

STORY OF A SOLAR STORM

Ever had the lights go out, or your favorite radio show suddenly erupt in static? These sorts of things happen all the time but have you stopped to wonder what caused them? More often than not circumstances such as these are due to local glitches, either at your fuse box, the power station or the radio station. Sometimes, however, the source of such problems is much farther away. Our planet lies in the atmosphere of the star we call the Sun and although it is 150 million kilometers away, the Sun can have a powerful impact on Earth.

While living near a star has many advantages, the Sun is not a quiet neighbor and Earth's location puts it in the path of explosive solar storms. The plasma cloud ejected during a solar storm can travel the vast distance from the Sun and reach Earth in as little as 1 to 4 days. At one time, the only evidence of the arrival of this cloud was the spectacular display of color it would produce in the night sky; the northern or southern lights. However, with our increased reliance on technology, solar storms now have a much more disruptive effect on everyday lives.

Space weather disturbances can disrupt satellite operations, and interfere with electronic and radio communications, impacting our lives and inconveniencing us for prolonged periods of time. One of the more destructive effects of solar storms is their ability to short-circuit power grids, leaving thousands of people without electricity. Increased radiation from solar storms can also be harmful to astronauts in orbit. To improve predictions of what is called "Space Weather", scientists work to better understand the causes of solar storms through careful observations of the Sun leading up to a storm, and of the storm itself. The life of a solar storm is interesting and exciting and can be told through a careful examination of such observations.

In the spring of 2001 an extremely large sunspot group surfaced on the Sun. As the colossal dark region crossed the solar disk it grew to become more than 13 times the size of Earth. Known as active region number 9393 (the 9393rd region to be observed since counting officially began in 1973) this giant was the largest sunspot group to appear in 10 years! Active region 9393 proved to be not only large in size, but persistent in nature. The region remained strong for three complete solar rotations each lasting 27 days, revealing itself in March, April and May of 2001.

On April 2, 2001 at 5:51 p.m. EDT, active region 9393 released a major solar flare. The flare occurred off the northwest limb of the Sun and was quickly determined to be one of the largest flares on record. Fortunately, the accompanying eruption, called a Coronal Mass Ejection or CME, was not pointed directly at Earth, helping to limit the damaging impact of the storm.

Several days later a large influx of energetic particles generated by the April 2nd solar storm arrived at Earth, producing beautiful auroral displays which were seen as far south as Mexico! This particular storm did little damage to the Earth's electrical systems, with no major satellite disruptions or power-grid failures reported. However, next time we might not be so lucky!

The images at the right depict the sequence of events which comprised the solar storm of April 2, 2001. The first is an image of the large sunspot group taken by the SOHO satellite. The second is an image of the Sun's chromosphere (the layer of atmosphere just above the sunspots). This image was taken by the Big Bear Solar Observatory in California. The third image shows the corona of active region 9393, taken by the Soft X-ray telescope on board the Yohkoh satellite. The active region is visible on the northwest (upper right) side of the solar disk, near the limb. The fourth is an image of the coronal mass ejection being ejected off the northwest limb of the Sun. This image was also taken by the SOHO satellite. The last is an image of the aurora generated by this solar storm. The aurora image was taken by David McKenzie in Bozeman, Montana.

This sequence of solar storm images has been hidden in the collage to the left. Can you find 16 solar storm sequences? Remember to look up and down, left and right and diagonally. The puzzle and answer key can be found on the web at: <http://www.LMSAL.com/YPOP/sequence>

Good luck!

Lockheed Martin Solar & Astrophysics Lab

<http://www.LMSAL.com>

Yohkoh Public Outreach Project

<http://www.LMSAL.com/YPOP>

EUV arcade image courtesy of TRACE, a mission of the Lockheed Martin Solar and Astrophysics Laboratory and the Stanford Solar Observatories Group, funded by the NASA Small Explorer program.

He 10830 image courtesy of NSO/Kitt Peak and produced cooperatively by NSF/NOAO, NASA/GSFC, and NOAA/SEL.

Magnetogram, EUV and coronagraph images courtesy of MDI, EIT and LASCO science teams. SOHO is a project of international cooperation between ESA and NASA.

White light image courtesy of Big Bear Solar Observatory and the New Jersey Institute of Technology.
Aurora image courtesy of Dr. David McKenzie, Montana State University.