A Flock of Sundogs

(or "Some consolation for the poor observing weather we've had")
by John Garrett

This recent February and March has produced few good observing nights, but the daytimes have been rich in quasi-astronomical effects known a parhelia. I've seen and photographed dozens of incidents of sundogs, sun arcs as well as one rare circum-zenithal arc.
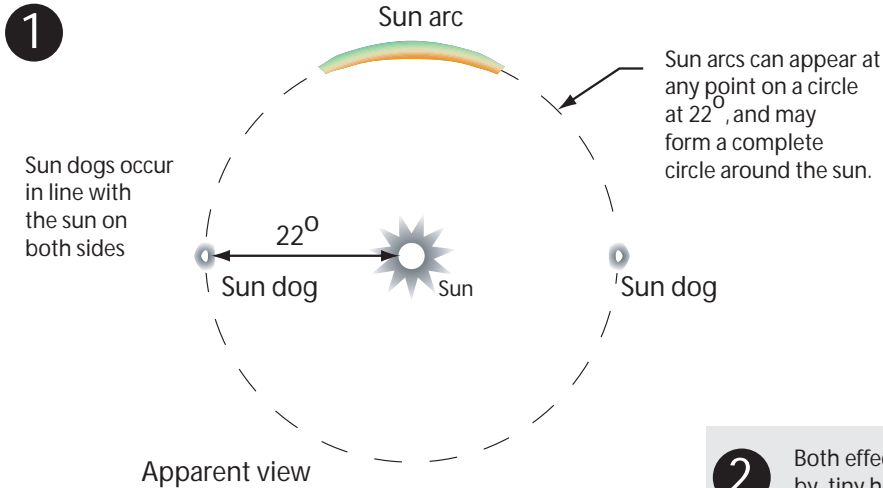
Parhelia is the word for optical effects created by sunlight on the atmosphere. A common effect is the rainbow, seen when your back is to the sun.

This series of photos shows a sun arc and a sun dog created by cirrus clouds on February 4, 2006.

The most brilliant sundog I had ever seen formed to the right of the sun. I ran inside to get my camera and discovered I was out of film. I grabbed my digital aim-and-shoot camera and subsequently learned that it shuts down automatically if you point it near the sun.

By the time I loaded film , the sundog was fading. But within a minute, the arc formed and the two photos here show how it moved from the right to the center before fading. Last, a sundog formed on the left of the sun (bottom).

These and similar phenomena, such as the moon bow, occur when ice crystals refract sunlight or moonlight. As the angle of refraction for ice crystals is 158 degrees, the effect is sundogs, bows, or arcs at a distance of 22 degrees from the light source. (See diagram on the next page..)

1

Sun arc

Sun arcs can appear at any point on a circle at 22°, and may form a complete circle around the sun.

Sun dogs occur in line with the sun on both sides

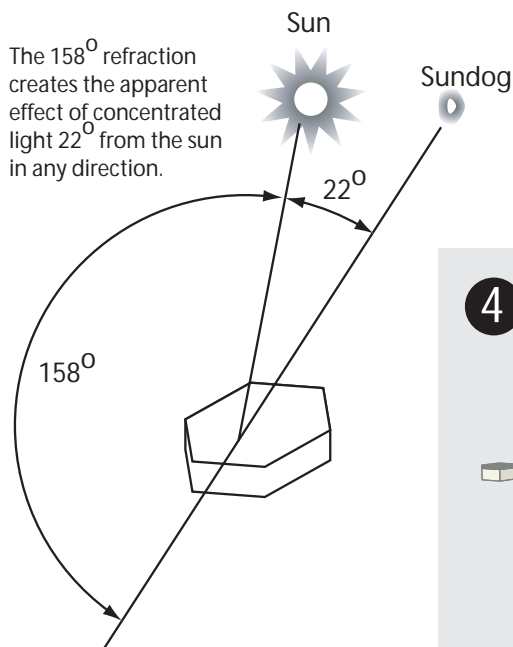22°

Sun dog		Sun			Sun dog

Apparent view

2 Both effects are the result of sunlight refracted by tiny hexagonal ice crystals, typically found in cirrus clouds at or above 16,000 ft. when temperatures at this height are below -20° C.
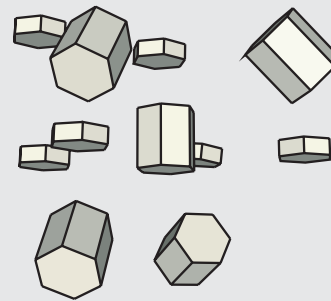
These hexagonal crystals, about 0.5 micrometers in diameter, are either flat or pencil shaped. The flat crystals tend to be oriented horizontally. The longer crystals tumble, and can be in any orientation.

3 Ice crystals refract sunlight at a 158° angle.

Sun

Sundog

The 158° refraction creates the apparent effect of concentrated light 22° from the sun in any direction.

22°

158°

4 Arcs are formed by the longer crystals. Any of these crystals at the right oientation 22° from the sun will refract light toward the observer.
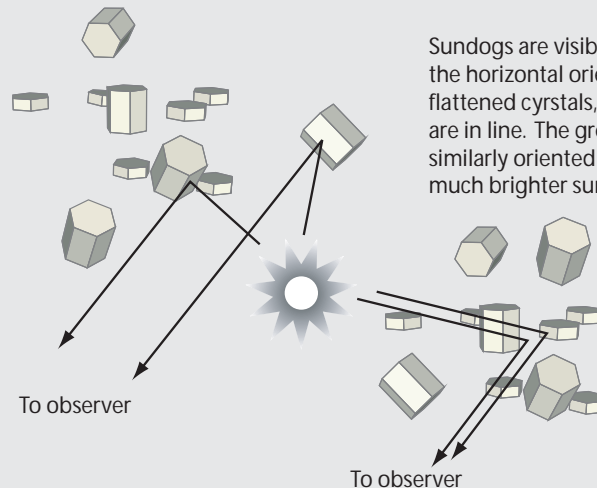
Sundogs are visible when the sun, the horizontal orientation of the flattened cyrstals, and the observer, are in line. The greater abundance of similarly oriented crystals creates the much brighter sundog.

To observer

To observer