European Strategy for Particle Physics Update 2026 (ESPPU) – LIP ECO

Contribution to the Portuguese document for the ESPPU 2026
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Introduction

The update of the European Strategy for Particle Physics is a good opportunity to review the related efforts in Education, Communication and Outreach, as well as the initiatives in promoting Advanced Training activities in our field. In particular, the entire process, with the participation of the community, should be communicated both to justify the final decisions and as an example of collaborative efforts in fundamental science, with a primary focus on communication over the next two years. In the specific case of Portugal, following the 40th anniversary of its accession to CERN, the strategy update will also help to focus on the future, showcasing a vibrant scientific community in Portugal, with CERN as a base and with connections worldwide.
Portugal has a very strong program on Education, Communication and Outreach, primarily aimed at high-school students and teachers, such as the IPPOG's International Masterclasses in Particle Physics, reaching more than 15000 participants worldwide (1600 of whom are from Portugal under a LIP's coordination). Portugal also has an impressive track record in advanced training of undergraduate students in research institutions and post-graduate engineers in international facilities. Additionally, Portugal has significant experience in education and outreach activities with Portuguese-speaking countries, particularly through the CERN Portuguese Language Teachers Programme, coordinated by LIP and recognized as one of the most important CERN Teachers Programmes. This program annually receives 48 teachers from Portugal, Brazil, and other Portuguese-speaking countries in Africa and East Timor. It is a unique and very important tool for reaching diverse communities with Modern Physics and Technologies, specially in our field, and provides opportunities to connect with many different school communities. Efforts to develop advanced training activities related to our field in these countries could be encouraged, particularly within the framework of the UFPLP (Union of Physicists of Portuguese Speaking Countries).

Recommendations on Education, Communication, Outreach

Taking into account that current and future projects in Particle Physics span several decades and require very large investments in people, instrumentation, technology developments, education, communication and outreach, and international collaborations, the following recommendations related to Education, Communication, and Outreach are proposed as part of LIP's contribution to all the relevant documents to be submitted to the ESPPU 2026 process.

1. **Training of students** in Particle Physics should include a broad view of the field, incorporating connections to Nuclear Physics and Astrophysics, fostering an open mind in both experimental physics and instrumentation, as well as theoretical physics and phenomenology, at all levels starting from University (undergraduate internships,

participation in M.Sc. and Ph.D. programmes) to the training of researchers through specific programmes. A component on efficient communication, public engagement and outreach should be integrated in the standard training of our future generations of scientists and in training programmes of researchers.

2. **High-school teachers and students' engagement** should increase, through activities that train teachers, creating significant multiplier effects, and activities for students either at the University or Schools. Support for science clubs in schools should also be provided. Programmes for teachers, such as CERN Teachers Programmes, should be supported and further developed. An example is the CERN Portuguese Language Teachers Programme, which brings together a very diverse group of teachers from different realities. Activities for students, such as the IPPOG's International Masterclasses in Particle Physics, using real data from various experiments, should be organized at an increasing number of Universities/Institutes, to convey the excitement of the discovery with real data to students from all places. This would allow the growth of the geographical and socio-economical reach, motivating more high-schools students to pursue a scientific career in Physics.

3. **Public Engagement and Outreach** in Particle Physics, and associated methods and technologies, should be an integral part of the activities of every researcher in the field, with an appropriate level of commitment. This level depends on many factors, but a minimum level of 1% of a researcher's time (roughly 2 working days per year) should be recommended, with higher levels encouraged. Institutions should ensure that public engagement and outreach actions are carried out and/or supported financially. The scientists and engineers connected with the field should be actively involved in these activities.

4. **Communication** about the Particle Physics successes, in all its missions – discoveries and searches in research, technology and methodological developments and applications, education of the future generation, public engagement, and peaceful collaborations – should be a key priority of the field. This is essential to gain public and societal support for present and future projects. As a fundamental science field, it is mandatory to communicate the scientific method and the importance of experimental data to produce new knowledge. In today's context, environmental sustainability and the energy consumption of current and future projects are also crucial aspects that need to be communicated properly.

   Effective communication strategies in particle physics should prioritize inclusivity and accessibility, ensuring that complex scientific concepts are presented in ways that resonate with diverse audiences, including non-specialists, underrepresented groups, and individuals from varied educational and cultural backgrounds. This requires leveraging a mix of traditional and modern communication tools, including interactive digital platforms, storytelling techniques, and visualization technologies, to make the science engaging and comprehensible.

   Preparing these communications requires collaboration between experts in the field and

communication professionals to craft efficient messages tailored to the audience, medium, and goals. Many researchers remain unaware of the importance of social media, which presents unique challenges in communication methods and requires dedicated investments and resources.
Additionally, it is also essential to provide training opportunities for scientists to enhance their communication skills, enabling them to connect effectively with varied audiences.

5. **Recognition** of the efforts in public engagement and outreach, as well as in communication activities should become a mandatory criterion in the assessment of researchers and faculty. These contributions should be considered on par with achievements in technology developments, software tools and methodologies, published papers and advanced training, etc.

6. **Scientific Diplomacy** should be actively encouraged among researchers, enabling them to act as ambassadors of the field. This can multiply the impact of their work, fostering understanding and support among peers (specially those outside the field), their family and friends, and general audiences at public events.