

Tracking Louis Leprince-Ringuet's contributions to cosmic-ray physics

We were a bit surprised that Per Carlson's otherwise well-documented review, "A century of cosmic rays" (PHYSICS TODAY, February 2012, page 30), did not mention the contributions of Louis Leprince-Ringuet. We write to correct that omission.

Leprince-Ringuet (1901–2000) began studying cosmic rays in Maurice de Broglie's laboratory in the early 1930s, during a time of controversy over whether cosmic rays were charged particles or gamma rays, since experiments with ionization chambers had produced conflicting evidence for geomagnetic effects. In 1933 Pierre Auger and Leprince-Ringuet used a more direct technique based on coincidence counters aboard a ship traveling from Le Havre, France, to Buenos Aires, Argentina, and back. With that approach they counted 170 000 individual cosmic rays and accurately measured the geomagnetic effects.¹

Later, Leprince-Ringuet and his collaborators built a cloud chamber that was triggered by counters, and they inserted it in the big magnet of the French Academy of Sciences in Bellevue. In 1936 Leprince-Ringuet was appointed professor of physics at École Polytechnique in Paris, where he created the school's first research laboratory, initially devoted to cosmic-ray physics. In March 1939, shortly after the discovery of the muon, he and coworkers used the cloud chamber to directly measure its mass.² With the onset of World War II, however, the researchers could not submit their paper until the end of 1940.

During the war the cloud chamber and the magnet were moved to L'Argentière-La-Bessée in the French Alps. In a series of 10 000 cloud-chamber photographs they took in 1943, Leprince-Ringuet and his collaborators found the first evidence for a heavy meson³ with a mass some 870–1110 times the electron mass. The new particle could not be interpreted as a muon but was not unanimously accepted as a heavy meson; as Hans Bethe argued, the upper limit on the mass could reach the proton mass if all the probable errors were doubled and added together with the same sign. However, as J. Robert Oppenheimer stated in his concluding remarks at the Symposium on Cosmic Rays at Caltech in 1948, it was "hard to disbelieve Leprince-Ringuet's evidence for a very heavy meson." Despite the low probability of the proton hypothesis, his evidence was not deemed decisive, and George Rochester and Clifford Butler were credited with the discovery of the K^+ in 1947. The next year Leprince-Ringuet and his team presented further evidence⁴ for the K^+ , obtained using the emulsion technique at the Laboratoire des Cosmiques, a high-altitude facility he had created in the French Alps.

In 1949–50 the search for strange particles and the study of their properties became primary goals of the physicists at École Polytechnique. Two large superposed cloud chambers were installed at the observatory of Pic du Midi de Bigorre, 3000 m above sea level in the French Pyrenees. The chamber on the top was located inside a magnet, whereas the bottom chamber was equipped with a series of metallic plates. The setup allowed incident particles to be identified and their energies measured.

At the time, Leprince-Ringuet, as secretary of the cosmic-ray commission of the International Union of Pure and Applied Physics (IUPAP), was in charge of organizing the 1953 Cosmic Ray Conference at Bagnères-de-Bigorre. A recent summary by James W. Cronin (Carlson's reference 14) of that conference and its consequences emphasizes Leprince-Ringuet's role. In view of early results

from the first big US accelerators, Leprince-Ringuet insisted that the conference focus on particle physics aspects. A new nomenclature for strange particles was proposed by a commission that included the best specialists in the field. Most were quoted in Carlson's article, but not Leprince-Ringuet, who had coined the word "hyperon."

In the following years, Leprince-Ringuet's focus turned toward accelerator experiments. He was instrumental in the creation of CERN, and several physicists from his laboratory at École Polytechnique were major actors in the scientific developments of CERN's first 20 years.

Through his affiliations with the French Academy of Sciences and the Commissariat à l'Énergie Atomique and his valued participation in IUPAP and CERN, Leprince-Ringuet was a major force in cosmic-ray physics and in the transition to particle physics, at both the national and international levels.

References

1. P. Auger, L. Leprince-Ringuet, C. R. *Hebd. Séances Acad. Sci.* **197**, 1242 (1933).
2. L. Leprince-Ringuet, S. Gorodetzky, E. Nageotte, R. Richard-Foy, *Phys. Rev.* **59**, 460 (1941).
3. L. Leprince-Ringuet, M. Lhéritier, C. R. *Hebd. Séances Acad. Sci.* **219**, 618 (1944).
4. L. Leprince-Ringuet, *Rev. Mod. Phys.* **21**, 42 (1949).

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James Clerk Maxwell, a modern educator

Many of the works dedicated to the life of Scottish physicist James Clerk Maxwell contend that his scientific accomplishments were much more significant than his teaching achievements. During his lectures, for example, he would often correct himself and double-check what he'd written, which tended to frustrate and confuse

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