

Particle Physics in Portugal

Portugal joined CERN in 1986, the same year the Laboratório de Instrumentação e Física Experimental de Partículas (LIP) was created to coordinate experimental particle physics and associated technologies, activities that now involve around 170 university researchers as well as LIP scientific and technical staff. In theoretical particle physics, two large groups are active in Lisbon at CFTC-FCUL and CFTP-IST, with activity at other universities and research centres in the country.

LIP's strong involvement in CERN programmes focuses on the LHC, with ATLAS, CMS and the Grid, and the COMPASS Collaboration. The Portuguese Centre for Sciences and Nuclear Technologies of Instituto Superior Técnico (C2TN-IST) coordinates Portuguese work at CERN's ISOLDE facility. LIP also participates in other particle and astroparticle physics projects: the Pierre Auger Observatory in Argentina, the Sudbury Neutrino Observatory in Canada, the LUX experiment in the USA and the GSI facility in Germany. LIP is also involved in several medical projects involving technologies developed at LIP, CERN and elsewhere.

LIP has a long history of R&D with gaseous and liquid xenon detectors, and today plays a leading role in the development of Resistive Plate Chambers (RPCs), detectors that have a very good time resolution over large areas at moderate price. RPCs are gaining widespread use. Research is ongoing in the development and characterization of new gas detectors with many potential applications, for example in low energy neutron imaging (FP7 project NMI3), the NeuLAND high energy neutron detector for FAIR at GSI and the CERN based RD51 collaboration. CERN is an important training ground for young Portuguese engineers, and LIP coordinates a programme under which some 200 engineers spend two-year training periods at CERN in key areas of advanced technologies. This programme is now funded by the Foundation for Sciences and Technology. LIP also coordinates a large international doctorate programme involving large European research facilities and 20 universities, of which eight are Portuguese.

In IT, LIP is member of some of the world's biggest projects, such as the LHC Computing Grid and the European Grid Initiative. LIP runs the central computing node of Portugal's National Grid Initiative, the biggest scientific computing facility in Portugal, offering computing resources to a wide range of research communities.

In 2007, with support from Agency Ciência Viva, LIP launched the CERN Portuguese Language Teachers Programme, a week-long programme for high-school teachers at CERN. In 2009, this programme became international with the participation of teachers from all Portuguese-speaking countries. This is part of LIP's commitment to outreach and training, from small programmes at LIP for a few students (Agency Ciência Viva's occupational programmes), to annual Masterclasses involving around 2000 students in 14 institutions all over the country.

Society and Skills

- Portuguese universities and institutes run Particle Physics Masterclasses for more than 2000 high school students every year. The students work with real data from the CERN ATLAS and CMS experiments in one-day sessions that take place in 14 different sites in Portugal.
- Until 2012 (inclusive), a total of 367 high school teachers (253 Portuguese, 82 Brazilian, 17 Mozambican, 4 Angolan, 4 East-Timorese, 3 Capeverdian, 3 Santomense, and 1 from Guiné-Bissau), have taken part in the CERN Portuguese Language Teacher Programmes to find out about the latest developments in particle physics. Their enthusiasm is inspiring students in their home countries about CERN and particle physics, and about being part of the great scientific endeavour that is taking place at CERN.

Industry and Economy

From the time Portugal joined CERN up to 2006, Portuguese companies exported to CERN goods and services in excess of 53 million euro. A substantial part of these sales is in turn associated with the transfer of CERN technology to Portuguese companies and, in some cases, joint development to respond to specific challenges. The graph shows the industrial benefits of Portugal at CERN as a function of time.

But more important than measuring the industrial benefit of Portugal at CERN is that it represents the technological development of the suppliers, their international competitiveness, and the experience gained at CERN, where the required standards are always higher than the highest market standards.

Health and medicine

- LIP has developed two detectors for PET-Mammography that are now being tested in clinic trials in Marseille (to be moved to Milan) and in Coimbra.
- Using high energy physics expertise in simulating the interaction of radiation with matter, allows for the development of better models in the application of accelerators to radiotherapies, helping out in the planning stage of the treatment, with more correct calculations of the doses perceived by the patients.

LIP is in Portugal the Laboratory for Experimental High Energy, Particle and Astroparticle Physics, and related instrumentation and technologies