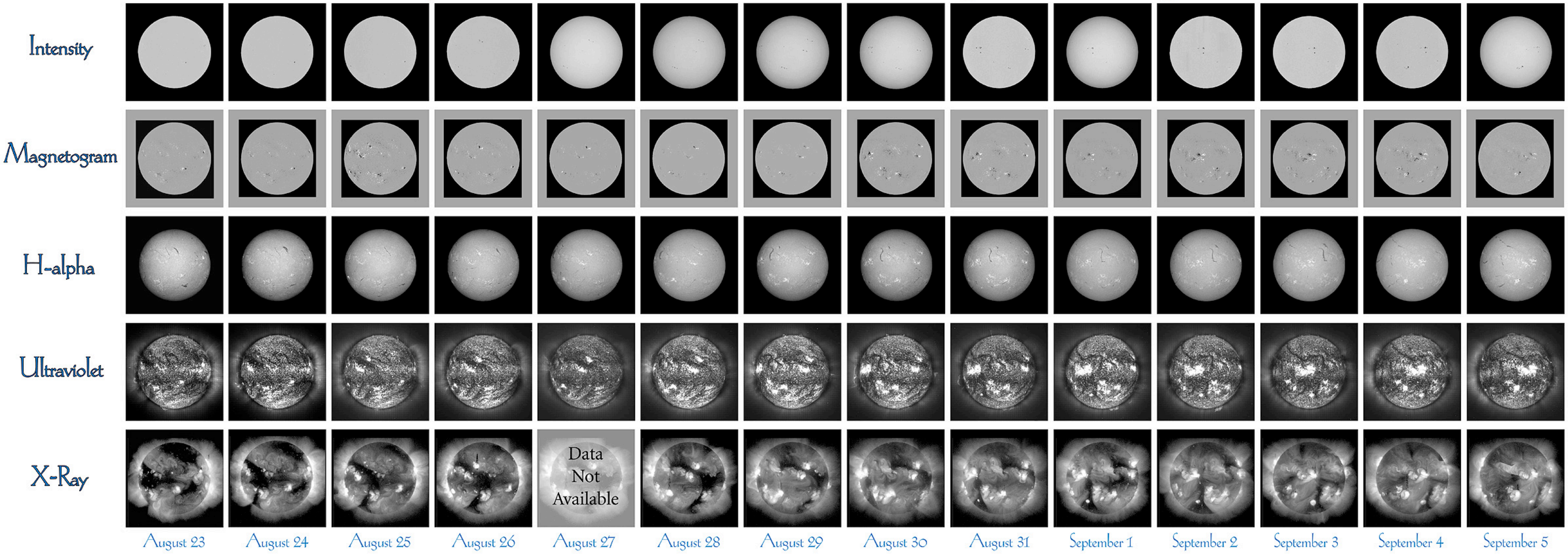
The Many Faces of the Sun: Multi-wavelength Solar Images Over Time



ABOUT THE IMAGES - Everyone has seen pictures of the Sun taken in visible light. Few have seen the many faces of the Sun in different kinds of light – that is, at "wavelengths" other than visible. To understand what is meant by light at different wavelengths, think of light as a bundle of energy. The amount of energy in each bundle of light is determined by the size of the bundle or "wavelength". Strange as it sounds, the bigger the size of the bundle or wavelength, the less energy it has. For example, a bundle of X-ray light (the size of an atom) is about 1000 times smaller than a bundle of visible light (the size of viruses), but has about 1000 times as much energy. A bundle of ultraviolet light (the size of a molecule) is about 10 times smaller than a bundle of visible light, but has about 10 times as much energy. To learn more about light, visit:
http://ethel.as.arizona.edu/~collins/astro/subjects/electromag1.html

Here are five sets of images (Intensity, Magnetograms, H-alpha, Ultraviolet and X-ray) taken at five different wavelengths. Each of the five sets of images of the Sun was taken over a 14-day period (about half a solar rotation) between August 23 and September 5, 2000. Comparison of the images at different wavelengths provides a unique view of ever-changing solar features. To view recent solar images and learn more information about what these images tell us about what's happening on the Sun and where these emissions come from in the solar atmosphere, visit:
http://www.windows.ucar.edu/spaceweather/suntoday.html
For general information about the Sun, and explanations about solar structure and solar features, visit: *http://science.nasa.gov/ssl/pad/solar/*
For images at several wavelengths and indexed by day since 1998, visit:
http://www.sec.noaa.gov/solar_images/index.html.

INTENSITY - The intensity images are snapshots of the photosphere or visible "surface" of the Sun. Because sunspots are cooler than the surrounding regions, they show up as black splotches.

The intensity images on August 23 – 26, August 31 and September 2 – 4 were taken at the National Solar Observatory (NSO) at Kitt Peak, AZ. Gaps in the NSO observations during the two-week period were primarily caused by cloudy weather. The images were taken at a wavelength of 868.8 nanometers (nm), corresponding to observations of a line of neutral iron (Fe I). Additional information about the NSO at Kitt Peak can be found at:
http://nsokp.nso.edu

The intensity images for August 27 - 30, September 1 and September 5 were taken by the Solar & Heliospheric Observatory (SOHO) spacecraft. The images were taken at a wavelength of 676.8 nanometers (nm), corresponding to observations of a line of neutral nickel (Ni I). Although taken at a slightly different wavelength than the NSO images, the SOHO images also show the Sun's "surface". Additional information on SOHO can be found at:
http://sohowww.nascom.nasa.gov/

MAGNETOGRAMS - The magnetograms are maps of the Sun's magnetic field strengths and polarity near the photosphere or visible "surface" of the Sun. Active magnetic regions on the Sun appear as white and black blotches. A further explanation about magnetograms can be found at:
http://solar-center.stanford.edu/solar-images/magnetograms.html

The magnetograms on August 23 – 26, August 31 and September 2 – 4 were taken at the National Solar Observatory (NSO) at Kitt Peak, AZ. Gaps in the NSO observations during the two-week period were primarily caused by cloudy weather. The images were made from polarization measurements of a line of neutral iron (Fe I) with a wavelength of 868.8 nanometers (nm). These measurements give the magnetic field strength near the solar photosphere. Additional information about the NSO at Kitt Peak can be found at:
http://nsokp.nso.edu

The magnetograms on August 27 - 30, September 1 and September 5 were taken by the Solar and Heliospheric Observatory (SOHO) spacecraft. These images were made from polarization measurements of a line of neutral nickel (Ni I) with a wavelength of 676.8 nm. Although the measurements are made from a line of an element other than iron, they still give the magnetic field near the solar photosphere. Additional information on SOHO can be found at:
http://sohowww.nascom.nasa.gov/

H-ALPHA - The H-alpha images are made from light with wavelengths very near 656.3 nm, the center of a very strong line of neutral hydrogen called the Hydrogen alpha line. (Hydrogen constitutes about 90 percent of all of the atoms in the solar atmosphere.) H-alpha images show layers of the Sun's lower chromosphere (up to 1700 km above the visible "surface"). A wide variety of features on the Sun can be seen in H-alpha images. Plages appear bright, as do short-lived solar flares. Sunspots appear dark, as do the usually elongated filaments. When seen beyond the edge of the solar disk, filaments appear bright and are then called prominences.

The H-alpha images were taken at the National Solar Observatory (NSO) at Sacramento Peak, New Mexico. Additional information about the data and NSO at Sac Peak can be found at:
http://www.nso.edu/sunspot/pr/200-maps.html.

ULTRAVIOLET - The ultraviolet images were taken by the Solar and Heliospheric Observatory (SOHO) spacecraft at a band of wavelengths centering on 30.4 nanometers (nm). Light at 30.4 nm is emitted by He II gas (helium missing one electron) at temperatures near 70,000 degree Celsius in the Sun's chromosphere. (The chromosphere is a layer of atmosphere just above the Sun's visible "surface".) Solar features such as filaments, coronal holes, active regions and erupting prominences show up at this wavelength. Definitions and further explanations for these features can be found under the glossary on the SOHO Education and Public Outreach webpage at:
http://sohowww.nascom.nasa.gov/explore/

Additional information on SOHO can be found at:
http://sohowww.nascom.nasa.gov/

X-RAY - The X-ray images were taken from the Yohkoh spacecraft at wavelengths between 0.3 and 5 nanometers. While the photosphere or visible "surface" of the Sun is hot, some 5,600 degrees Celsius, "X-radiation" is given off by much hotter gases with temperatures over 2 million degrees Celsius. The "cool" photosphere gives off very few X-rays, so it appears dark in the X-ray images. Instead, the X-ray images show the extremely hot corona that envelops the Sun and extends far out into space. Some prominent solar features seen at these X-ray wavelengths are coronal holes, active regions, coronal streamers, polar plumes, and large, isolated magnetic loops. Further explanations about these features can be found at:
http://isass1.solar.isas.ac.jp/yohkoh/phy_intro.html

For images, movies and activities for youngsters, parents and teachers, designed as public outreach for Yohkoh, visit:
http://solar.physics.montana.edu/YPOP/

Additional information on Yohkoh can be found at:
http://www.lmsal.com/SXT/

National Optical Astronomy Observatory

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