The Sun in the Electromagnetic Spectrum

Want to see what the Sun looks like today? Go to http://sdo.gsfc.nasa.gov/data. There you will see images from NASA's Solar Dynamics Observatory. This spacecraft looks at the Sun in visible and extreme ultraviolet light ("extreme" means in the far end of the ultraviolet spectrum, near the X-rays). The SDO scientists have colored the visible light images orange to help them distinguish features (the Sun is white to our eyes. See http://solar-center.stanford.edu/activities/SunColor/). And, since the human eye cannot see ultraviolet light, the scientists have picked some bright colors to show their data in, colors like neon green, hot pink, turquoise, etc. Artificially colored images like these mean the real light that produced the images cannot be seen by human eyes. The image on the right is in ultraviolet light that scientists have artificially colored bright orange.

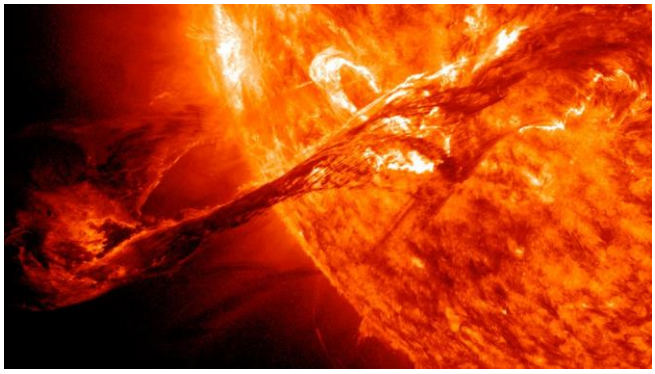
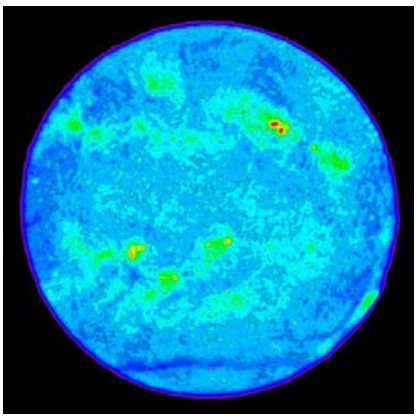


Image courtesy NASA SDO/AIA

The following images show the Sun in various parts of the electromagnetic spectrum. The images except the radio waves and gamma waves were taken on the same day (19 June 2015). Sunspot areas ("Active Regions") show up at the same area in many of the images. All but the visible light image are artificially colored.

Radio Waves

Here's a picture of the Sun in radio waves, imaged by the Very Large Array in New Mexico. The brightest features (red) in this false-color image have temperatures of a million degrees C and correspond with sunspots. The green features are cooler and show where the Sun's atmosphere is very dense. The dark blue features are cooler yet. At this frequency the radio-emitting surface of the Sun has an average temperature of 30,000 degrees C. The radio Sun is somewhat bigger than the optical Sun: the solar limb (the edge of the disc) in this image is about 20000 km beyond the optical limb.

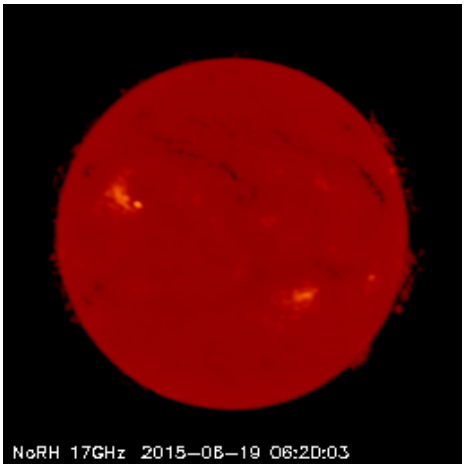


http://www.cv.nrao.edu/course/astr534/Tour.html

Image courtesy of NRAO/AUI

Microwaves

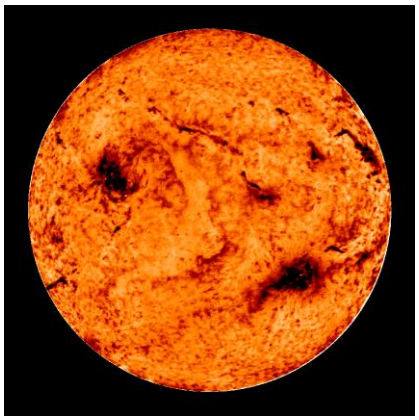
Microwave and radio wave are the names given to light with wavelengths from about 1 millimeter to meters. These penetrate through the outer layers of solar gas. The depth to which the radio waves and microwaves come from depends on their exact wavelength. The image here is constructed from microwaves with a wavelength of 1.7 centimeters. It shows us the structure of the Sun's atmosphere near the "transition region" between the chromosphere (2nd of the 3 main layers of atmosphere) and the corona (outer atmosphere), about 2000-2200 km above the photosphere (surface). The bright "spots" are active regions associated with sunspots. You can also see prominences, that are great strands or loops of plasma caught in magnetic fields. These extend above the edge of the Sun.
http://solar.physics.montana.edu/ypop/Spotlight/Today/microwave.html
Image from the Nobeyama Radio Observatory in Japan.



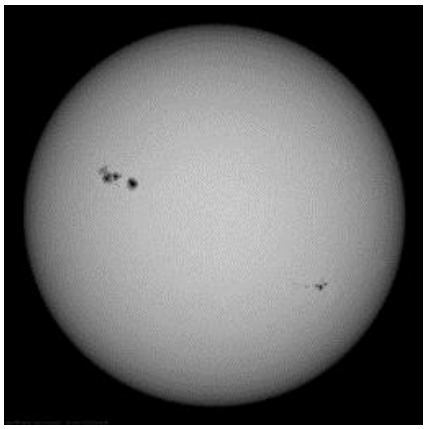
Infrared Light

We feel infrared light as heat, the same as heat lamps in restaurants keep food warm. More than half the Sun's power output is in the form of infrared light, though much of it is absorbed by the Earth's atmosphere. The picture here is made from light with a wavelength of 1083 nanometers (a little more than a thousandth of a millimeter.) It shows some features of the area just above the Sun's surface (chromosphere), and some features in the Sun's atmosphere (corona).

Infrared pictures often show dark markings on the Sun that are caused by absorption of the infrared light. Some of the light is absorbed wherever it collides with gas in the Sun's atmosphere, so the darker features in an infrared picture show where the gas is more dense. If there are loops of plasma in magnetic fields on the Sun (filaments), they typically show up dark.
http://solar.physics.montana.edu/ypop/Spotlight/Today/infrared.html
Image courtesy of the National Solar Observatory at Kitt Peak, Arizona.



Visible Light



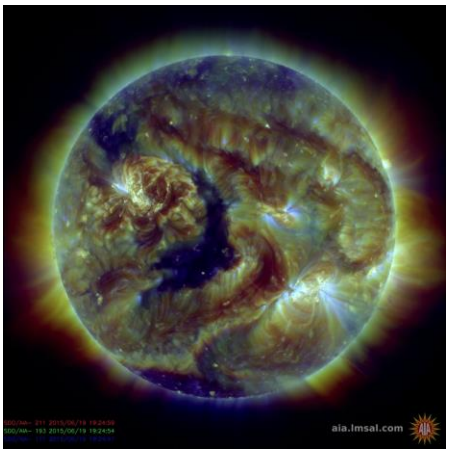
Never look at the Sun directly with your eyes!

This image was taken by a solar telescope with the proper filters. White light pictures show how the Sun appears to the naked eye, when all the colors of visible are merged and appear white. In a white/visible light photo, the part of the Sun that we see is called the photosphere (its surface), with a temperature of about 6000 degrees Celsius, much cooler than the corona (atmosphere) but still very hot. Sometimes there are notable dark spots. These "sunspots" are caused by magnetic storms on the Sun ("Active Regions"). Sunspots come and go, so features on the Sun change every few days.

http://solar.physics.montana.edu/ypop/Spotlight/Today/visible.html

Image courtesy NASA SDO/HMI

Ultraviolet Light

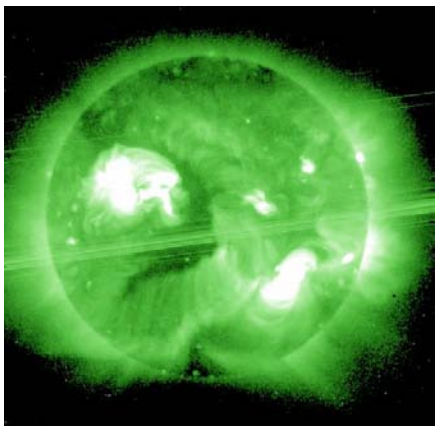


The image shows a portion of the layer of the Sun's atmosphere known as the chromosphere, just above the Sun's surface. Most of the UV light comes from the sunpot "active regions", where we can sometimes see loops, large prominences rising high above the surface of the Sun. At the north and south poles of the Sun, less UV light is emitted -- these regions often end up looking dark in the pictures, giving rise to the term "coronal holes." The darkness of these polar regions can sometimes also be seen in images made with X-rays.

http://sdo.gsfc.nasa.gov/

Image courtesy NASA SDO/AIA

X-rays



The term "X-Rays" refers to light with wavelengths shorter than about 10 nanometers. (That's only 10 *billionths* of a meter!) The picture was taken with a camera that sees light with wavelengths between about 0.3 and 4.5 nanometers, the so-called "Soft X-rays." The X-rays we see all come from the corona, the outermost and hottest visible layer of the Sun's atmosphere.

Not all the corona emits the same amount of X-rays. We often see structures called "loops" and "arches" and "streamers". Some of these are found around active regions, while some are occasionally found in more quiet parts of the corona. Movies made from X-ray pictures show that the corona is a very stormy place, constantly changing and erupting. In X-ray images you can often see the "coronal holes," regions of low brightness at the north and south poles and sometimes crossing the Sun's equator. The coronal holes are also sometimes seen in the UV images as well.
http://solar.physics.montana.edu/ypop/Spotlight/Today/xray.html

Gamma Rays

The Sun produces *lots* of gamma rays during fusion in its core. However, by the time these work their way through the dense interior of the Sun, they have all lost energy and emerge from the Sun as visible light waves. Gamma-rays can also be emitted directly from the Sun during rare very intense solar flares.
http://today.slac.stanford.edu/feature/gammaraysfromthesun.asp
https://www.youtube.com/watch?v=9shsKcpZswY

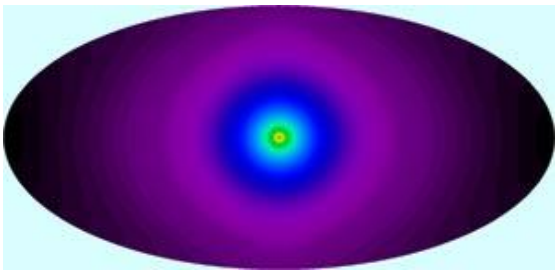


Image courtesy SLAC/Stanford