

SAPHIR NEWSLETTER

MILLENNIUM INSTITUTE  
FOR SUBATOMIC PHYSICS  
AT HIGH-ENERGY FRONTIER  
SAPHIR

SUBSCRIBE

SAPHIR MILLENNIUM INSTITUTE

RECENT NEWS

RESEARCH

RECOMMENDED ARTICLE

“Transient Monte Carlo simulations with OpenMC(TD): A catalyst towards advancing research in next-generation reactors and to improve fission nuclear data”

Romero-Barrientos, J.; Molina, F.; Zambra, M.; López-Uquailano, F. “Nuclear Engineering and Design”, vol. 423, 2024, 113189. DOI: [10.1016/j.nucengdes.2024.113189](https://doi.org/10.1016/j.nucengdes.2024.113189)

Researchers at the Millennium Institute SAPHIR and the Research Center for Nuclear Physics and Neutron Spectroscopy of the Chilean Nuclear Energy Commission (CCHEN) have developed OpenMC(TD), an extended version of the OpenMC nuclear simulation code that explicitly incorporates the time dimension and enables individual treatment of delayed beta-neutron precursors. This development marks a significant milestone in the field of Monte Carlo modeling applied to advanced reactors and stands as one of the few international initiatives tackling this complexity in an open-source framework.

This publication consolidates a research line that began in 2015 with the doctoral dissertation of Jaime Romero, a researcher at CCHEN and SAPHIR, conducted at CCHEN under the supervision of Prof. Hugo Avelino from the Faculty of Physical and Mathematical Sciences at the University of Chile and the guidance of Dr. Francisco Molina.

Scientific Context and Relevance

Monte Carlo simulations are critical tools for high-fidelity modeling of neutron transport phenomena in complex geometries. However, most conventional codes lack temporal dependence, which severely limits their ability to analyze transients or assess key kinetic parameters.

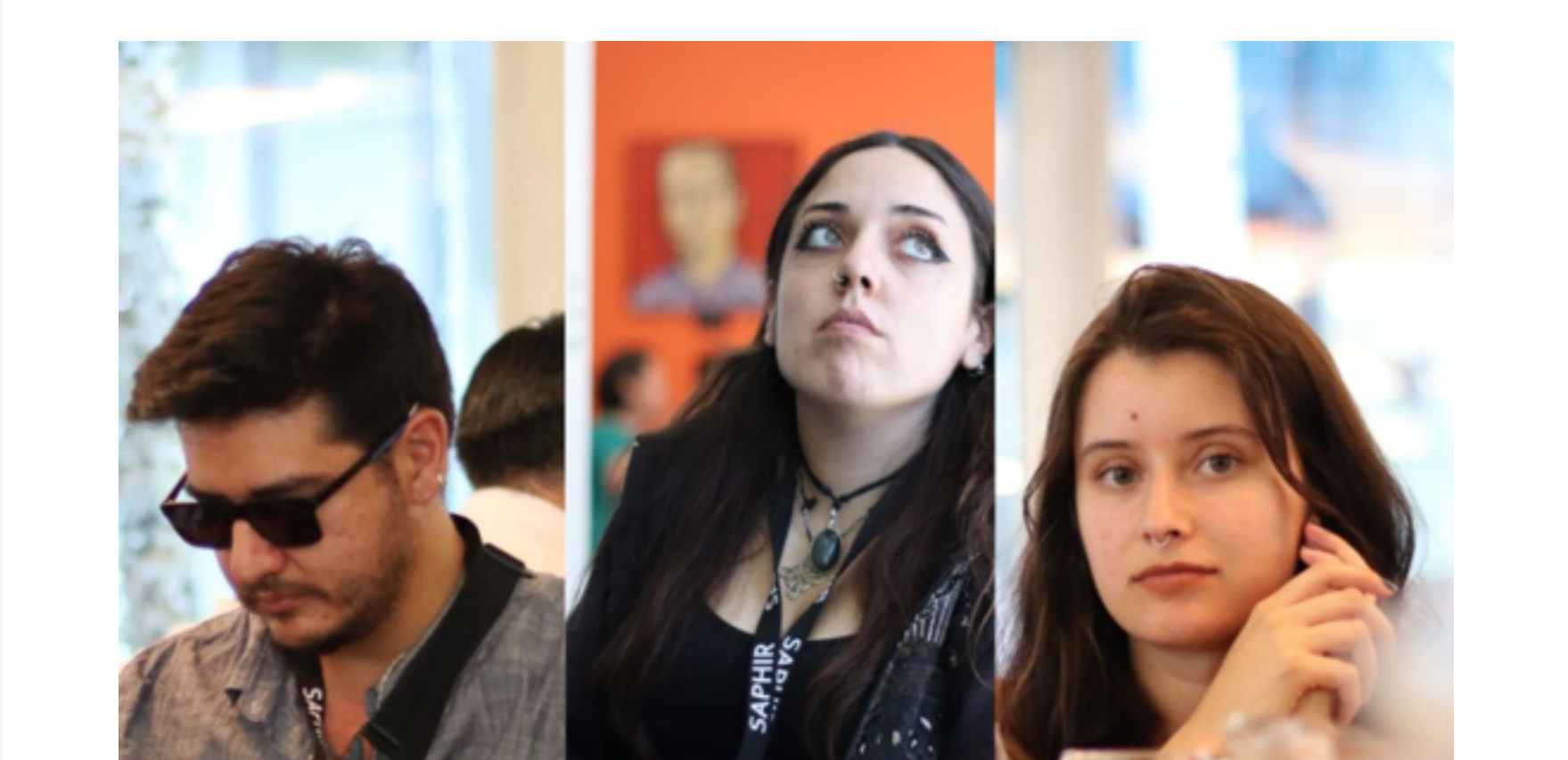
In a nuclear reactor, prompt neutrons are emitted immediately following fission, while delayed neutrons may appear several minutes later. This temporal distinction is fundamental to reactor stability and control. Accurate modeling requires constructing time meshes and managing processes that occur over vastly different timescales—an ability that OpenMC(TD) achieves robustly and for the first time with full open-source access.

Moreover, the capability to treat each delayed beta-neutron precursor individually, instead of grouping them into a reduced number of effective families, allows for the direct integration of new nuclear data and evaluation of their impact on each precursor species. This approach also enables the study of reactors fueled by novel or uncharacterized materials without relying on pre-adjusted kinetic parameters. By modeling the decay of each precursor according to its isotopic contribution, the system's kinetic response can be constructed more flexibly and extensively, broadening the applicability of the code in exploratory and design contexts.

READ MORE

YOUNG TRAINING

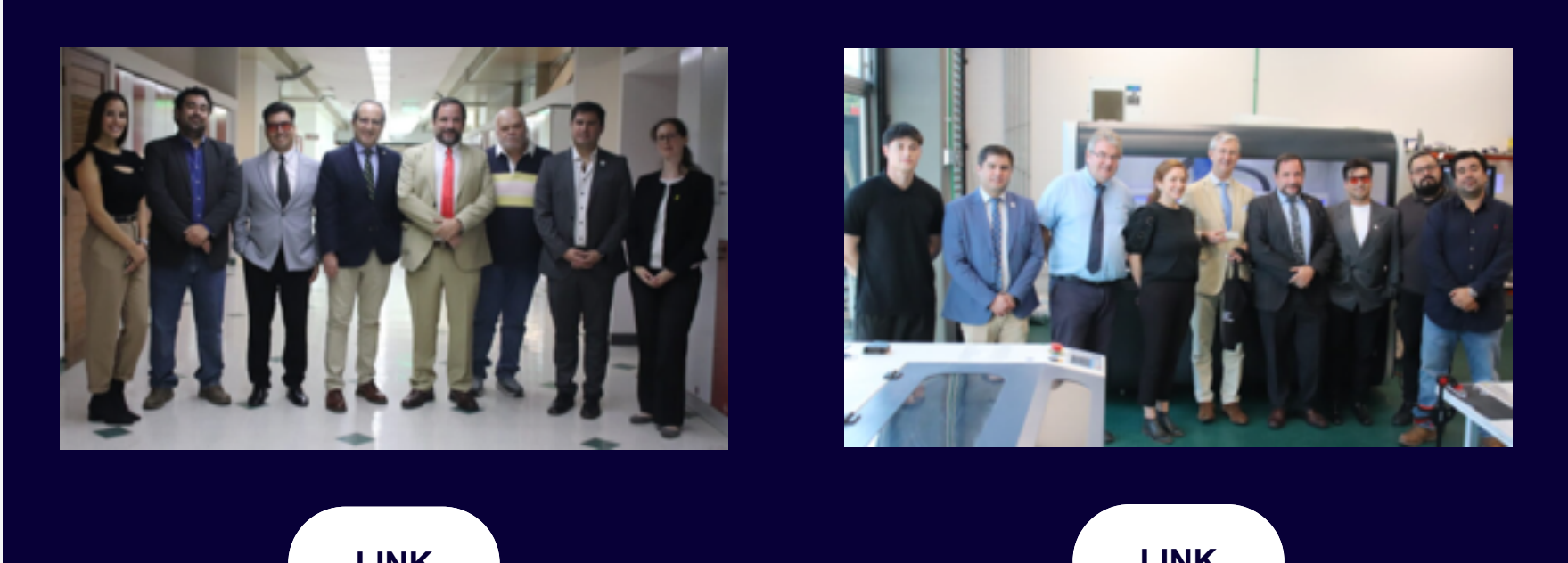
The continuous education of students and professionals in the scientific domain is a fundamental pillar for the sustained advancement of academic and research capacities. The formulation and execution of research projects are frequently intertwined with postgraduate training pathways, which provide the methodological, theoretical, and technical foundations necessary for scientific development beyond the undergraduate level.



READ MORE

NETWORKING

Strengthening international networks through scientific collaboration, technology transfer, and knowledge exchange is a core objective of the team behind the Millennium Institute SAPHIR. Researchers, students, and a significant portion of the management team are actively engaged in building strategic partnerships that not only integrate diverse disciplines and technical domains—many of which are associated with the development of advanced instrumentation for particle physics—but also promote interdisciplinary approaches aimed at ensuring the long-term sustainability of the institute's scientific and technological advancements.



LINK

LINK

SCIENTIFIC NEWS

The Millennium Institute SAPHIR is proud to announce the recent resolution by CERN, in which the Council approved Chile's admission as an Associate Member State, pending the completion of the accession and ratification processes in each country (Source: [home.cern](https://home.cern)).



READ MORE

Chile's incorporation into CERN, the European Organization for Nuclear Research, marks a milestone in the consolidation of a longstanding and fruitful relationship. For decades, Chile has been a key player in the field of particle physics, working closely with CERN on research into the subatomic particles that make up matter. Chilean expertise has been instrumental in the development and implementation of cutting-edge technologies, such as particle detectors, which are essential to experiments at the Large Hadron Collider (LHC), the world's most powerful particle accelerator.

“SAPHIR’s Participation in the 12th Meeting of the International Collaboration of the SWGO Project”

The Southern Wide-field Gamma-ray Observatory (SWGO) is an international project aiming to build a wide-field gamma-ray observatory in the Southern Hemisphere. Its goal is to detect and study very high-energy astrophysical sources—such as supernovae, pulsars, and active galactic nuclei—by observing particle showers generated when gamma rays interact with Earth's atmosphere. By complementing existing observatories in the Northern Hemisphere, SWGO will enable broader sky coverage, significantly enhancing our understanding of the most extreme processes in the universe.



READ MORE

“Breakthrough Prize Awards 2025,” known as the “Oscars of Science,” highlight work in Particle Physics related to the LHC and the ATLAS experiment”

The 2025 Breakthrough Prize in Fundamental Physics has been awarded to the experiments at the Large Hadron Collider (LHC), recognizing their transformative impact on our understanding of the universe. This prestigious international award celebrates cutting-edge scientific achievements and, in this edition, highlights the crucial role of experiments such as ATLAS, which have led to groundbreaking discoveries in particle physics. The award not only honors the collective efforts of thousands of scientists and engineers from around the world but also affirms CERN's collaborative and visionary approach to exploring the fundamental building blocks of matter.



READ MORE

SAPHIR was recognized during the 61st anniversary ceremony of the Chilean Nuclear Energy Commission for its strategic role in the work carried out at CERN.

The collaboration between the Millennium Institute SAPHIR, dedicated to subatomic physics at the high-energy frontier, and the Chilean Nuclear Energy Commission (CCHEN) represents a strategic and fundamental step toward strengthening cutting-edge scientific research in Chile. This partnership serves as a model of inter-institutional cooperation that enhances national capabilities in highly specialized fields, fostering advances in particle physics, the training of highly qualified professionals, and technological development with international reach.



READ MORE

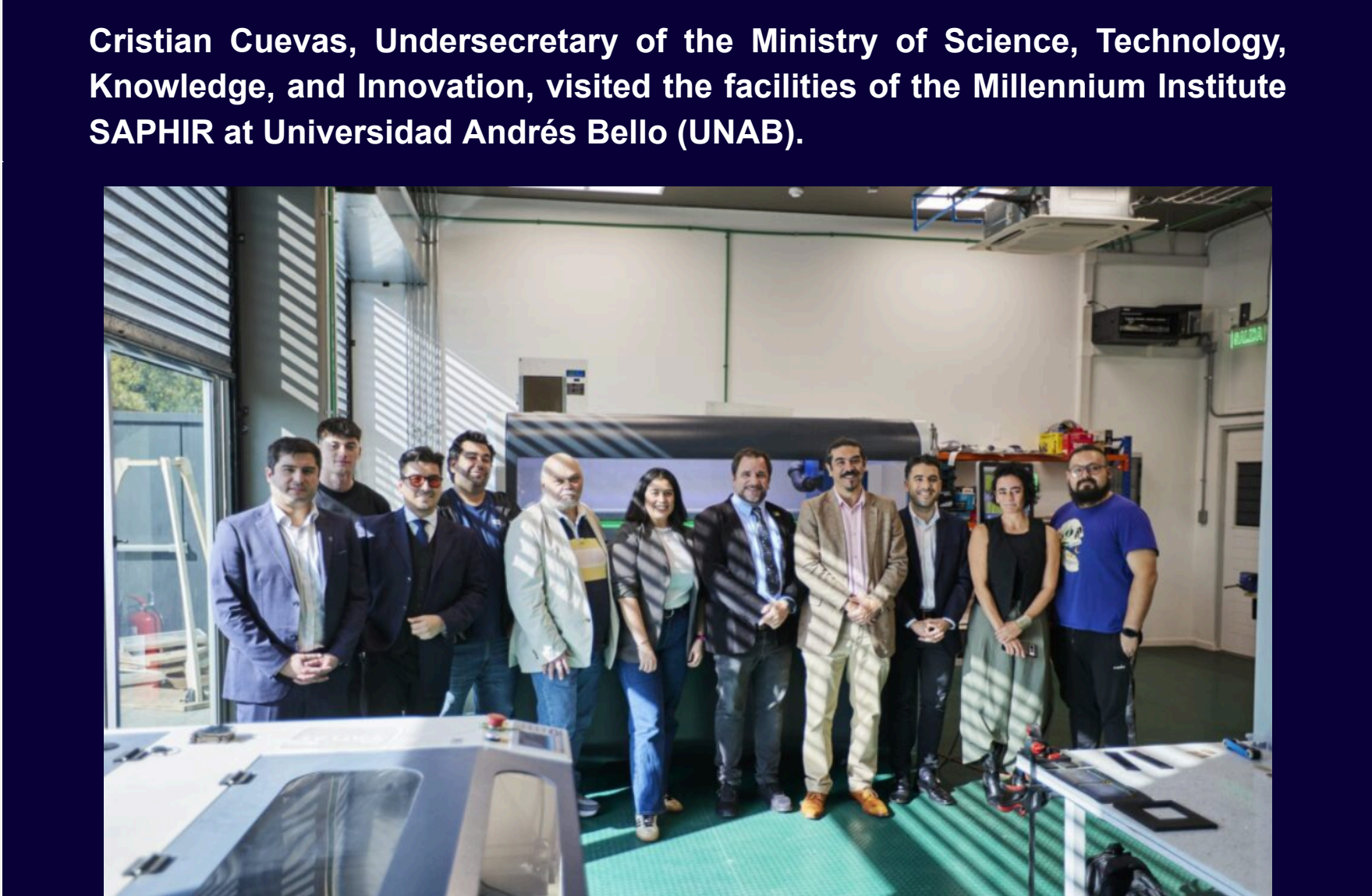
INSTITUTIONAL

Alejandra Pizarro, National Director of ANID, together with Nicole Ehrenfeld, Deputy Director of Centers and Associative Research, and an official delegation, visited the facilities of the Millennium Institute SAPHIR at Universidad Andrés Bello (UNAB).



READ MORE

Cristian Cuevas, Undersecretary of the Ministry of Science, Technology, Knowledge, and Innovation, visited the facilities of the Millennium Institute SAPHIR at Universidad Andrés Bello (UNAB).



READ MORE

OUTREACH

Millennium Institute SAPHIR Participates in the 2025 Edition of Puerto de Ideas Antofagasta.

The collaboration between the Millennium Institute SAPHIR and the Puerto de Ideas Antofagasta Foundation represents a significant effort to bring science closer to the public, fostering dialogue between researchers and the general audience. This partnership is especially meaningful as it took place within the framework of the science outreach festival held in the city of Antofagasta from April 24 to 27, an event that brought together various scientific centers and institutions from across the country. Through talks, workshops, and interactive activities, the bond between the scientific community and society was strengthened, highlighting the fundamental role of knowledge in the cultural and social development of northern Chile.



READ MORE

“The Life of an Accelerated Proton”, given by Marco Ayala at Liceo Tájamar in Providencia. The session was attended by students from 9th to 12th grade, and the activity was led by physics teacher Liliana Pinilla.

At the world's largest particle accelerator, protons traveling at nearly the speed of light are made to collide under the cleanest possible conditions. To study what happens during these collisions, we rely on cutting-edge technology that allows us to identify the different “characters” in the unfolding story of these protons. The aim of the presentation is to explore the technological details that make such studies possible.

Additionally, it is worth mentioning that the Millennium Institute SAPHIR is a research center focused on subatomic physics that collaborates with CERN. Thanks to the efforts of the institute's Communications and Outreach Coordinator, Mr. Patricio Grunert, and its Executive Director, Mr. Felipe Olivares, the talk was made possible and delivered by postdoctoral researcher Marco Ayala.



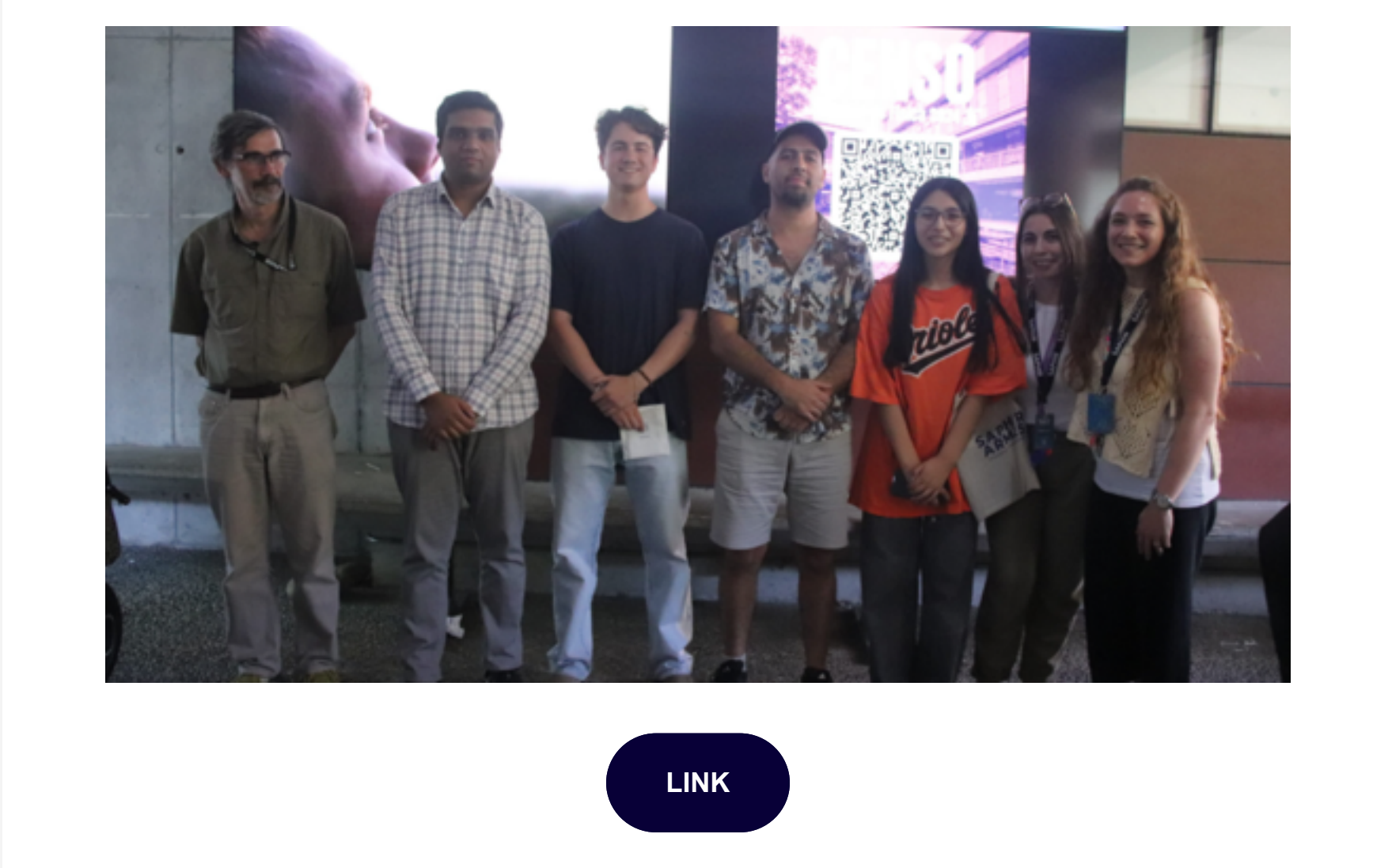
READ MORE

SAPHIR ARM25 in pictures



MORE PHOTOS ON THE NEXT LINK

You can also find some SAPHIR ARM25's poster on the next link



LINK