National Aeronautics and Space Administration
Office of Space Science Sun-Earth Connection

"Seeing the Sun-Earth Connection"

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A test of HDTV display technology. Work in progress.. Please do not copy.

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Transition Region and Coronal Explorer (TRACE) data courtesy of the TRACE Team, Dr. Alan Title, Principal Investigator, Lockheed Martin Solar & Astrophysics Labs. TRACE) is a NASA Small Explorer (SMEX) mission. TRACE image sequence processed by Jeffrey R. Hall.

SOHO LASCO data courtesy of the SOHO/LASCO Consortium, Dr. R. A. Howard, NRL, Principal Investigator. SOHO is an ESA-NASA Mission of International Cooperation SOHO EIT data courtesy of the SOHO/EIT Consortium, Dr. J.-P. Dèlaboudiniere, Principal Investigator. SOHO is an ESA-NASA Mission of International Cooperation. LASCO/EIT Image sequences processed by George Wendt III.

Visible Imaging System (VIS) data courtesy of Dr. John B. Sigwarth, Project Scientist, and Dr. Louis A. Frank, Principal Investigator, University of Iowa. Visible Imaging System Visualization by Greg Shirah, NASA GSFC-Scientific Visualization Studio. The Polar spacecraft is the second mission of NASA's Global Geospace Science (GGS) Program.

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On July 14, 2000 a large Coronal Mass Ejection (CME) erupted from the Sun. This was preceded by a large solar flare, which was observed with SOHO's extreme ultraviolet telescope (EIT). Earlier the TRACE spacecraft observed a filament eruption followed by the formation of "post flare loops" in the same solar active region. The LASCO coronagraph on the SOHO spacecraft saw this CME as a halo around the blocked solar disk. Almost simultaneously, the CCDs on board SOHO were bombarded by relativistic particles created during the flare. Taken together, these events indicated that the CME was headed directly towards the Earth. The CME traveled toward Earth at a speed of three million miles per hour and created a major geomagnetic storm at Earth a day and a half later. The storm, which peaked on July 15, was classified by NOAA as a G5 or "extreme" storm. Geomagnetic activity causes auroral emissions, which results from energetic particles exciting atoms in the upper atmosphere. The POLAR spacecraft's visible imager observed this activity.

TRACE (Transition Region and Coronal Explorer) is a NASA Small Explorer (SMEX) mission for high resolution imaging of the solar corona and transition. The TRACE field of view covers about an eighth of the visible disk. The goal is to explore and trace the connection between the solar surface and the outer solar atmosphere. TRACE can make nearly simultaneously images of the photosphere, the transition region, and the corona with a spatial resolution of one second of arc. The data in this video were taken in 195 Å and show the hot corona (about 2 Million Kelvin). The dark features above the solar surface contain cooler, denser material that absorbs the 195 Å light. Solar prominences appear as dark features against the background EUV flux. The eruption and "lift off" of a one solar prominence in the following sequence marks the start of the Bastille Day Event.

The Extreme Ultraviolet Imaging Telescope is one of 11 instruments on the Solar and Heliospheric Observatory (SOHO) takes full disk images of the Sun in four wavelengths. The data shown here are taken in either 171 Å or 195 Å and show the hot corona (about 2 Million Kelvin). In the Bastille Day segment, this data is shown superimposed on the data from the SOHO LASCO coronagraphs. The disk has been enlarged by about a factor of 2 relative to the coronagraph data. On July 14, 2000 (Bastille Day) a solar flare is seen at the same time as the prominence eruption recorded by TRACE. The flare is so bright that it saturates the CCD pixels and causes them to "bleed" into neighboring pixels. The LASCO instrument on the SOHO spacecraft is a set of three coronagraphs that image the solar corona from 1.1 to 32 solar radii. (One solar radius is about 700,000 km, 420,000 miles or 16 arc minutes.) A coronagraph is a telescope that is designed to block light coming from the solar disk, in order to see the extremely faint light scattered from the Sun's atmosphere, called the corona. Here, in the Bastille Day segment, data from two of the coronagraphs (C2 and C3) is combined to cover the corona from about 2 to 20 solar radii. The EIT images of the Sun are superimposed over the C2 occultor disk. The large arc-like expulsions of coronal material seen in the data are called coronal mass ejections (CMEs). Fast CMEs impacting the Earth's magnetosphere are the cause of the most severe geomagnetic storms. CMEs heading directly towards Earth form a "halo" around the blocked solar disk in the images. A halo CME is seen in the C2 coronagraphs on Bastille Day about a half an hour after the flare is seen in EIT.

The Polar spacecraft is the second mission of NASA's Global Geospace Science (GGS) Program. The regions near the Earth's magnetic poles are highly susceptible to solar variability. High above the poles, the particles of the solar wind and the energy of the wind can find their way into the magnetosphere. At lesser altitudes energy is transferred from electric fields and electromagnetic waves to electrons that then plunge into the upper atmosphere to create the aurora. The POLAR spacecraft's highly eccentric polar orbit is designed to obtain data from both high and low-altitude perspectives. Here data from POLAR's Visible Imaging System (VIS) is used to show the effects of the Bastille Day Event on the Earth's upper atmosphere. This data starts on July 15, 2001, about a day and a half after the CME left the Sun.

On February 28, 2001, LASCO observed a "halo" CME. We show both EIT and LASCO C3 images from this very active timeframe. The resulting auroral activity was filmed from the ground on the Earth. We display images of the aurora recorded by NHK in Sweden.