PROCEEDINGS OF SCIENCE

Physics on the Infinity Canvas: A New Tool for Popularization and Pedagogy

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We present *Physics on the Infinity Canvas*, a collaboratively designed workshop for science outreach and education. It invites participants to reconstruct a two-dimensional canvas that maps key discoveries in physics across both historical time (horizontal axis) and physical scales (vertical axis), from the subatomic to the cosmological scales. Using illustrated thematic card sets (Science, Open Questions, Scientists, Technologies, Scientific Instruments, Jobs in Physics, and Science Fiction), participants collectively explore connections between theories, experiments, instruments, and societal impacts.

The workshop is facilitated rather than lectured, encouraging active learning, negotiation, and inclusive participation, notably by highlighting the contributions of women in physics. Two complementary formats have been developed so far: a three-hour collaborative session and a lighter "quiz" version designed for festivals and public events.

The project is open-source, implemented in LaTeX with TikZ and Python tools, and freely distributed under a Creative Commons license. We describe the pedagogical design principles, workshop formats, early feedback from schools and public events, the production pipeline, the translation process, and opportunities for international collaboration.

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1. Introduction

Science outreach and education play a vital role in fostering public engagement and inspiring the next generation of scientists. Bringing contemporary physics to diverse audiences requires formats that are intellectually rigorous, visually engaging, and adaptable to different audiences with varying levels of prior knowledge and time constraints. *Physics on the Infinity Canvas* (originally *La Fresque des deux infinis* in French) was created in 2024 by a collective of researchers, engineers, and communicators from the Centre de Physique des Particules de Marseille (CPPM) and the Centre de Physique Théorique (CPT) [1]. It offers an original and innovative approach to this challenge, with a dual objective: (i) to provide a compelling outreach experience for the general public, and (ii) to supply teachers with a reusable educational resource that complements secondary and university curricula.

The central idea is to help participants situate major discoveries within a broad conceptual landscape that spans scales from subatomic physics to cosmology, while preserving historical depth. Instead of relying on passive reception, the workshop leverages collaborative reconstruction to foster engagement, dialogue, and curiosity. This methodology is partly inspired by the success of collective workshops such as *The Climate Fresk* (originally *La Fresque du Climat* in French[1]), which have demonstrated the effectiveness of this participatory approach. Moreover, both the general public and younger generations have also become increasingly familiar with these formats, making them more receptive to such initiatives.

This paper presents the structure, content, and underlying philosophy of the workshop, along with its open-source distribution model and prospects for future development.

2. Project overview

The workshop is built around a collection of printed cards, each combining a concise explanatory text with an illustration. When relevant, the cards also include metadata such as the date of the discovery and the characteristic physical scale. The texts are designed to provide clear cues that naturally suggest logical, technical, or historical connections between cards.

The **Science** set (70 cards in the full version) presents major theoretical and experimental breakthroughs across centuries, grouped into thematic packs. This is the core set of cards and forms the foundation of the workshop.

The other sets are optional and can be introduced by the facilitator depending on the audience and the objectives of the session. The **Open Questions** set focuses on unresolved problems in modern physics, such as dark matter, quantum gravity, and vacuum energy, and can be used to initiate discussions on current research directions. The **Scientists** set highlights the human side of physics through short biographies, with particular attention paid to the contributions of women. It provides an opportunity to inspire young women and promote diversity in science. The **Technologies** set illustrates practical applications stemming from the discoveries presented in the **Science** set, such as GPS, medical imaging, and electric motors. These cards emphasize how academic research has a direct impact on society and daily life. The **Scientific Instruments** set focuses on the tools developed to make these discoveries possible, from historical devices to

[1] One of us, T.M., is a certified facilitator for this workshop.

modern large-scale instruments such as particle detectors. It is particularly appealing for audiences interested in the history of science and in the development of cutting-edge research facilities. The **Jobs in Physics** set introduces a variety of professional roles within the physics ecosystem. It is especially relevant for younger participants, helping them envision how they might contribute to scientific research in a way that matches their skills and aspirations. Finally, the **Science Fiction** set presents speculative "technologies" inspired by science fiction, inviting participants to explore the boundaries between what is physically possible and what remains purely speculative.

The construction of the canvas relies on two geometric dimensions: *time*, displayed along the horizontal axis, from antiquity to the present, and the *characteristic physical scale* of phenomena, displayed along the vertical axis, from the infinitesimally small to the infinitesimally large. As participants organize the cards, they progressively reveal connections between discoveries, such as explanations, confirmations, refutations, and unifications. These relationships can be made explicit by drawing visual links directly on the canvas.

3. Workshop formats and facilitation

The activity is designed to be led by a facilitator who is familiar with the topics but not necessarily an expert in each subfield. Two complementary formats have been developed so far, each adapted to different contexts and audiences.

3.1 The *Full Workshop* format

In this format, a typical session involves 5 to 10 participants and lasts approximately three hours, divided into two main phases: the **Mapping Phase** and the **Debriefing Phase**, each lasting about 90 minutes.

During the **Mapping Phase**, the facilitator gradually introduces thematic packs from the **Science** set. Participants read, discuss, and place the cards on a large canvas (for example, a magnetized blackboard), arranging them by time along the horizontal axis and by physical scale along the vertical axis. The process relies on collective intelligence: participants negotiate meanings, identify patterns, and propose links between discoveries. They decide together how to represent these links visually and how to organize groups of related cards. Through this process, they collectively build their own visual and physical representation of the history and concepts of physics.

In the **Debriefing Phase**, the collaboratively constructed canvas becomes the foundation for further discussion. Depending on the audience and available time, the facilitator chooses which themes to explore and which optional card sets to integrate, such as **Scientists**, **Scientific Instruments**, **Technologies**, **Jobs in Physics**, or **Science Fiction**. The facilitator also selects the most appropriate format for these discussions, which may range from open exchanges to guided thematic explorations. The primary objective of this phase is to spark curiosity, deepen understanding, and inspire participants, especially high school and university students, to consider pursuing scientific studies or careers.

This format supports multiple learning objectives: building a shared conceptual framework, recognizing the iterative nature of scientific progress, and practicing both argumentation and collab-

oration. Throughout the session, the facilitator's role is to guide and encourage exploration rather than to deliver a traditional lecture.

This workshop format reliably produces rich canvases that participants can navigate along historical, conceptual, and human dimensions. The bidimensional layout and explicit linking help learners see connections among theories, experiments, technologies, and instruments, and encourage questions that bridge scales. However, this full format requires sufficient space, dedicated time, and a trained facilitator. Work is ongoing to adapt the material and pacing for younger audiences.

3.2 The *Quiz Workshop* format for public venues

For drop-in audiences, such as at science festivals or conference exhibitions, a lighter, more flexible format was developed. A portable display with a curated selection of cards allows for short and interactive exchanges. The facilitator engages visitors through questions and mini-challenges, often based on optional thematic cards, to help them uncover relationships between discoveries and navigate specific areas of the canvas. This simplified format lowers the barrier to participation while preserving the core principle of active engagement and collaborative meaning-making.

4. Pedagogical design principles

The workshop builds on principles of collective intelligence and active learning. During the mapping phase, participants are invited to externalize their often unstructured prior knowledge and to engage in evidence-based negotiation. By requiring explicit placement of cards and the creation of links between them, the activity naturally elicits explanations and justifications, aligning closely with research on collaborative learning and concept mapping.

The bidimensional framing along *time* and *scale* ensures that both historical sequencing and the physical scales of phenomena remain continuously visible. This perspective encourages participants to make cross-scale comparisons, for example by following the electromagnetic spectrum across many orders of magnitude, and to recontextualize theories, technologies, and instruments within a broader conceptual landscape.

Inclusivity is another central feature of the tool. The **Scientists** cards were carefully designed to highlight women's contributions to physics, and facilitators are trained to address equity and representation. This visibility plays an important role in motivating students, particularly young women, to consider careers in science.

The workshop is suitable for high school and university courses, where it complements traditional lectures, as well as for broader public outreach. It also gives facilitators the flexibility to tailor its structure and approach to different durations, audiences, and curricular goals.

5. Early deployments and audiences

The initial writing style of the **Science** cards was aimed at high-school students and above. Early feedback from public events using the quiz format has been very positive, showing strong engagement with the visual and hands-on approach. In educational contexts, teachers at both secondary and university levels have expressed significant interest in integrating the activity into

their curricula. Discussions are ongoing with pedagogical specialists and academic program directors to define appropriate formats and levels of complexity.

One recurring request from educators has been the development of a dedicated **Jobs in Physics** set. These cards are designed to connect scientific concepts with career pathways, helping students better understand the diversity of roles in the physics ecosystem and inspiring them to explore future opportunities.

6. Production pipeline and open-source distribution

From the start, the project has emphasized reproducibility, openness, and ease of contribution. The cards are authored in **LaTeX**, leveraging **TikZ** (with externalization) for vector-based illustrations. The remaining artwork is being progressively migrated to TikZ for consistency.

Automated **Python** scripts streamline the production process, allowing the generation of print-ready PDF files. Users can download pre-formatted packs or compile everything locally. Public information and downloadable materials are available at [1].

The project adopts an open licensing approach under the Creative Commons license (CC BY-NC-ND), which promotes accessibility while ensuring long-term sustainability. To avoid vendor lock-in, the tool relies exclusively on open-source technologies, including fonts such as *Libertinus*. Contributions are coordinated through a shared Git repository [2], enabling collaborative development of content and tooling.

A Python-assisted workflow has been implemented to bootstrap translations using a Large Language Model. The English translation is now complete, the German version is in progress, and additional languages are planned to broaden accessibility.

7. Collaboration model and roles

The project is conceived as a collectively built tool, open to contributions from the broader community. We actively invite participation in several roles. **Ambassadors** can promote the workshop within universities, schools, and outreach events. We aim to train new **facilitators** to lead sessions in diverse contexts. **Developers** familiar with LaTeX, TikZ, or Python are welcome to contribute improvements to the technical infrastructure and production pipeline. Since content development is ongoing, we encourage **content creators** to refine existing cards and propose new ones, including topics on intermediate-scale physics[2]. Finally, to support international adoption, we are seeking **translators** to adapt the tool to additional languages and cultural contexts.

To ensure quality and consistency, a **Scientific Council** is being established, initially composed of the current project team members. Its role is to oversee both the scientific accuracy and the societal dimensions of the content, while broadening the pool of contributors. The council aims to represent the diverse uses of the tool and will therefore include researchers, research support staff, and secondary school teachers. We also welcome international participation to facilitate the tool's global diffusion.

[2]We are also open to contributing to the adaptation of the tool to other scientific disciplines

8. Conclusions

Physics on the Infinity Canvas offers a portable, open, and inclusive framework for engaging with the history and concepts of modern physics across scales. With a focus on collaborative rebuilding, it supports both awareness and education. Materials, translations, and contribution guidelines are made available to promote international adoption and co-development.

The next steps include (i) formalizing facilitator training and evaluation rubrics; (ii) expanding card coverage at intermediate scales and current topics; (iii) developing complementary digital resources (website, wiki-style articles, short videos); and (iv) exploring adaptation to other disciplines where a time/scale canvas can provide similar benefits.

Acknowledgements

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References

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