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Cosmic-ray detectors for high-schools in France

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Teaching particle physics at high-school level is always challenging, one issue being that there is no easy window onto the world of the “infinitely small”. Cosmic rays are therefore an invaluable tool to allow the students to sense the elementary particles and to understand the problems raised by their detection.

In France, a collaboration started several years ago between the “Institut National de Physique Nucléaire et de Physique des Particules” (IN2P3) of the CNRS and “Sciences à l’Ecole”, a project from the French Education Ministry which is promoting science in high schools and higher education. Large cosmic ray detectors called “Cosmodétecteurs” are built in the Marseille IN2P3 laboratory (CPPM) and loaned to high school teachers selected by Sciences à l’Ecole. These teachers are trained prior to receiving the detector – a one week-long seminar at CERN, part of the High School Teacher program, plus a technical course in Marseille to learn how to use the apparatus. These teachers then exchange information through a dedicated internet forum and present the educational activities they develop with their Cosmodétecteur. There are currently 17 such detectors in France and 15 more will be released in 2014.

These cosmic-ray detectors consist in three mobile plastic scintillators, each coupled to a photomultiplier. The scintillators can be arranged in different geometries in order to perform several complementary experiments (flux and angular distribution of the cosmic rays, Auger-like and Rossi shower experiment, etc.). In addition, one larger block of scintillator allows the measurement of the muon lifetime. These devices are operated over long periods in order to fully exploit their potential. Therefore, they usually remain several months in the same location, under the responsibility of reference teachers educating their colleagues about using them. The Cosmodétecteur is routinely used by these teachers as a part of their pedagogical projects. As an example, in the framework of the “Olympiades de Physique 2010”, a project based on a Cosmodétecteur has been awarded.

IN2P3 is developing a different cosmic-ray detector, called COSMIX, which fits in a small case, is lighter and does not require any setting nor calibration – simply an USB power plug. This new detector, designed at the Gradignan IN2P3 laboratory (CENBG), uses spare scintillator bars from the Fermi satellite and custom electronics. It includes a GPS, a pressure-meter and a data acquisition system allowing data to be stored onto a SD memory card. Many applications are possible for this detector, of which about 15 copies will be produced this year: short introduction to cosmic rays in classrooms, demonstrations at the end of a public lecture or during an exhibit, etc. A collaborative website will allow participating teachers to publish their data while describing how they were acquired – one example: teachers from everywhere in France will be able to study the cosmic ray rates at the different floors of the Eiffel tower, hence reproducing Wulf’s experiment from 1909.

The well-recognized Cosmodétecteur, combined with the IN2P3 physical and technical knowledge and the Sciences à l’Ecole educational expertise, will allow more and more high-school students and teachers to discover particle physics through cosmic rays. The new IN2P3 COSMIX detector is a different tool which offers new opportunities to provide an introduction to cosmic rays to audiences which do not have access to a Cosmodétecteur. All the related activities will be presented in the talk proposed in the “Education and Outreach” ICHEP 2014 parallel session.

Summary

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