New experiment to investigate cosmic connection to clouds

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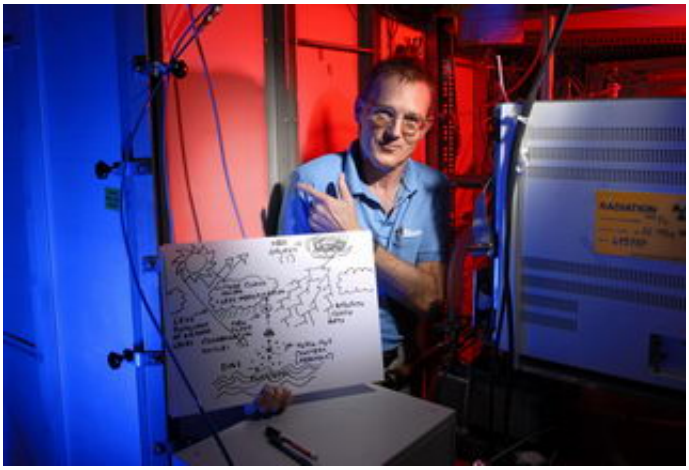

Jasper Kirkby in front of the CLOUD prototype, with a sketch to illustrate the possible link between galactic cosmic rays and cloud formation." Credit: CERN

A novel experiment, known as CLOUD (Cosmics Leaving OUtdoor Droplets), begins taking its first data today with a prototype detector in a particle beam at CERN, the world's largest laboratory for particle physics. The goal of the experiment is to investigate the possible influence of galactic cosmic rays on Earth's clouds. This represents the first time a high energy physics accelerator has been used for atmospheric and climate science.

The CLOUD experiment is designed to explore the microphysical interactions between cosmic rays and clouds. Cosmic rays are charged

particles that bombard the Earth's atmosphere from outer space. Studies suggest that cosmic rays may influence the amount of cloud cover through the formation of new aerosols (tiny particles suspended in the air that seed cloud droplets). Clouds exert a strong influence on the Earth's energy balance, and changes of only a few per cent have an important effect on the climate. The CLOUD prototype experiment aims to investigate the effect of cosmic rays on the formation of new aerosols.

Understanding the microphysics in controlled laboratory conditions is a key to unravelling the connection between cosmic rays and clouds. CLOUD will reproduce these interactions for the first time by sending a beam of particles - the "cosmic rays" - from CERN's Proton Synchrotron into a reaction chamber. The effect of the beam on aerosol production will be recorded and analysed.

The collaboration comprises an interdisciplinary team from 18 institutes and 9 countries in Europe, the United States and Russia. UK scientists from the University of Leeds, University of Reading and CCLRC Rutherford Appleton Laboratory are members of the CLOUD collaboration. It brings together atmospheric physicists, solar physicists, and cosmic ray and particle physicists to address a key question in the understanding of clouds and climate change.

"The experiment has attracted the leading aerosol, cloud and solar-terrestrial physicists from Europe; Austria, Denmark, Finland, Germany, Switzerland and the United Kingdom are especially strong in this area" says the CLOUD spokesperson, Jasper Kirkby of CERN.

"CERN is a unique environment for this experiment. As well as our accelerators, we bring the specialist technologies, experimental techniques and experience in the integration of large, complex detectors that are required for CLOUD." An example in the present CLOUD prototype is the gas system, designed by CERN engineers, which

produces ultra-pure air from the evaporation of liquid oxygen and liquid nitrogen. "It's probably the cleanest air anywhere in the world", says Kirkby.

Professor Bob Bingham, a UK CLOUD collaborator from CCLRC Rutherford Appleton Laboratory, said, "By studying the micro-physical processes at work when cosmic rays hit the atmosphere we can begin to understand more fully the connection between cosmic rays and cloud cover."

Dr Giles Harrison, a UK CLOUD collaborator from the University of Reading, adds, "We know that charged particles and cluster ions occur throughout the lower atmosphere but the physical consequences of their charge for cloud and aerosol processes is an under-explored area of atmospheric science. CLOUD should provide unique new measurements in atmospheric aerosol science and atmospheric electricity."

The first results from the CLOUD prototype are expected by the summer of 2007. The full CLOUD experiment includes an advanced cloud chamber and reactor chamber equipped with a wide range of external instrumentation to monitor and analyse their contents. The temperature and pressure conditions anywhere in the atmosphere can be re-created within the chambers, and all experimental conditions can be controlled and measured - including the "cosmic ray" intensity and the contents of the chambers. The first beam data with the full CLOUD experiment is expected in 2010.

Background: The roots of the experiment can be traced as far back as two centuries, when the Astronomer Royal, William Herschel, noticed a correlation between sunspots and the price of wheat in England. This marked the first observation that Earth's climate may be affected by variations of the Sun. However solar-climate variability has remained a great puzzle since that time, despite an intensive scientific effort. The

well-known Little Ice Age around the 17th and 18th centuries - when sunspots all but disappeared for 70 years, the cosmic ray flux increased and the climate cooled - seems to be merely the latest of around a dozen similar events over the last ten thousand years. However there is no established mechanism for the brightness of the Sun to fluctuate on these time scales. The possibility of a direct influence on the climate of galactic cosmic rays (which are modulated by changes of the solar wind) is therefore attracting the interest of scientists.

Source: PPARC