10.9: Studying the Sun

We can clearly see the sun's surface features, examine its characteristics in a variety of wavelengths, and glean insight into the nuclear mechanisms of not only the sun, but also of other stars. When observing the sun in **Visible light**, you MUST use a proper solar filter — in front of your eyes, the telescope or binoculars to view the sun safely. A proper solar filter is safe because it does not transmit ultraviolet or infrared radiation, both of which are much more harmful to your eyes than light. It also drops the sun's brightness to a comfortable level. And a pinhole viewer can also be constructed to safely – and indirectly – view the sun and sunspots.

You might have heard that you should never look at an eclipse. First of all, all lunar eclipse phases are safe to view. The partial phase of a solar eclipse, or an annular solar eclipse requires a proper solar filer. It is NOT the eclipse that causes eye damage, it is the sun. During solar eclipse totality, no filter whatsoever is required.

In 1814, optician and physicist Joseph Frauenhofer (1787-1826) invented the first spectroscope. Frauenhofer was comparing the spectra of fire to that of the Sun when he noted dark lines in the sun's continuous spectrum. Named the **Frauenhofer lines**, these absorption lines are a function of the sun's photosphere.

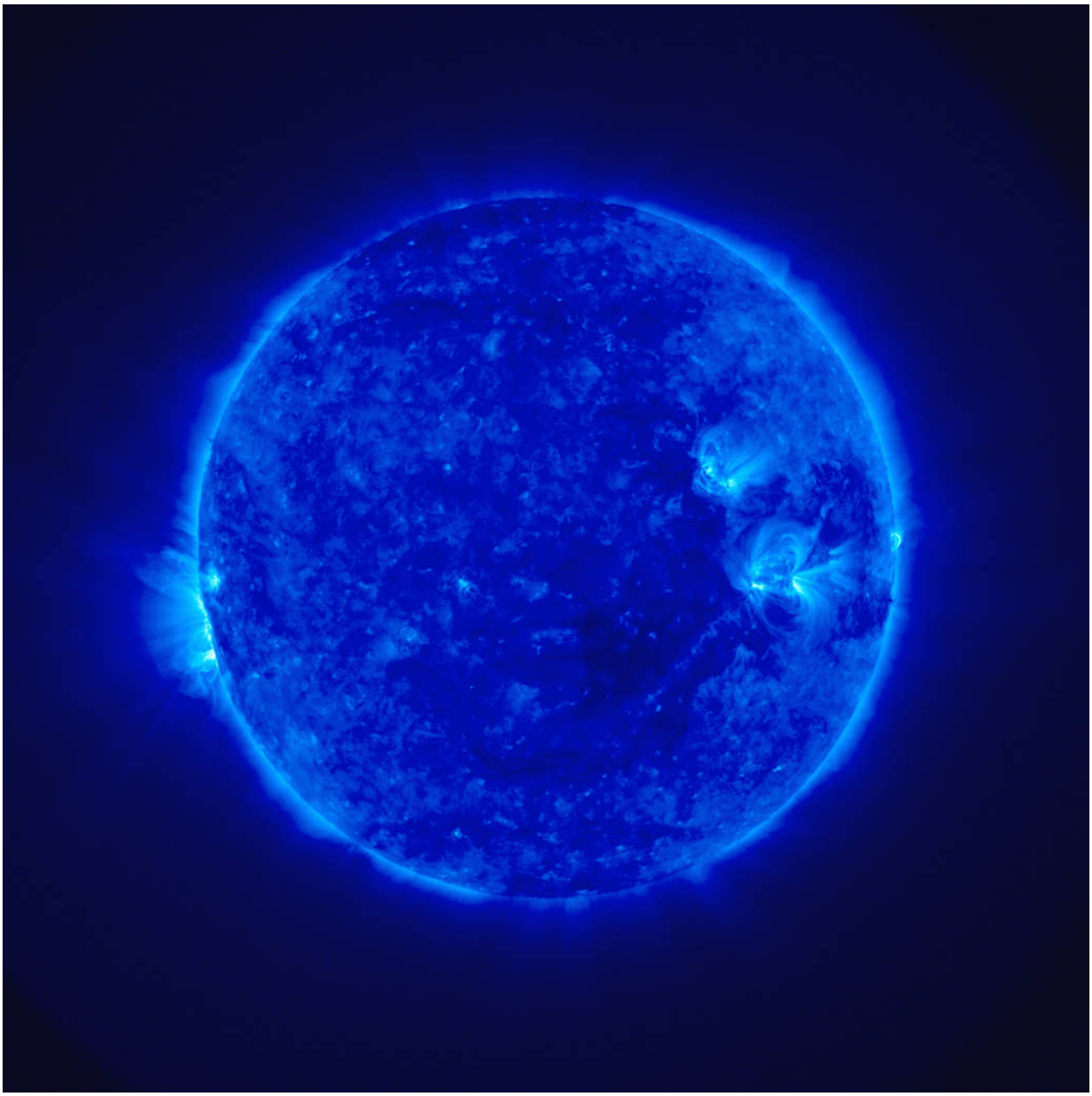
Such a spectrum is created when light passes through a gas or a liquid, or strikes a solid surface. You see the spectrum of the absorption; the wavelengths of light absorbed by the material are absent in the spectrum, leaving blank spaces behind

Perhaps the most-impressive is **Hydrogen-Alpha, H-a**. H-a filters center on a wavelength of 6562. 8 Å and allow through only a tiny part of the red light the sun produces, blocking all other colors. Solar flares and prominences are best seen through an H-a filter.

Studies of the element calcium, Ca, on the sun are done at **Calcium H** (3969Å) and **Calcium K-lines** (3933. 7Å). This is instrumental in determining the solar atmosphere's depth.

Other specific features are visible at narrow bandwidths. High granulation and supergranulation detail, and impulsive-phase flare eruption kernels are visible at the **Sodium Na-D line** (5895. 9Å). Flare and magnetic lines research is conducted at the **Helium D3 line** (5875. 61Å); this is one of the most impressive visually.

Light emitted by highly charged iron (Fe) ions at high temperatures is best studied in the **Ultraviolet, UV. And X-Rays** are released from the sun's upper atmosphere and corona.



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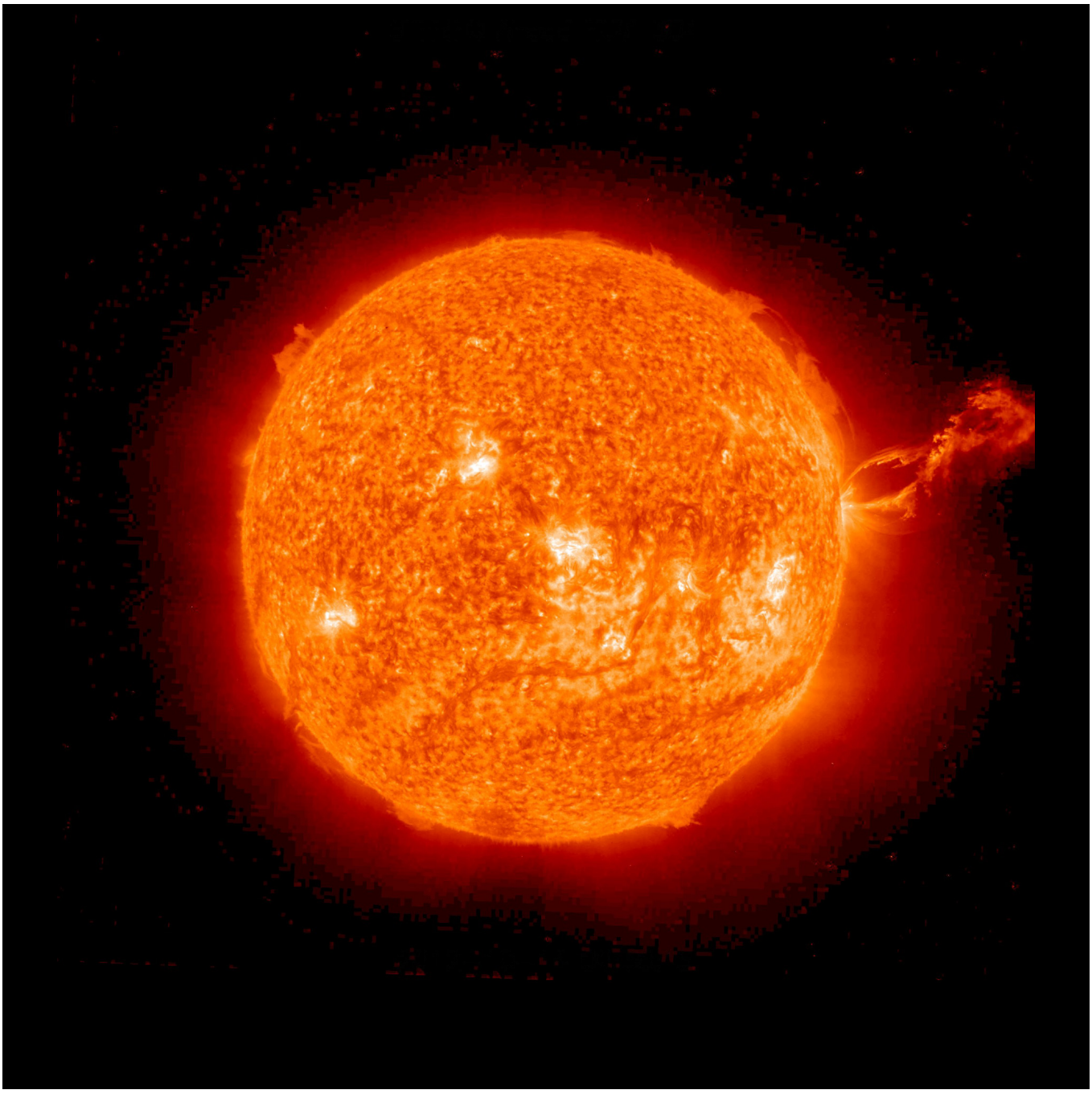

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Our Sun is important – *critical* – to life on Earth, yet is it not the calm star, which we all might presume…

Watch on YouTube these NASA solar videos:

"Fiery Looping Rain on the Sun," Video Link *Note the Earth to scale from 1:06 to 1:22.*

"Eruptive events on the sun can be wildly different. Some come just with a solar flare, some with an additional ejection of solar material called a Coronal Mass Ejection (CME), and some with complex moving structures in association with changes in magnetic field lines that loop up into the sun's atmosphere, the corona" (NASA, retrieved, March 29, 2015).

On July 19, 2012, an eruption occurred on the sun that produced all three events:

- The Solar Dynamics Observatory's AIA Instrument collected the footage in this video. SDO collected one frame every 12 seconds, and the movie plays at 30 frames per second, so each second in this video corresponds to 6 minutes of real time. The

video covers 12:30 a. m. EDT to 10:00 p. m. EDT on July 19, 2012.

"Magnificent Eruption," Video Link

Consider the following questions based on the YouTube videos:

1. What was your first reaction to seeing/hearing these videos?
2. How would you describe the Earth when compared to the Sun in size in the first video, *"Fiery Looping Rain on the Sun? "*
3. As we 'look' at our Sun in the sky, it seems fairly quiet. Yet what do these videos show us?
4. Why would we want to monitor the Sun's activity? What can this teach us about other stars?
5. Your speculation: if one of these Coronal Mass Ejection outbursts were to strike Earth directly, could it cause any problems?
