Icy in the Sky with Ovals

Fifty miles above the earth's polar regions—where the pressure is 100,000 times lower than at sea level, and the temperature is a frigid –1,900° F—tiny grains of ice can form phenomena known as noctilucent clouds. Visible just after dusk in northern cities like Stockholm, these wispy formations are much higher than—and quite unrelated to—the other clouds we're used to here on Earth. In the past, researchers thought that the ice grains in these clouds would be tiny spheres, but a recent study in the laboratory of applied physicist Paul Bellan suggests that the grains might actually be much more elongated—a property that may help scientists better understand these curious clouds.

Noctilucent clouds—as well as the tails of comets and a few of Saturn's more diffuse rings—are examples of "dusty plasmas." Plasma, a gas of freely moving electrons and ions, is one of the four states of matter. When dust particles (such as tiny ice grains) enter the equation, they capture electrons from the plasma and become electrically charged, forming a dusty plasma.

Rather than studying the actual formation of ice grains high above the earth, Bellan and postdoctoral scholar Kil-Byoung Chai decided to make a water-ice dusty plasma in the laboratory. They did this by injecting water vapor into an electron-ion plasma in a vaccum chamber at low temperature and low pressure—conditions similar to those needed for the formation of noctilucent clouds.

The result? Oval-shaped ice particles that are four times longer than they are wide. Spherical shapes can easily be used in calculations and models, so many physicists assumed nature would also reflect this simplicity. Bellan and Chai were the first to show experimental evidence contradicting this assumption.

Because ellipsoidal shapes react with light and radio waves much differently than their spherical counterpart, those elongated ice grains could also explain another curious property of noctilucent clouds: their interaction with electromagnetic radiation.

Although Bellan's experiment in the laboratory can't confirm that these tiny ovals are responsible for the behaviors of high-up noctilucent clouds, the results will give scientists a new possibility to ponder.
—*JSC*