Applied Physics Seminar

Radar Reflection from Naturally Occurring Metal 50 miles up in the Sky -A Proposed Explanation for a 25 Year Old Mystery-

Professor Paul Bellan

Caltech

Noctilucent clouds are wispy high altitude phenomena visible in summer at polar latitudes during twilight. These clouds occur at 85 km altitude and are about 1 km thick. They were first described in 1885, two years after the eruption of the massive Krakatoa volcano. The Krakatoa eruption affected global climate and weather for years and may have produced the first noctilucent clouds. The incidence of noctilucent clouds appears to be increasing and this increase is believed to be associated with global warming. Noctilucent clouds occur in summer because the polar latitude mesosphere is coldest in summer, promoting the formation of the 10-100 nm radius ice grains making up the clouds.

While the effects of Krakatoa have faded, noctilucent clouds remain as a poorly understood mesospheric phenomenon (the mesosphere is the altitude at which pressure is four orders of magnitude less than at sea level). Twenty-five years ago it was discovered that noctilucent clouds have a substantial reflectivity for 50 MHz radar. This was a big surprise, because being so small, the noctilucent ice grains were expected to produce insignificant incoherent or coherent backscatter at the 6 meter radar wavelength. Various models were proposed, typically presuming that the radar reflection was a result of Bragg backscattering from free electrons in a spatially inhomogeneous plasma associated with the noctilucent cloud. However, sounding rocket measurements of the free electron density in a noctilucent cloud showed that the altitude at which maximum radar reflection occurs is precisely where the free electrons are completely depleted.

I propose that the unexpected high noctilucent cloud radar reflectivity can be explained by assuming that the ice grains constituting the cloud are coated by a thin metal film of extra-terrestrial origin. My explanation [1] is based on observations involving radars, rockets, and lasers, on laboratory experiments, and on first-principle electromagnetic theory. The explanation combines ideas from meteor physics, cryophysics, plasma physics, atmospheric turbulence theory, and coherent Bragg scattering.

Biography:

Paul M. Bellan is Professor of Applied Physics at the California Institute of Technology. He received his B. Sc. from the University of Manitoba and his Ph.D from Princeton University. He has worked on many areas of experimental and theoretical plasma physics relating to fusion, magnetospheric, space, solar, and astrophysical plasmas.

Tuesday October 21st
4:00pm-5:00pm.
Watson 104

Refreshments will be available in the Watson Lobby at 3:45pm