**Solar Activity**

**Purpose:** In this lab, you will be using authentic, near-real-time data from SDO’s AIA and HMI instruments to observe sunspots, flares, solar eruptions, and other forms of solar activity.

**Items:** Computer with internet connection

**Introduction:** Most organisms on Earth depend on the Sun for survival. While it is necessary for our existence, the Sun may also be our undoing. Our modern way of life depends on technology, and the more technology-dependent we become the more vulnerable we are to the Sun’s outbursts. On March 13 1989, an estimated 6 million people in the region of Quebec Canada lost power for 9 hours. This extensive blackout was caused by the Sun. A massive eruption of plasma, called a *coronal mass ejection,* had occurred on the Sun and eventually impacted Earth. These eruptions and other solar activity are actually quite common. We call this connection between solar activity and its impact on Earth “*space weather*”.

NASA’s Solar Dynamics Observatory ([SDO](http://sdo.gsfc.nasa.gov)) -- a solar space telescope launched in February 2010, circles in geosynchronous orbit about 22,000 miles above the surface of the Earth. SDO includes three scientific instruments: the Atmospheric Imaging Assembly ([AIA](http://aia.lmsal.com)), the Helioseismic and Magnetic Imager ([HMI](http://hmi.stanford.edu)), and the Extreme-ultraviolet Variability Experiment ([EVE](http://lasp.colorado.edu/home/eve)).

**Procedure:**

**Part I: Solar Dynamics Observatory Laboratory**

Watch the introduction video, ***Journey to the Sun***, and answer the following questions. Link: [*http://www.youtube.com/watch?v=fqKFQ7z0Nuk*](http://www.youtube.com/watch?v=fqKFQ7z0Nuk)

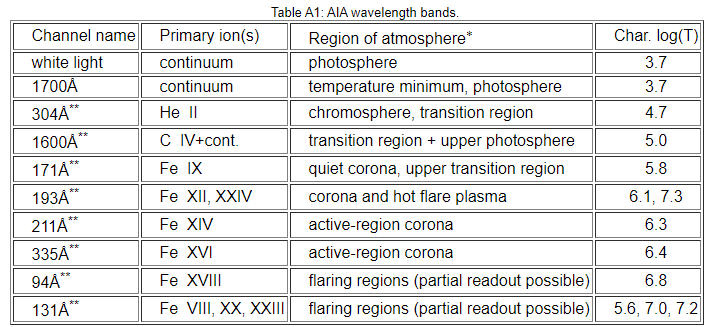
1. What do we call the extension of the Sun’s atmosphere into the solar system?
2. How will SDO help us deal with “space weather”?
3. How are sunspots and space weather connected?
4. The AIA instrument measures light in what range of light? What region of the Sun emits this radiation?

1. What does the HMI instrument measure?
2. Helioseismology studies the inside of the Sun by using what kind of Waves?
3. What do the black and White colors on the magnetic map of the Sun represent?

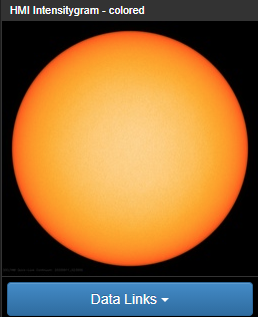
**Part II: Observing solar activity**

Sun image with the text AIA 193Now view the following website [http://sdo.gsfc.nasa.gov/data](http://sdo.gsfc.nasa.gov/data/)/. Here we can see the data from the Sun *today*. Each image has been labeled with important information. At the top you will see “AIA” and then a number (like AIA 193). This tells you the AIA instrument took the data and that the wavelength of light in that image is 193 ***angstroms***. The figure on the right is an example. All the AIA images are taken in extreme ultraviolet light (EUV). The HMI images are in visible light. All images are artificially colored.

1. Compare and contrast the different wavelength images. Specifically comment on which of the images seems the most “active”, which of the images seem the most “quiet”? Also mention what criteria you are using to differentiate quiet from active.

Each wavelength represents a different region and temperature on the Sun. Let’s explore that in more detail. The table below list the AIA wavelength, region, and temperature 

1. What region of the Sun do images taken with wavelength 193 A represent?
2. What is the temperature of that region? (Char. Log (T) means the power of ten, for example, it you have value is 3.7, the temperature is 103.7 K= 5011K)



Click to see the enlarged image of Sun in HMI Intensitygram for today. The figure on the right is an example.

1. Record the date of today
2. How many active regions (Sunspots) can you see on the Sun in the image?
3. Do you think today is a time of high solar activity or low solar activity? Explain why.

Watch the video, an active region in three different wavelengths of light side by side.

Link: <https://www.youtube.com/watch?v=yQiaHQL1rwg>

Sun images with different colors, orange, yellow and black-whiteAn ***active region*** is an area on the Sun where the magnetic fields are stronger than the surrounding area. ***Sunspots*** are visible manifestations of active regions. Active regions are also responsible for solar eruptions like ***flares, prominences,*** and ***coronal mass ejections***. In this video, we see an active region in three different wavelengths of light, side by side.

1. Does the flare emanate from an active region (sunspot) or does it emanate from a “quiet” place on the Sun?
2. What other solar activity can you see occurring in the same region?

What features of the Sun are *uniquely* visible in each of the three frames of the video? Please choose one from the following available features: prominences, flares and sunspots for each question below.

1. Orange (AIA 304 A, Chromosphere, 50,000 K)
2. Yellow (AIA 171 A, Corona, 630,000 K)
3. Black and White (HMI intensitygram, Photosphere, 5,000 K)