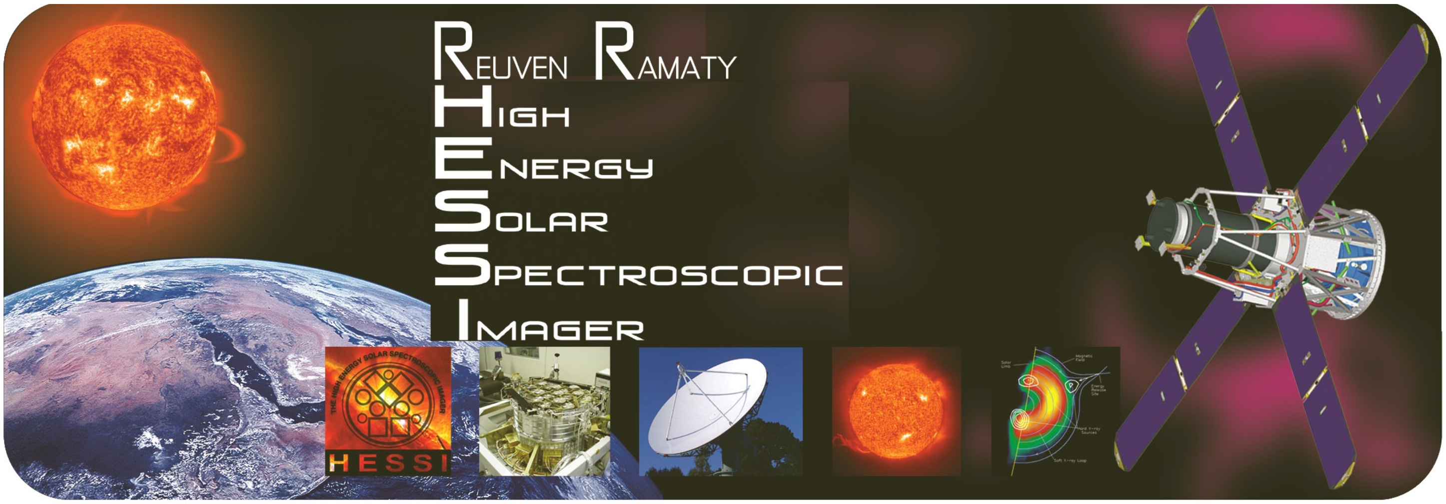


Mission

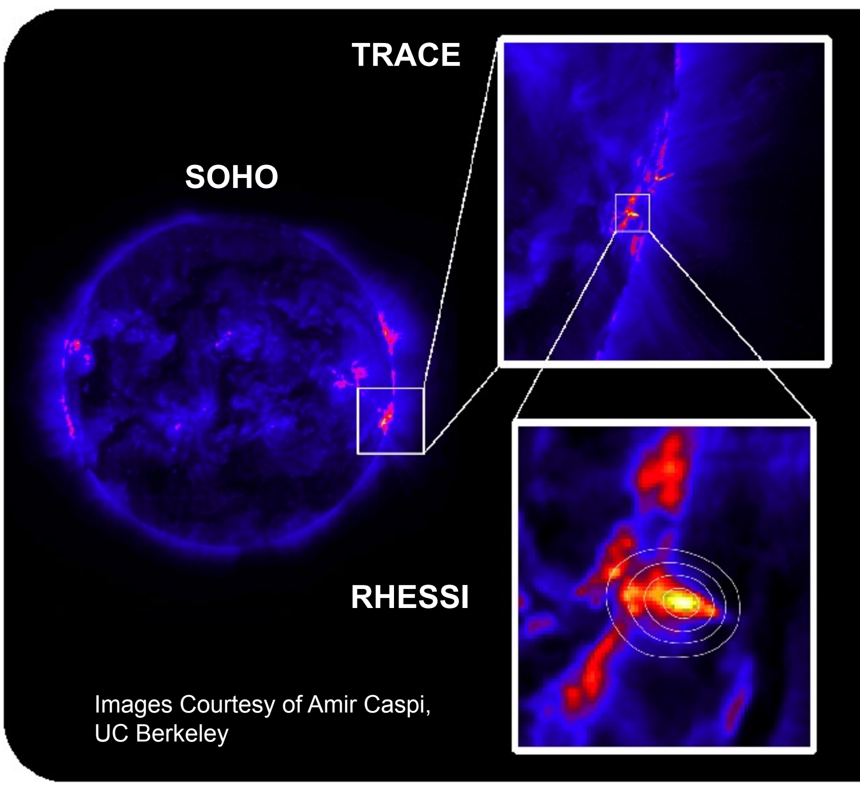
The Reuven **Ramaty** **High** **Energy** **Solar** **Spectroscopic** **Imager**, **RHESSI**, studies the active Sun and energetic solar flares.

A flare results from the rapid release of magnetic energy which has built up in the solar atmosphere. Flares are seen as intense brightenings in active regions on the Sun. The amount of energy released in a flare can be ten million times greater than the energy released in a volcanic eruption. This energy is released in a very short time – as little as a few tens of seconds.

RHESSI launched in February, 2002.

RHESSI addresses the following questions:

1. How is such a large amount of energy released so rapidly during a flare?
2. How can such a large part of this energy go towards accelerating electrons and protons to very high energies?
3. Where in the solar atmosphere are the electrons and protons accelerated and where do they deposit their energy?



Images Courtesy of Amir Caspi, UC Berkeley

On April 21st, 2002 RHESSI observed its first flare of class X. The flare lasted for several hours. In the photos on the left we see this flare as recorded by several NASA missions. The EIT instrument aboard the SOHO spacecraft views the entire Sun in extreme ultraviolet light. TRACE sees in ultraviolet light as well but observes smaller regions of the Sun in greater detail. RHESSI records high energy X-rays also for smaller regions of the Sun.

In the RHESSI frame we see countours of constant X-ray brightness overlaid on a zoomed-in part of the TRACE image. The inner countours represent the greatest X-ray brightness and the outer countours the lowest.

For more information on the mission science visit ***http://hessi.ssl.berkeley.edu/*** *or* ***http://hesperia.gsfc.nasa.gov/hessi/***
Also visit the education website ***http://cse.ssl.berkeley.edu/hessi/***

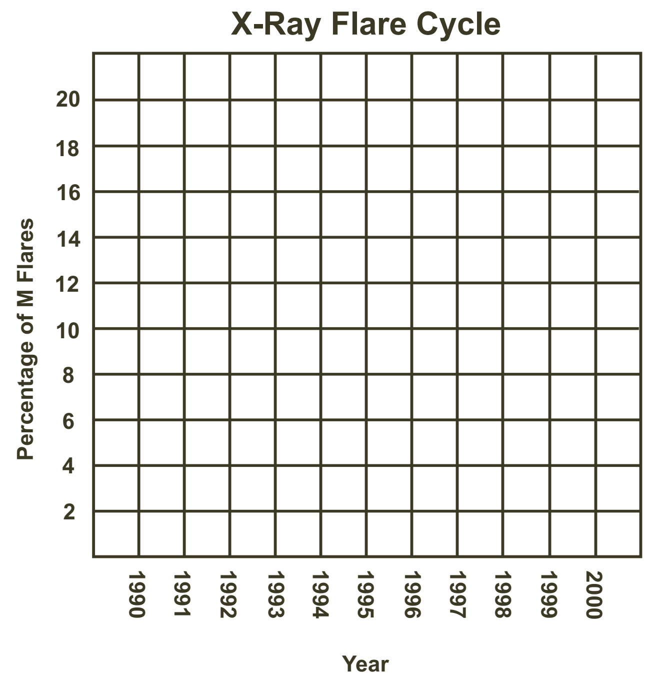
Discover the Solar Cycle

Solar flares are one of the fastest and most energetic events on the Sun. During a flare, the Sun releases a large amount of energy in a short period of time. Scientists observe solar flares in many different wavelengths, from low-energy radio waves to high-energy gamma rays. The RHESSI satellite makes much sharper pictures of solar flares in high-energy X-rays and gamma rays than any satellite to date. This activity uses X-ray flare data from GOES, a Geostationary Operational Environmental Satellite, since RHESSI has not been collecting data for very long. GOES satellites primarily monitor environmental conditions on Earth, but there is an X-ray monitor on board which records X-ray emission from the Sun.

Scientists use a series of letters and numbers to classify the energy level of an X-ray flare. The letters used are A, B, C, M and X, with A being the weakest and X being the strongest class of flare. This activity singles out M class flares because they occur fairly often and are always strong enough to show up above the normal X-ray emission level of the Sun.

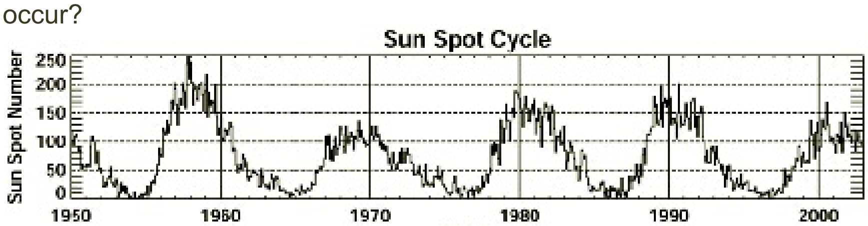
Listed in the table below are the total number of X-ray flares observed from the Sun for each year during an 11-year period. The total number of M class flares is also listed. For each year, calculate the percentage of X-ray flares that are M class. Fill in column 4 with your results. Use the graph on the right to plot the percentage of M class flares over time. If you choose, you could also plot the total number of flares, or the number of M class flares on a different graph.

Year	Total Number of Flares	Number of M Flares	Percentage of M Flares
1990	2630	273	
1991	3324	590	
1992	2815	202	
1993	2446	74	
1994	1610	25	
1995	1124	11	
1996	515	4	
1997	1141	21	
1998	2248	94	
1999	2425	170	
2000	2661	215	



What do you notice from your graph? Is the percentage of M class flares on the Sun constant in time? What about the total number of X-ray flares, and the number of M class flares alone? When do you see a maximum or minimum percentage of M class flares? What does it mean if the percentage of M class flares changes with time?

In the graph below the number of sunspots observed on the Sun are plotted for a 52-year period. Solar flares are known to originate in regions where there are sunspots. An interactive web activity about the correlation between sunspots and flares can be found at **http://cse.ssl.berkeley.edu/segwayed/lessons/sunspots/**. Do you see any similarity in the number of sunspots and the number of X-ray flares? Can you identify a repeating pattern in the number of sunspots? What is the period of time over which this pattern repeats? From these data, can you predict when the next maximum or minimum of solar activity will occur?



This activity is intended for middle school students. In the full version available online, *X-ray Candles: Solar Flares on Your Birthday* (**http://cse.ssl.berkeley.edu/hessi/html/cur.html**), middle or high school students count the number of high-intensity X-ray flares in their birth month and combine their findings with the rest of the class to obtain and graph complete flare counts for each year.

Please send questions to: ***outreach@ssl.berkeley.edu***