THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

SEMINAR

Cosmic Rays: Where They Come from and How They Get Here

by

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Date: May 6, 2026 (Wednesday)
Time: 10:00 - 10:45 a.m.
Place: Rm G26, Science Centre North Block, CUHK

ALL INTERESTED ARE WELCOME
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Abstract

Cosmic rays are high energy particles or gamma rays from space, and pose an important hazard to humans and instruments in space. Key populations include solar energetic particles of energies up to the GeV (10^9 eV) range accelerated by occasional solar storms, which are associated with numerous "space weather" effects on human activity, and a continuous flux of more energetic Galactic cosmic rays. The acceleration and transport mechanisms relate to space plasma processes, especially turbulent magnetic fluctuations. I will briefly summarize our design and construction of high energy particle detectors for the Chang'E 7 & 8 lunar missions, and results from ground-based detectors that we operate in Thailand and Antarctica. Based on our analyses of solar energetic particle data, as well as public data from NASA's Parker Solar Probe, it can be concluded that solar energetic ions are predominantly accelerated at interplanetary shocks, their interplanetary transport is nearly scatter-free within the solar wind's Alfvén surface, and then they are scattered by intense slab fluctuations near Alfvén surface, finally experiencing weaker scattering and longer mean free paths at 1 au and beyond. Turning to higher energies, as part of the LHAASO Collaboration that operates huge cosmic ray detector arrays in China, we have for the first time discovered solar storm effects on TeV (10^{12} eV) range Galactic cosmic rays. The origin of Galactic cosmic rays up to ~1 PeV (10^{15} eV) has long been attributed to supernova remnants. Now high-precision LHAASO data allow the determination of spectra of individual cosmic species, for protons and helium, identifying the spectral "knee" in each population at multiple PeV. The sources of these super-PeV populations may be associated with Galactic PeV gamma-ray sources identified by LHAASO, including microquasars.

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