100 years of cosmic rays mystery

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As physicists gather in early August to celebrate a century since the initial discovery of cosmic rays, Alan Watson, emeritus professor of physics at the University of Leeds, explains how physicists have gradually revealed the nature of these mysterious objects and examines the progress being made in understanding where they come from.

It is now widely accepted that cosmic rays are the nuclei of atoms, from the entire range of naturally occurring elements, that travel at near-light-speeds for millions of years before reaching Earth. However, identifying the source of cosmic rays has proved to be a very difficult task.

The Pierre Auger Observatory – a 3000 km^2 site in Argentina – is one of many institutions around the world scouring the universe for the source of cosmic rays and currently has 1600 Cherenkov detectors in operation, each looking to find the source of cosmic-ray showers with extremely high energies.

This is in massive contrast to the techniques used by Austrian scientist Victor Hess, who was the first to discover cosmic rays on 7 August 1912 by travelling 5000 m above ground in a hot-air balloon. He was awarded the Nobel Prize for Physics in 1936 for his efforts.

The story of cosmic rays started in the 1780s when French physicist Charles-Augustin de Coulomb noticed that an electrically charged sphere spontaneously lost its charge, which at the time was strange as scientists believed that air was an insulator, rather than a conductor.

Further investigations showed that air became a conductor when the molecules were ionized by charged particles or X-rays.

The source of these charged particles puzzled scientists as experiments revealed that objects were losing their charge even when shielded by a large volume of lead, which was known to block X-rays and other radioactive sources.

Hess was the first to discover that the ionization of air was three times greater at high altitudes than it was at ground level, leading him to conclude that there was a very large source of radiation penetrating our atmosphere from above.

In this feature, Watson states that there is an unexpected benefit stemming from Hess's original cosmic-ray research: the designer of the communications system at the Pierre Auger Observatory has used the same sophisticated software to build a radio-based signalling system that now extends over 700 km of the single-track train line in the Scottish Highlands.

"The safety and reliability that rail travellers now enjoy while passing by lochs and through glens is a benefit from Hess's daring flight a century ago that surely he could never have foreseen," Watson writes.

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