, so that we can converge together on how such an online platform would best represent the HECAP community and help to coordinate our efforts as we drive for greater sustainability.

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Future directions and workshop close / 14

Open Discussions

Author: Valerie Lang¹

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Future directions and workshop close / 15

Workshop close

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Impulse talk / 17

Sustainability in the scientific information industry

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Like any field of human activity, the scientific information industry (publishers, preprint repositories, online databases, etc.) has an environmental impact that needs to be lowered as much as possible. Additionally, given the important role that the production and dissemination of scientific information play in scientific research, it can help shape community practices to become more sustainable.

Using the INSPIRE HEP information platform as a case study, I will highlight concrete challenges and potential solutions in achieving these two goals. I will also present recent initiatives to make the publishing industry more sustainable and argue that strong institutional action is crucial to achieve real change.

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Impulse talk / 18

Nurturing Girls in Ghana in the Mathematical Sciences

Author: Angela Tabiri¹

¹ *African Institute for Mathematical Sciences Ghana*

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This talk will provide details on the Girls in Mathematical Sciences Program (GMSP), a public engagement program by the African Institute for Mathematical Sciences (AIMS) Ghana. The GMSP nurtures

the talents of secondary school girls from across Ghana in the mathematical sciences. After almost 2 years of successful implementation, an overview of the program will be discussed.

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Input and Discussion / 20

Towards ISO 50001 certification at CERN

Author: Nicolas Bellegarde¹

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With the growing environmental awareness of the recent decades, CERN strives to be an example for environmentally-friendly research. Energy is one of the factors in reducing the Organization's ecological footprint. In continuation with efforts to improve energy efficiency since 2015 through the Energy Management Panel (EMP), the Organization has initiated the process of obtaining the ISO 50001 certification for energy management. This process requires to define the Laboratory's energy baseline and energy performance indicators covering the Organization's main energy uses. It then sets objectives and energy targets and a plan to achieve them. Getting the certification also entails reviewing and completing CERN's energy policy, designing new tools to measure performance, and organizing formal audits carried out by an accredited certification body. This talk will cover the current status towards the certification.

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Input and Discussion / 21

Mobility and Bike Infrastructure at Universities

Corresponding Author: sabrina.oppermann@zv.uni-freiburg.de

Mobility at universities does not only concern business trips but also the way to work as well as the own vehicle fleet. A survey was conducted at the University of Freiburg to determine the mobility behavior of employees. The evaluation shows a clear desire to strengthen the bicycle infrastructure. This is one of the many points of the mobility concept.

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Panel discussion / 22

Panel Discussion: Preparing a sustainable future for HEP

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Impulse talk / 23**Towards a climate resilient future****Author:** Lindsay Stringer^{None}**Corresponding Author:** lindsay.stringer@york.ac.uk

The Intergovernmental Panel on Climate Change (IPCC) Working Group II Report on Adaptation, Impacts and Vulnerability identifies the urgent need for Climate Resilient Development. Climate Resilient Development acknowledges that adaptation needs to be undertaken together with mitigation and development actions, in inclusive, just and equitable ways. This joined-up approach should span multiple arenas of engagement, enabling progress towards the Sustainable Development Goals (SDGs) and guiding us toward more sustainable futures beyond 2030. This presentation considers what climate resilient development pathways can look like, with a focus on complex climate-sensitive development contexts (highlands, drylands and small islands). It highlights the importance of stakeholder engagement and partnerships to harness diverse knowledge sources, situating equity and justice concerns at the core of decision making and actions. While technological solutions offer potential to advance Climate Resilient Development, they need to be developed in an inclusive manner and used in ways that do not undermine Indigenous and local knowledge or exacerbate inequalities, with due consideration paid to the assessment and mitigation of trade-offs. The presentation concludes by identifying major urgent research gaps considering upscaling, finance, stakeholder responsibilities and governance, alongside the need for appropriate monitoring, evaluation and learning.

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Yes, I have already registered.

Input and Discussion / 24**Environmental Impact of Future Colliders****Authors:** Marlene Turner¹; Spencer Gessner²¹ *LBNL*² *SLAC***Corresponding Author:** sguess@stanford.edu

We present the results of the Snowmass Implementation Task Force (ITF) analysis of 15 future collider concepts. We consider both the environmental cost of construction (CO₂ footprint per meter of tunnel) and the carbon footprint associated with collider power consumption. We discuss strategies to mitigate the power consumption of future high-energy colliders, such as energy recovery. We also consider options to power colliders with renewable energy sources, and how to present a new collider as a benefit to society.

I understand that submitted abstracts will only be considered from registered participants.:

Yes, I have already registered.

Input and Discussion / 25**CERN Webfest 2022: exploring climate action challenges through open web technologies**

Author: Alexia Marie Yiannouli¹

¹ *Imperial College (GB)*

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The CERN Webfest - CERN's annual hackathon based on open web technologies - celebrated its tenth anniversary this year. Different to previous Webfest hackathons, this year's event ran through the summer, with the participants working in small teams on challenges relating to climate action and sustainability, with the aim of creating solutions.

This talk will outline some of the solutions created during the hackathon, highlighting how open web technologies can be utilised with climate action and sustainability efforts, both at CERN and across wider society.

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Yes, I will register before the Call for Abstracts deadline.

Input and Discussion / 26

Slow Science

Author: Sumati Surya^{None}

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I make a case for slow science that focuses not on the exploitation of land, labour and the environment, but on knowledge for its own sake. While modern science over the last century has been aided heavily by its promise of future exploitation (its "usefulness") it has also opened unimaginable windows of our minds, with a large fraction of interesting science being "useless". I argue that science should not be viewed as a "service provider" for exploitative growth, but rather be embraced as a fundamental human endeavour. Decoupling science from exploitation is the first step towards a sustainable science practice.

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Yes, I have already registered.

Input and Discussion / 27

Encouraging Sustainable Catering Practices in the HEP Community

Author: Sophie Mallows¹

¹ *KIT - Karlsruhe Institute of Technology (DE)*

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Agriculture, food production and distribution are major contributors to global greenhouse gas emissions and can be hugely detrimental to our environment in terms of land use, biodiversity and eutrophication. The food system in so-called developed nations is currently unsustainable and needs dramatic changes in order to prevent global warming to less than 1.5 degrees Celsius.

Given the large industrial accelerator complexes and travel methods upon which much of HEP research relies, changing the food and catering practices will, admittedly, have a relatively small environmental impact within HEP itself.

Nevertheless catering and food consumption are visible and social practices. The potential effect of reputable academic sectors promoting more sustainable eating habits could have a potentially much larger influence on an industry which has a relatively huge impact on climate change globally.

With a particular focus on the detrimental effects of meat and dairy consumption and the impacts of animal agriculture, this talk hopes to justify and explore methods by which we can encourage more sustainable eating practices in our facilities, conferences and private lives.

I understand that submitted abstracts will only be considered from registered participants.:

Yes, I have already registered.

Input and Discussion / 28

Food at work - opportunities and challenges

Author: Stefan Fredenhagen^{None}

Corresponding Author: stefan.fredenhagen@univie.ac.at

In the last IPCC report one reads that “..., reduction of excess meat (and dairy) consumption is amongst the most effective measures to mitigate green house gas emissions, ...”. Besides changing individual behaviour regarding food, we as community can also contribute here by changing common practice when it comes to catering at events or food offer at regular canteens.

I present some thoughts and experiences about the benefits of catering with a plant-based focus, its practicability and possible challenges.

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Yes, I have already registered.

Input and Discussion / 29

The carbon footprint of future Higgs studies

Author: Patrick Janot¹

Co-author: Alain Blondel²

¹ CERN

² Universite de Geneve (CH)

Corresponding Author: patrick.janot@cern.ch

The energy consumption of an e^+e^- Higgs factory in operation will be everything but negligible. Future Higgs boson studies may therefore have a significant environmental impact. We propose ways to estimate the environmental footprint during the operation of all the Higgs factory projects that can credibly operate immediately after the end of LHC, namely the projects for three linear colliders (CLIC, operating at $\sqrt{s} = 380$ GeV; and ILC and C³, operating at $\sqrt{s} = 250$ GeV) and two circular colliders (CEPC and FCC-ee, operating at $\sqrt{s} = 240$ GeV). The projected carbon footprint varies from single to a hundredfold depending on the Higgs factory considered.

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Yes, I have already registered.

Input and Discussion / 30

Scale back compute when electricity produced from gas

Author: Rodney Walker¹

¹ *Ludwig Maximilians Universitat (DE)*

Corresponding Author: rodney.walker@physik.uni-muenchen.de

In view of the particular gas shortage in Germany, we propose a method to scale back HEP computing usage at times where the electricity production mix has an increased gas component. The predicted gas component is dependent on weather and demand forecasts. It is freely available and has very pronounced peaks due to the merit-order model. A compute site could use this to minimize consumption at times where gas would be needed to produce that electricity. This could be by stopping new jobs, to drain nodes, perhaps combined with suspending running jobs. A typical 2 socket server uses 250W loaded, but only 50W idle. Even at the LHC computing scale, this would be a very small load reduction, but raises awareness and brings outreach potential. For example, by publicizing times to avoid, other consumers could voluntarily reduce usage.

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Yes, I will register before the Call for Abstracts deadline.

Input and Discussion / 31

Optimising the computational footprint in precision particle physics

Author: Peter Skands¹

Co-author: Christian Preuss²

¹ *Monash University (AU)*

² *ETH Zürich*

Corresponding Authors: cpreuss@phys.ethz.ch, peter.skands@monash.edu

During 2020, I was working on a grant proposal in precision particle physics, on so-called matching and merging strategies, for the widely used Pythia event generator. For complex processes, these types of calculations can be quite resource-intensive. That same summer, my home country of Australia had experienced catastrophic bush fires. It made me reconsider what I was doing, proposing calculations that would take immense computing resources to perform. I rewrote the grant with a central focus on reducing the computational footprint necessary to do these calculations - but still pushing the state of the art. The grant was awarded and we are now beginning to work in this direction. It was the first grant proposal I have written in which reduction of computational footprint in itself had been an explicit goal.

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Yes, I will register before the Call for Abstracts deadline.

Input and Discussion / 32**An Intelligent Air Quality Monitoring and Prediction System for Smart Cities****Author:** Ryan Peter Mckenzie¹¹ *University of the Witwatersrand (ZA)***Corresponding Author:** ryan.peter.mckenzie@cern.ch

In 2019 99% of people were found to breathe air that exceeds WHO air quality limits, and 7 million people die from air pollution annually. This motivated the formation of the South African Consortium of Air Quality Monitoring. The international consortium was founded with the goal of bringing together government institutions, HEP research institutions, and private enterprises into a mutually beneficial ecosystem to deliver an industry-disrupting open-source low-cost intelligent Internet-of-Things (IoT) air quality monitoring and prediction system for the benefit of the world. The system combines existing air quality sensors with a low-cost IoT network architecture to enable the use of Artificial Intelligence (AI) for air quality predictions. The expertise has been developed through the maintenance, operations, and Phase-II upgrade of the electronics of the ATLAS Hadronic Calorimeter as well as the use of machine learning techniques during data analysis of ATLAS data.

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Yes, I have already registered.

Input and Discussion / 33**Climate impacts of particle physics: a Snowmass white paper****Author:** Ken Bloom^{None}**Corresponding Author:** kenbloom@unl.edu

The ongoing “Snowmass” process in the United States included a focus on community engagement issues within the field. The climate impacts of particle physics was identified as one such issue. I will discuss how the Snowmass paper came to be, and briefly discuss some parts of its content.

I understand that submitted abstracts will only be considered from registered participants.:**Input and Discussion / 34****A Year of ParticleBites****Author:** Flip Tanedo¹**Co-author:** Eve Vavagiakis²¹ *UC Riverside*² *Cornell University*

Corresponding Authors: flip.tanedo@ucr.edu, ev66@cornell.edu

ParticleBites.com is a blog-based journal club written by graduate students targeted to undergraduates. Posts are accessible summaries of current research papers. While the public-facing blog is valuable for disseminating research, the group is also a science communication community within high-energy physics. Science communication can be powerful tools for supporting a sense of professional belonging among under-represented early career academics. We propose adapting the best practices from remote meetings to support this early-career particle physics community.

This year we are using ParticleBites as a laboratory to apply methods of remote/virtual community building to pilot it as professional networking platform between graduate student writers. The goal is to train graduate students in research literacy, building a science communication portfolio, and supporting meaningful research interactions between early career physicists. Traditionally this type of networking only begins for advanced graduate students and is limited by geography and travel budgets. Our “Year of ParticleBites” pilot program will test if the sustainable virtual meetings can support student self efficacy and equitable training opportunities among graduate students.

I understand that submitted abstracts will only be considered from registered participants.:

Yes, I have already registered.

Future directions and workshop close / 35

Why you should help me run a 'HEP from Home' conference

Author: Shaun Hotchkiss^{None}

Corresponding Author: shaun.hotchkiss@gmail.com

Cosmology from Home is an online conference that has now been running for three years (I am a co-organiser).

Each year we have more than 200 *active* participants, more than 100 pre-recorded talks, thousands of asynchronous messages sent discussing these talks, more than 25 hours of live discussion of talks, about the same time spent in formal discussion of themed topics suggested by participants, and many additional hours spent in informal breakaway discussions and socials.

Cosmology from Home is an online conference format that works: it is enjoyable, and brings value to the cosmology community - without a single flight needed.

It is about time we began HEP from Home too, but I can't do it alone...

I understand that submitted abstracts will only be considered from registered participants.:

Yes, I will register before the Call for Abstracts deadline.

Impulse talk / 36

Mitigation of climate change: what options ahead?

Corresponding Author: elena.verdolini@eiee.org

The Intergovernmental Panel on Climate Change (IPCC) Working Group III Report on Mitigation of Climate Change represents the most updated global assessment of climate change mitigation progress and pledges, and examines the sources of global emissions. It explains developments in

emission reduction and mitigation efforts, assessing the impact of national climate pledges in relation to long-term emissions goals. This presentation illustrates emission pathways and alternative mitigation portfolios consistent with limiting global warming to different levels, and assesses specific mitigation options at the sectoral and system level. It also discusses the importance of enabling conditions related to institutional design, policy, finance, innovation and governance arrangements and how these can contribute to climate change mitigation in the context of sustainable development.

I understand that submitted abstracts will only be considered from registered participants.:

Input and Discussion / 37

Energy Efficient Computing with Sustainable Infrastructure at KIT

Corresponding Author: rudolf.lohner@kit.edu

Modern Data Centers are running the latest and often very efficient hardware in terms of power consumption. However, when it comes to cooling or even waste heat recovery most data centers do a bad job by sticking to very old fashioned concepts of using low temperature air cooling, waisting additional power for chillers and a lot of water for evaporative cooling which alltogether is very inefficient and not sustainable at all.

At Karlsruhe Institute of Technology (KIT) we decided already more than five years ago for a much more sustainable way of cooling our HPC data center: We use a warm water cooling concept where water with about 40°C - 45°C is flowing through cooling plates mounted on the chips inside the servers thus capturing the waste heat directly at the points where it is generated. This temperature level allows for dry cooling without chillers or evaporation almost all around the year. And even more, the waste heat is used to heat office buildings in the cold seasons, thus reducing the heating cost significantly.

The talk will demonstrate how we have realized this concept and what benefits it brings to us.

I understand that submitted abstracts will only be considered from registered participants.:

Welcome / 38

Welcome (Day 2)

Author: Peter Millington¹

¹ *University of Manchester*

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Input and Discussion / 39

Summary of SDG Discussion Session

Author: Ayan Paul¹

¹ *Northeastern University*

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