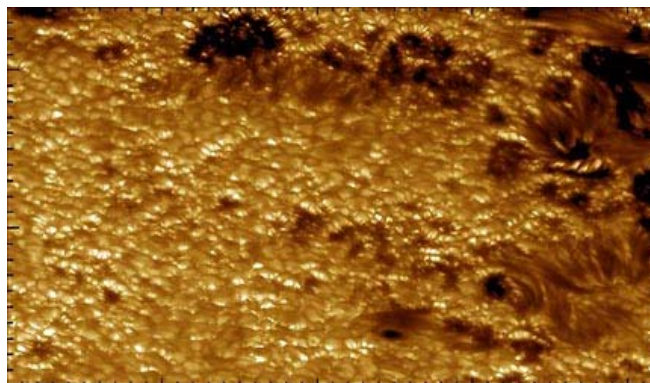




## First 3-D Images of the Sun's Granular Surface

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Black tick marks at the perimeter of this solar image are 1000 kilometers (622 miles) apart. Each granule, or cell, on the sun's surface is about the size of Texas. This image near the eastern

limb of the sun was first taken on July 24, 2002, by Prof. Goran Scharmer and processed by Dr. Mats G. Lofdahl, Institute for Solar Physics, Royal Swedish Academy of Sciences.

Earthfiles, news category.

**July 16, 2003 Palo Alto, California** - At the recent American Astronomical Society's Solar Physics Division meeting in Laurel, Maryland, solar physicists from Lockheed Martin Solar and Astrophysics Lab (LMSAL) at the company's Advanced Technology Center in Palo Alto, California, along with other European scientists, presented the highest resolution images ever taken near the visible edge of the sun.

Tom Berger, Ph.D., principal scientist on the LMSAL study said, "Until recently, we thought of the solar photosphere as the relatively flat and featureless 'surface' of the Sun, punctuated only by an occasional sunspot. Now, using the newly commissioned Swedish one-meter Solar Telescope (SST) on the island of La Palma, Spain, we have - for the first time - imaged the three-dimensional structure of the convective 'granules' that cover the photosphere."

Instead of a flat surface, new images show granules, or irregular cellular patterns, thought to be caused by temperature changes similar to the way bubbles rise to the surface in boiling water. The size of each granule is astounding - about the size of Texas - and there are hundreds of thousands of them. In these new, highly detailed images, sunspots appear as dark holes amid all the granules.

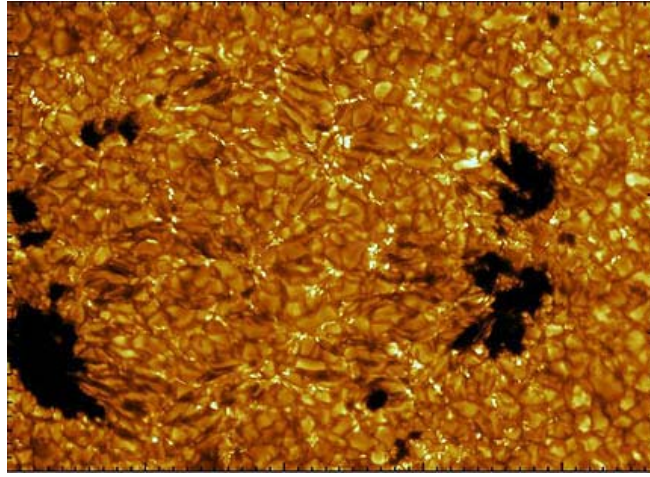


Image of solar active region taken on May 13, 2003, near the center of the sun. Small magnetic elements show up as small bright features in the dark lanes between granules.

Their actual physical size is about 100 kilometers in diameter. One of the great mysteries about the sun is how do magnetic fields go from being small bright 'dots' at the sun's center to large faculae near the limb? 2003 image by Dr. Tom Berger of the LMSAL, Palo Alto, California.

## Increased Sunspots Produce A Brighter Sun

Bright structures near the edge of the sun known as "faculae" (little torches), could be linked to increased solar brightness that occurs in the eleven year cycles of maximum solar magnetic activity. One of the paradoxes has been that solar maximums bring high concentrations of dark sunspots and logic would assume all those black spots would decrease solar light radiation over days and weeks. Instead, satellite radiometer data in the 1980s showed the sun's brightness *increased* as sunspot magnetic storms proliferated. That "extra brightness" of the sun is now thought to be caused by the faculae. *Spaceflight Now* writes, "Most of the bright structures seen are between 150 and 400 kilometers tall and are typically elongated towards the limb. Simultaneous measurements of the magnetic field establish that the bright faculae are exactly aligned with the magnetic fields."

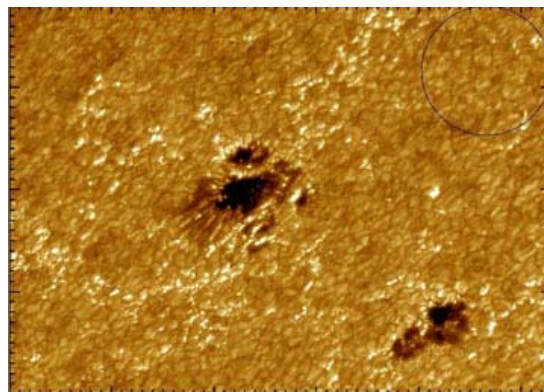


Image of a solar active region taken on June 6, 2003, near the eastern limb of the sun. The circle in upper right corner shows the Earth's diameter. The 3-dimensional granular surface of the sun is distinct, the regions around the dark sunspots are higher than the surrounding surface, and the faculae appear as bright "walls" on some of the solar granules. Image by Dr. Luc

Roupe van der Voort, University of Oslo, Norway, and processed by Dr. Lofdahl, Royal Swedish Academy, and Dr. Tom Berger, LMSAL.

## The Bright Sun Connection to Global Climate Change

If increased magnetic storms/sunspots are linked to increasing brightness of the faculae and increased brightness is linked to more solar radiation on Earth and subsequent warming of temperatures, then understanding exactly what makes the solar light fluctuate might give us insights into global climate change. Prof. John Lawrence of California State University, Northridge, said, "We can hope to incorporate the effects of magnetoconvection into solar irradiance models to better predict variations in solar output."

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## Website:

**<http://www.lmsal.com/Press/SPD2003.html>**

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