Report of WG14 on Accelerator Science
2021 - 2024
Christine Darve, WG14 Chair

Status Report: IUPAP Working Group 14 (WG14) on Accelerator Science

1. Introduction

- **Formation and Leadership:** The IUPAP Working Group 14 (WG14) on Accelerator Science was created in 2015 to promote global collaboration in particle accelerator science. Led by Lia Merminga (FNAL) till 2021, then Gianluigi Arduini from 2021 to 2023/24, and now chaired by Christine Darve since March 2024, WG14 focuses on fostering innovation, sharing knowledge, and driving progress in accelerator technologies.
- **Mission and Goals:** WG14's primary objective is to enhance communication among the international accelerator science community. The group promotes theoretical advancements, supports accelerator applications in various industries, and highlights their potential in addressing societal challenges, such as healthcare, energy, and environmental sustainability. Its focus areas include:
    - the theory and experiments concerned with the nature and properties of particle accelerators and beam physics
    - the improvement of international communication in Accelerator Science through the sponsorship of professional meetings
    - the future of accelerator facilities for various fields that benefit science and society
    - the industrial, medical, energy production and environmental applications of relevant accelerator technologies
    - the accelerator technologies and connection to engineering.

2. General WG14 activities summary

In this paragraph, we are summarizing the general activities completed in 2022 and 2023.
2022 activities - restarting the WG activities after a hiatus due to the pandemics:

- Membership finalized with improved gender and regional representation
- IPAC22 – June 12-17: first International Particle Accelerator Conference in person after the pandemics (but including also remote presentations). Endorsed by IUPAP.
    - ~750 participants: 30% female representation, 1000 papers, 71 student grants
- WG14 Web page under construction (hoping to go on-line soon)

2023 activities:

- Joint ICTP-IAEA Advanced Workshop on Future Trends in Multidisciplinary Ion Beam Analysis (10-14 October 2022 – Vienna, Austria)– endorsed by IUPAP. About 20 participants. Given short presentation on IUPAP & WG14
- International Particle Accelerator Conference - IPAC23 (7-12 May 2023 – Venice, Italy): Supported by IUPAP. Largest number of participants ever.

    - ~1660 participants from 37 countries: 1800 papers, ~100 student grants, 116 industrial exhibitors. For the first time an IPAC in Europe included an Equal opportunity session
- International Accelerator School on Superconducting Science and Technology for Particle Accelerators (10-20 July 2023, Saskatoon, Canada). Supported by IUPAP. About 30 students.
- WG14 Web page on-line (including links to on-line courses in accelerator science)

In the following 2 paragraphs, we detail 2 specific WG14 activities, that we wish to enhance and expand.

3. Specific WG14 activity: Website as a Central Delivery Platform

Beyond the organization of the IPAC annual meeting, the WG14 has prioritized its website as the core platform for delivering information, fostering collaboration, and promoting educational initiatives in accelerator science. The website serves as a comprehensive resource for scientists, educators, students, and the public, ensuring that accelerator science reaches a global audience.

Centralized Information Hub

- **Content Delivery:** The website acts as a centralized hub for:
    - **News and Updates:** Regular reports on WG14's activities and the latest developments in particle accelerator technologies.
    - **Resources for Researchers:** Access to publications, reports, and presentations on accelerator science.
    - **Educational Initiatives:** A dedicated section with online courses, workshop details, and learning materials aimed at students, educators, and professionals in the field.

Educational Initiatives

The WG14 website plays a key role in promoting accelerator science education by offering a wide range of resources and materials. Educational efforts highlighted on the website include, but is not limited to:

- **International Particle Accelerator Conference (IPAC):** WG14 sponsors this yearly event, which is organized alternatively between America, Asia, Oceania and Europe. IPAC serves as a major platform for fostering collaboration and innovation in the global accelerator community. The IPAC gathers over 1,500 attendees and enable the publication of more than 1 000 papers annually in the conference proceedings, which are made available through the Joint Accelerator Conferences Website (JACoW).
- **International Accelerator School (IAS):** WG14 suppors this school, which trains future accelerator scientists. The 2023 session in Saskatoon, Canada, was a major success, and materials from this and past sessions are accessible via the website, allowing students and professionals to benefit from specialized training.
- **Nordic Particle Accelerator Project (NPAP):** WG14 promotes this initiative, which offers MOOCs and summer schools. Since its launch, NPAP has educated over

20,000 students worldwide, making advanced accelerator science education accessible globally. Through the website, participants can find links to register for courses and access testimonials from past students, expanding the program's reach. It is worth noting, that another MOOC sponsored by the European Commission (EC), "**Accelerate your Teaching**" is also available on our web page currently to teach high-school teachers about particle accelerators and their applications.

- **Workshops and Schools:** The website features information on upcoming and past educational events, including workshops and conferences. Users can access recordings and materials, ensuring continuous learning opportunities for a global audience.

4. Specific WG14 activity: Creative Commons-Licensed Presentation Materials

One of WG14's standout initiatives is the development of Creative Commons-licensed presentation materials. This project focuses on creating free, adaptable materials to promote accelerator science and its applications worldwide. This project, initially developed by Gianluigi Arduini and Swapan Chattopadhyay, is now led by Suzie Sheehy, with financial support provided by the University of Melbourne to ensure its successful completion.

- **Purpose:** These open-access materials will help standardize the messaging around accelerator science, making it easier for educators, outreach professionals, and researchers to communicate the field's significance. They are designed for:
    - **Public Engagement:** Engaging audiences from students to policymakers with clear, relatable content.
    - **Customization:** Allowing users to modify the materials for specific presentations, classrooms, or outreach events.
- **Content of the Materials:** The Creative Commons resources will include:
    - **Presentation Templates:** Covering fundamental topics like particle accelerators, their applications in medicine, industry, and energy, and their societal benefits.
    - **Infographics and Visual Aids:** High-quality visual content to explain complex accelerator technologies in simple terms.
    - **Ambassador Program:** Materials designed for accelerator scientists trained to engage with the public, making use of the customizable presentation templates for public talks and outreach events.

The initial phase of this project involves collecting existing materials in the following five categories and has started in 2024:

1. Applications of accelerators to environmental and societal challenges in line with the UN Sustainable Development Goals (SDGs)
2. Particle beams for medical applications
3. Accelerators from discovery to industry
4. Future accelerators, including showcases on plasma physics and compact accelerators
5. Accelerators as collaborative tools and enablers of peace

5. Public Engagement and Outreach

One of WG14's primary focuses is on public engagement, with a strong emphasis on making accelerator science more accessible to a wide audience. Educational materials aim to bridge the gap between complex scientific concepts and the general public, ensuring that diverse audiences can understand and appreciate the importance of accelerator technologies.

Comprehensive Report by the IAEA

To further enhance public engagement, WG14 has collaborated with the International Atomic Energy Agency (IAEA) on a thorough review of existing online content related to accelerator science. In 2023, a comprehensive report was conducted by Aliz Simon and Nkeiru Ubadike (IAEA), with the goal of evaluating the quality, scope, and accessibility of web-based resources in this field.

The findings of this review were shared during the Hybrid Meeting at the IPAC'23 Conference in Venice, Italy. Aliz Simon presented the progress of the project, which focused on identifying gaps in accelerator science content available online. The report evaluated key terms such as "Particle and Laser Plasma Acceleration," "Accelerator-Driven Systems (ADS)," and "Irradiation Facilities" across various websites.

While social media platforms were excluded due to time constraints, the report offered a sample of search results for "Accelerator Science," highlighting the strengths and weaknesses of current online resources. The goal was to ensure that WG14's website can fill any gaps in the public understanding of accelerator technologies, providing clear, reliable, and up-to-date information.

This report underscores WG14's commitment to improving public outreach by ensuring that accelerator science is presented in a comprehensible and engaging manner. The IAEA's review guided updates to WG14's website, making it a central resource for anyone interested in learning more about the role of particle accelerators in science and society.

Report on Particle Applications in Medicine

Bob Bingham and Michael Moyers are developing a report on accelerators in therapy, aligning with broader outreach efforts. This project is still on-going and a more comprehensible deliverables will be available via the web page and the cc licensed presentations.

The educational materials will be available on the website and included in intended to make these scientific and technological concepts more approachable, with free and open access to high-quality resources aimed at broadening public understanding and interest.

6. Strategic Synergies and Collaborations

WG14 activities highlight and promote its partnerships and collaborations with international organizations such as CERN, the African Light Source (AfLS), and SEASME. A special interest is dedicated to developing communities.

The website and the project of Creative Commons-Licensed Presentation Materials act as resource-sharing tools, ensuring that WG14's educational initiatives and collaborative efforts reach a global audience.

Alignment with IUPAP Goals

The WG14 aligns closely with IUPAP's broader mission to promote physics education, international collaboration, and the use of science for societal benefit. WG14's educational and outreach efforts, prominently featured on the website, support these objectives by:

- **Educational Outreach:** Highlighting efforts to make accelerator science more accessible to a diverse and global audience.
- **Sustainability and Development:** Showcasing the role of accelerator technologies in addressing global challenges in alignment with the UN Sustainable Development Goals (SDGs), particularly in healthcare, energy, and environmental sustainability.

Collaborations and Educational Events

In alignment with IUPAP's goals and strategy, and to foster effective collaboration, WG14 is actively bridging with WG1 (International Committee for Future Accelerators - ICFA). Notably, three WG1 members serve as permanent associate members of WG14, including:

1. The ICFA Chair
2. The Chair of the ICFA Panel on Sustainable Accelerators and Colliders
3. The Chair of the ICFA Beam Dynamics Panel

This partnership strengthens the exchange of expertise and insight between the two working groups.

It is important to note the distinction between the two teams: while ICFA primarily focuses on particle accelerators for high-energy physics (HEP), WG14 adopts a broader approach, encompassing all types of particle accelerators and their diverse applications, such as those related to the Sustainable Development Goals (SDGs) and healthcare. Our efforts emphasize the sharing and facilitation of knowledge and technology transfer from Research Infrastructures (RI) and Technology Infrastructures (TI) to both academic and industrial sectors, utilizing STEM and educational platforms to drive this exchange. See the presentation @ C11, by Gianluigi Arduini, "*IUPAP WG14 on Accelerator Science: Activities and Plans*" on 10/07/2022 for further details.

WG14 supports and collaborates with various global initiatives to promote accelerator science education, and the website plays a crucial role in publicizing these efforts:

- **Workshops and Conferences:** The website includes a calendar of upcoming events, with access to materials from previous workshops and conferences.

- **Cross-Organizational Initiatives:** WG14 works with partner organizations to promote knowledge exchange and expand access to accelerator science training and resources, especially in developing regions (e.g. ICTP, ASP, FIP).

For example, other organizations like APS, EPS, and others are currently featured, but much more needs to be added to our WG14 website.

Additionally, we need to better showcase the wide range of interests and the invaluable collaborations fostered by our WG14 members.

WG14 aims to strengthen its integration with each IUPAP Commission and Working Group, fostering deeper collaboration and alignment.

Collaboration with JACoW

WG14 has explored collaboration opportunities with the Joint Accelerator Conferences Website (JACoW), which facilitates the publication of papers from global accelerator science conferences. While financial constraints have prevented formal collaboration, WG14 continues to support JACoW informally by sharing expertise and resources. Discussions at the March 2022 stakeholders meeting, held during IPAC22, provided insights into how JACoW could evolve, but without dedicated financial support, WG14 cannot commission or seek direct services from JACoW.

7. Conclusion and Next Steps

In addition to the sponsoring of schools and conferences, WG14's website and the Project "Creative Commons-Licensed Presentation Materials" project serve as dynamic platforms for delivering educational content, facilitating global collaborations, and promoting the societal benefits of accelerator technologies. Several surveys and reviews conducted by IUPAP WG14 members ensure the accuracy and relevance of the content on these platforms, enhancing their value as educational and collaborative resources.

Key next steps include:

- **Expanding Educational Resources:** Developing more online courses and Creative Commons-licensed materials to support global outreach and education efforts.
- **Enhancing Collaborations:** Strengthening ties with international organizations and expanding the use of the website to share educational materials and promote joint efforts. A dedicated effort is currently underway in collaboration with IUPAP WG1 and other IUPAP units, aiming to strengthen synergies and enhance cooperative initiatives.
- **Public Engagement:** Further developing and delivering public engagement resources that make accelerator science more accessible and relatable to non-experts.

As WG14 continues its work, the website will play a pivotal role in ensuring that accelerator science remains a globally relevant and impactful field.

Appendix 1 - Memberships

Chair and Vice-Chair
Christine Darve
European Spallation Source, Sweden
Gianluigi Arduini
European Organization for Nuclear Research, Switzerland

Members
Maher Attal
Synchrotron-light for Experimental Science and Applications in the Middle East, Jordan
Robert Bingham
Science and Technology Facilities Council Rutherford Appleton Laboratory, UK
Ceri Brenner
Australian Nuclear Science and Technology Organization, Australia
Swapan Chattopadhyay
Fermi National Accelerator Laboratory/Stanford Linear Accelerator Center, USA
Simon Connell
University of Johannesburg, South Africa
Sarah Cousineau → to be replaced
Spallation Neutron Source - Oak Ridge National Laboratory, USA
Oliver Kester
TRIUMF, Canada
In Soo Ko
Korea Basic Science Institute, Korea
Tadashi Koseki
KEK, Japan
Lin Liu
Brazilian Synchrotron Light Laboratory, Brazil
Nikolai Lobanov→ to be replaced
Australian National University, Australia
Michael Moyers
Shanghai Proton and Heavy Ion Center, China
Sekazi Mtingwa
African Light Source and TriSEED Consultants, USA
Anke-Susanne Müller
Institute for Beam Physics and Technology - Karlsruhe Institute of Technology, Germany
Simon Mark Mullins
Botswana International University of Science & Technology, Botswana
Vaishali Naik
Variable Energy Cyclotron Centre, India
Qing Qin
European Synchrotron Radiation Facility, France
Christoph Quitmann
Research Instruments, Germany
Danas Ridikas
International Atomic Energy Agency, Austria
Leonid Rivkin
Paul Scherrer Institute / Ecole Polytechnique Federale Lausanne, Switzerland
Mike Seidel

Paul Scherrer Institute / Ecole Polytechnique Federale Lausanne, Switzerland
Suzanne Lyn Sheehy
University of Melbourne, Australia / University of Oxford
Liangting Sun
Institute of Modern Physics – Chinese Academy of Sciences, China
Bridinette Thiodjio Sendja
University of Yaoundé, Cameroon

Associate Members – might need to be updated ?

- Chris Barty - University of California at Irvine, USA - International Committee on Ultra-High Intensity Lasers
- Yunhai Cai - Stanford Linear Accelerator Center, USA - ICFA Beam Dynamics Panel, Chair
- Pierluigi Campana, Italy - ICFA Chair
- ? Sylvie Jacquemot - Laboratoire Utilisation Lasers Intenses – Ecole Polytechnique / Laserlab-Europe, France - IUPAP Commission 16 on Plasma Physics, Chair
- Ming-Chuyan Lin - NSRRC, TW- International Particle Accelerator Conference Coordination Committee, Chair
- Thomas Roser - Brookhaven National Laboratory, USA - ICFA Panel on Sustainable Accelerators and Colliders, Chair