LCWS2023 @SLAC: International Workshop on Future Linear Colliders (May 15-19, 2023)

The 2023 International Workshop on Future Linear Colliders (LCWS2023) will take place on May 15-19, 2023, SLAC, USA. The program will feature ILC progress in Japan, and the establishment of the International Technology Network (ITN) as the prominent topic, to review the progress in accelerator design, detector developments and physics studies. The progress of the CLIC studies within the same areas will also be covered and most sessions and topics will be common. The ILC project in Japan and CLIC project at CERN are also the central elements of the recently approved EU / EAJADE (Europe-America-Japan Accelerator Development and Exchange) program. Emerging new linear collider concept, C^3, will be also presented. More details about the workshop program may be found at the conference website: https://indico.slac.stanford.edu/event/7467. As a part of the LCWS2023 Symposium, we are pleased to announce the following special events:

Industrial Forum on Accelerator Technologies and Advanced Instrumentation for Future Linear Colliders

Date: 16 May 2023, 13:00 – 15:00 (PDT, US)

Indico link: https://indico.slac.stanford.edu/event/7467/sessions/441/#20230516

The goal of the event is to strengthen international cooperation between academia and industrial partners involved in the development of advanced accelerator technologies and instrumentation techniques. The forum will be devoted to the industrial aspects of future Linear Colliders, which offers an opportunity to valorise and highlight the expertise and innovation capabilities of national laboratories and their related industrial partners.

13:00-13:15 Introduction to Industry and Sustainability Forum – Session Conveners

13:15-13:35 Japan - AAA activity - Takahashi Tohru (Hiroshima Univ./AAA, Japan)

13:35-13:55 US Office of Accelerator R&D and Production (ARDAP) – Ginsburg Camille (Deputy Director of ARDAP, USA)

13:55-14:15 Advances in Spanish Science Industry – Fernandez Erik (INEUSTAR, Spain)

14:15-14:35 Development of C-band RF infrastructure and initial experiments at RadiaBeam - Murokh Alex (Radiabeam, USA)

14:35-14:45 Experience in participating in the development of an electron-driven positron source as a company in the Tohoku region – Kondo Masahiko (Kondo Equipment Corporation, Japan)

14:45-14:55 Development of Nb3Sn SRF cavity using electroplating method – Takahashi Ryo (Akita Chemical Industry Co., Ltd, Japan)

15:00-15:30 Coffee Break

Sustainability Forum for Future Linear Colliders

The environmental credentials of future colliders are increasingly in the spotlight, because of their size and complexity, and will be under scrutiny for their impact on the climate. Therefore, sustainability has become a prioritized goal in the design, planning and implementation of future accelerators; approaches to improved sustainability range from overall system design, optimization of subsystems and key components, to operational concepts. A direct quantification of the ecological footprint, be it greenhouse gas emissions during construction and operation, or consumption of problematic materials, is currently performed only sporadically, mostly through translation of electricity consumption into equivalent CO2 emissions.

This forum will highlight studies to reduce power consumption of accelerator systems, to quantify the impact of future facilities in terms of CO_2 footprint, to address smart integration of future accelerator infrastructure with the surrounding site and society (e.g. Green ILC concept), and to discuss medical and environmental applications of accelerator technologies.

Date: 16 May 2023, 15:30 – 18:00 (PDT, US)

Indico link: https://indico.slac.stanford.edu/event/7467/sessions/443/#20230516

15:30-15:50 Sustainability Studies for ILC and CLIC – Benno List (DESY, Germany)

15:50-16:10 High Efficiency Klystrons project at CERN: Status and updates – Syratchev Igor (CERN)

16:10-16:30 Linear Collider Carbon Assessments: A Life Cycle Assessment of the CLIC and ILC Linear Collider Feasibility Studies - Evans Suzanne (ARUP Group)

16:30-16:50 Green ILC Concept – Yoshioka Masakazu (Iwate University/KEK, Japan)

16:50-17:10 Permanent magnet technology for sustainable accelerators – Shepherd Ben (STFC, UK)

17:10-17:25 IHEP high efficiency, high power klystron development - Zhou Zusheng (IHEP, China)

17:25-17:35 Basic research using synchrotron radiation and commercialization of waste heat recovery technology from ILC - Mitoya Goh (Higashi Nihon Kidenkaihatsu Co., Ltd., Japan)

17:35-17:45 Town planning in the vicinity of ILC candidate site as a regional company - Kondo Masahiko (Kondo Equipment Corporation, Japan)

Accelerator: Sustainability and Applications Session

Date: 18 May 2023, 10:30 – 12:00 & 13:30 - 14:30 (PDT, US)

Indico link: https://indico.slac.stanford.edu/event/7467/sessions/450/#20230518

10:30-10:50 Sustainability Studies for the Cool Copper Collider- Bullard Brendon (SLAC)

10:50-11:10 Sustainability Considerations for Accelerator and Collider Facilities – Nappi Emilio (SLAC)

11:10-11:30 Strong-field QED Experiments for & at Linear Colliders – List Jenny (DESY)

11:30-11:50 High Temperature Superconducting RF cavity – Le Sage Gregory (SLAC)

13:30-13:50 Progress of High-Efficiency L-Band IOT Design for Accelerator Applications at SLAC - Othman Mohamed (SLAC)

13:50-14:10 High Efficiency, 1 MW, 1 MeV Accelerator for Environmental Applications – Shumail Muhammad (SLAC)

14:10-14:30 Applications of High Gradient Accelerator Research for Novel Medical Accelerator Technology - Snively Emma (SLAC)

LCWS2023 @SLAC: International Workshop on Future Linear Colliders (May 15-19, 2023)

Editorial *Nat. Phys.* 19, 761 (2023).
https://doi.org/10.1038/s41567-023-02117-0

https://doi.org/10.1038/s41567-023-02117-0

Strive towards sustainability

Check for updates

Exacerbated by the impacts of climate change and the recent energy crisis, concentrated efforts towards more sustainable research have become matters of urgency, in particular for large-scale accelerator complexes and light sources.

Towards the end of 2022, several large-scale research infrastructures had to cut down operation time due to an increase in the cost of electricity. The Large Hadron Collider's yearly technical stop was moved up by two weeks, and the machine's operation was reduced by 20% for 2023[1]. The Elettra synchrotron in Trieste, Italy, and its free-electron laser FERMI had to halve user beam time in the first semester — a fate shared by many other light sources.

Immediate actions to alleviate the situation are limited, as long-term planning is required for large-scale facilities. Therefore, it's not surprising that sustainability — mainly in terms of reduced power consumption and carbon footprint — was an important topic at this year's International Particle Accelerator Conference.

One point towards making research facilities more sustainable is the move towards greener energy. In this regard, the SESAME light source in Allan, Jordan, is a trailblazer. The facility has its own solar power plant (pictured) and was the world's first large accelerator complex, whose power stems only from renewable energy sources. Others followed suit: the HZB in Berlin, Germany, that operates the BESSY II synchrotron secured their full electricity needs with renewable energy, saving up to 17,400 tonnes of CO_2 per year compared to 2018.

Another issue is increasing the energy efficiency of accelerator complexes. Improvements of the injectors of the Large Hadron Collider have greatly reduced the overall energy consumption; for example, a powering scheme introduced a few years ago reduced the Super Proton Synchrotron's energy consumption by 40 GWh per year. For comparison, the whole canton of Geneva consumes around 3,000 GWh per year. Similarly, by integrating the previously separate SPring-8 synchrotron with the SACLA X-ray free-electron laser in Sayo, Japan, the power consumption was reduced by five MW — roughly an electric locomotive's power output. But this is not the end of the road. With future upgrades, these and many other facilities aim to substantially reduce their energy consumption.

Apart from measures directed at improving the sustainability of the research infrastructure, such as water and waste management, a few main themes concerning accelerator technology have emerged. The actual particle acceleration occurs in superconducting radiofrequency cavities. For bulk niobium, this requires operation at 2 K and thus cooling with superfluid helium. Increasing the operation temperature to around 4.5 K would result in substantial energy savings. One direction that's being explored is superconducting thin films on bulk copper for radiofrequency cavities, which also have the potential to achieve higher accelerating gradients and thus to enable more compact machines.

The bending and focusing of the accelerated particle beams relies on different magnets. For the future BESSY III synchrotron, electromagnets are estimated to amount to an annual energy consumption exceeding 5 GWh, which could be reduced by 80% by installing permanent magnets as dipole and quadrupole magnets[2]. But this does not necessarily make them a more sustainable choice. Permanent magnets often involve rare-earth elements; their mining not only has a substantial carbon footprint but also impacts the people living on the land[3].

A clever way to make linear accelerators more sustainable is through energy recovery. The idea is rather simple: instead of dumping two accelerated particle beams after colliding them, why not recover the beam energy? The principle of an energy recovery linear accelerator was first demonstrated in 1987 — enabled by superconducting radiofrequency technology. A recent experiment at the S-DALINAC machine demonstrated saving up to 87% of the consumed beam power in its main linear accelerator[4].

In the design of large-scale facilities, performance is weighted against cost. Factoring in sustainability parameters, such as CO_2 emission from energy use or the embodied CO_2, increases the level of complexity and changes the optimization. For the proposed Compact Linear Collider and the International Linear Collider, a life cycle assessment estimated the environmental footprint. Such assessments provide the accelerator community with guidelines for the planning of more sustainable large-scale projects.

Apart from considering the impacts of accelerators on climate change and making the research infrastructures more sustainable, they can contribute to sustainability as well. For example, pollutants in wastewater can be reduced through irradiation with electron beams. By switching from normal conducting to superconducting radiofrequency technology, electron beam irradiation could become more cost efficient and competitive with other treatment methods[5].

Sustainability is an all-encompassing issue, from research facilities to the code used to analyse data[6]. And it's much broader than considering electrical power consumption and carbon footprints. Striving towards sustainability requires a holistic understanding of the multiple and connected impacts on the environment — including the people that live in it.

Published online: 13 June 2023

References

1. Owens, B. *Nature* **610**, 431–432 (2022).
2. Völker, J., Dürr, V., Goslawski, P., Jankowiak, A. & Titze, M. In *Proc. IPAC22* 2763–2766 (JACoW Publishing, 2022).
3. Owen, J. R. et al. *Nat. Sustain.* **6**, 203–211 (2023).
4. Schliessmann, F. et al. *Nat. Phys.* **19**, 597–602 (2023).
5. Li, X. et al. *Nucl. Instrum. Methods Phys. Res. A* **1039**, 167093 (2022).
6. Lannelongue, L., Grealey, J. & Inouye, M. *Adv. Sci.* **8**, 2100707 (2021).

CREDIT: CARAIMAN GONZALEZ, NOEMIE / CERN / SCIENCE PHOTO LIBRARY

concepts. A direct quantification of the ecological footprint, be it greenhouse gas emissions during construction and operation, or consumption of problematic materials, is currently performed only sporadically, mostly through translation of electricity consumption into equivalent CO2 emissions.

This forum will highlight studies to reduce power consumption of accelerator systems, to quantify the impact of future facilities in terms of CO_2 footprint, to address smart integration of future accelerator infrastructure with the surrounding site and society (e.g. Green ILC concept), and to discuss medical and environmental applications of accelerator technologies.

Date: 16 May 2023, 15:30 – 18:00 (PDT, US)

Indico link: https://indico.slac.stanford.edu/event/7467/sessions/443/#20230516

15:30-15:50 Sustainability Studies for ILC and CLIC – Benno List (DESY, Germany)
15:50-16:10 High Efficiency Klystrons project at CERN: Status and updates – Syratchev Igor (CERN)
16:10-16:30 Linear Collider Carbon Assessments: A Life Cycle Assessment of the CLIC and ILC Linear Collider Feasibility Studies - Evans Suzanne (ARUP Group)
16:30-16:50 Green ILC Concept – Yoshioka Masakazu (Iwate University/KEK, Japan)
16:50-17:10 Permanent magnet technology for sustainable accelerators – Shepherd Ben (STFC, UK)
17:10-17:25 IHEP high efficiency, high power klystron development - Zhou Zusheng (IHEP, China)
17:25-17:35 Basic research using synchrotron radiation and commercialization of waste heat recovery technology from ILC - Mitoya Goh (Higashi Nihon Kidenkaihatsu Co., Ltd., Japan)

17:

Da

Ind

10:

10:

11:

11:

13:

13:

14:

Shively Emma (SLAC)

In the design of large-scale facilities, performance is weighted against cost. Factoring in sustainability parameters, such as CO2 emission from energy use or the embodied CO2, increases the level of complexity and changes the optimization. ***For the proposed Compact Linear Collider and the International Linear Collider, a life cycle assessment*** estimated the environmental footprint. ***Such assessments provide the accelerator community with guidelines for the planning of more sustainable large-scale projects.***

Europe – America – Japan (EAJADE) Program (2023-2027)

European Union's Horizon Europe Marie Sklodowska-Curie Staff Exchanges programme under grant agreement no. 101086276

2014 → 2023

http://www.eajade.eu/

E-JADE
Europe -Japan Accelerator Development Exchange Programme

EAJADE
Europe-America-Japan Accelerator Development Exchange Programme

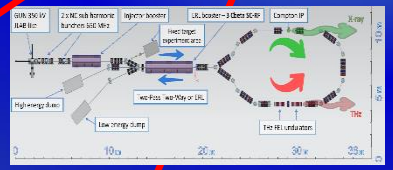
Work package no.	Work package title	Activity type	Number of person-months involved per secondment	Lead beneficiary	Start month	End month
1	R&D&I at currently operating state-of-the-art facilities	Research, training	143	CNRS	1	48
2	State-of-the-art high-gradient, high-efficiency, reduced-cost radio-frequency structures and power sources	Research, training	68	INFN	1	48
3	Special technologies, devices and systems [illegible]	Research, [illegible]	74	CERN	1	48
4	Sustainable technologies for scientific facilities	Research, Training	12	CEA	1	48
5	Investigation of potential early applications of novel and advanced technologies for colliders	Research, training	52	DESY	1	48
6	Management, dissemination, training, knowledge transfer, and communication	Management, training, dissemination, communication	4	DESY	1	48

WP4: Sustainable Technologies for Scientific Facilities

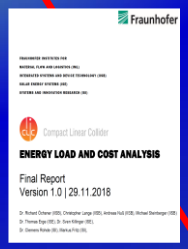
WP4

Task 4.1: High Efficiency & Sustainable SC cavities

Task 4.2: High efficiency RF power amplifiers



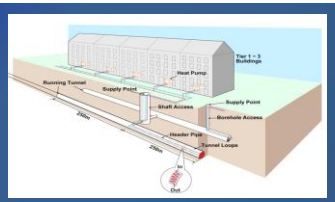
Task 4.3: Energy Recovery Linacs



Task 4.4: Power Modulation

Task 4.6: "Green ILC"

Task 4.5: Smart Tunneling



EAJADE Workshop on Sustainability in Future Accelerators (WSFA2023)

MORIOKA, JAPAN, SEPTEMBER 25-27, 2023

Alina Center, the same venue as LCWS2016, hosted by Iwate University

All sustainability aspects:
Power, Energy & Green ILC / ESS

EAJADE
Europe-America-Japan Accelerator Development Exchange Programme

https://indico.desy.de/event/39980/

Monday, 25 September

08:00	→ 12:00	Facility Tour
13:00	→ 17:00	Sustainability Session I

Tuesday, 26 September

09:00	→ 12:00	Sustainability Session II
13:00	→ 17:00	Sustainability Session III

Wednesday, 27 September

09:00	→ 12:00	Sustainability Session IV

International Program Committee:

Phil Burrows (University of Oxford, UK)
Benno List (DESY Hamburg, Germany)
Shin Michizono (KEK, Japan)
Takayuki Saeki (KEK, Japan)
Tomoyuki Sanuki (Tohoku University, Japan)
Steinar Stapnes (CERN, Switzerland)
Thomas Schoerner-Sadenius (DESY Hamburg, Germany)
Nobuhiro Terunuma (KEK, Japan)
Maxim Titov (CEA Saclay / IRFU, France)
Marc Winter (IJCLab, France)
Masakazu Yoshioka (Iwate University, Japan)

Local Organizing Committee:

Satomi Fujisaki (Iwate University, Japan)
Kiyotomo Kawagoe (Kyushu University, Japan)
Masao Kuriki (Hiroshima University, Japan)
Shinya Narita (Iwate University, Japan) – Chair
Aiko Shoji (Iwate University, Japan)
Tohru Takahashi (Hiroshima University, Japan)
Tohru Takeshita (Shinshu University, Japan)
Satoru Yamashita (Iwate Pref.l University, Japan)