

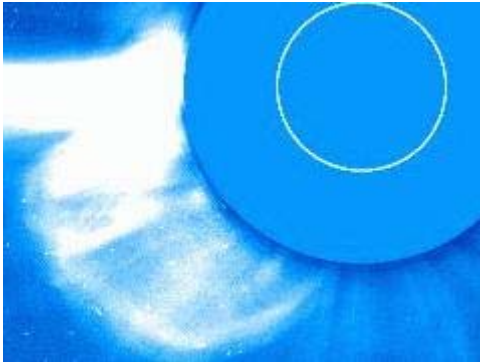
Investigate the Speed of a CME¹

Objective: Use a series of images taken by the SOHO satellite to estimate the velocity of the solar material leaving the sun.

Materials: ruler, calculator, coronagraph image sheets

Background and Procedure: During a CME (coronal mass ejection), huge bubbles of gas are ejected from the Sun over the course of several hours. Space weather scientists are interested in the velocity of the CME material. The SOHO satellite contains an instrument called the Large Angle Spectrometric Coronagraph (LASCO) which takes images of the sun. A coronagraph is a telescope that is designed to block light coming from the solar disk, in order to see the extremely faint emission from the region around the sun, called the corona.

An example of a coronagraph image is shown below. The white circle represents the size and location of the sun.



Courtesy of SOHO/LASCO consortium. SOHO is a project of international cooperation between ESA and NASA

Using the two sets of coronagraph images attached, develop a procedure to estimate the velocity of the CME material as it ejected from the sun. Your procedure should allow you to measure the velocity from each of the slides that follow the first slide in a set. Therefore you will estimate the velocity four times in each set. Only the materials listed above can be used.

The times on each coronagraph image includes a date and time. The time is universal time listed in hour:minute format. For example, 17:18 means 17 hours 18 minutes. There is one known distance on each image. Recall that the white circle represents the size of the sun. The diameter of the sun is 1.4 million kilometers (1.4×10^6 km).

Provide a detailed description of your procedure and a table of your data. Remember to include all calculations performed. Calculate an average velocity for each set.

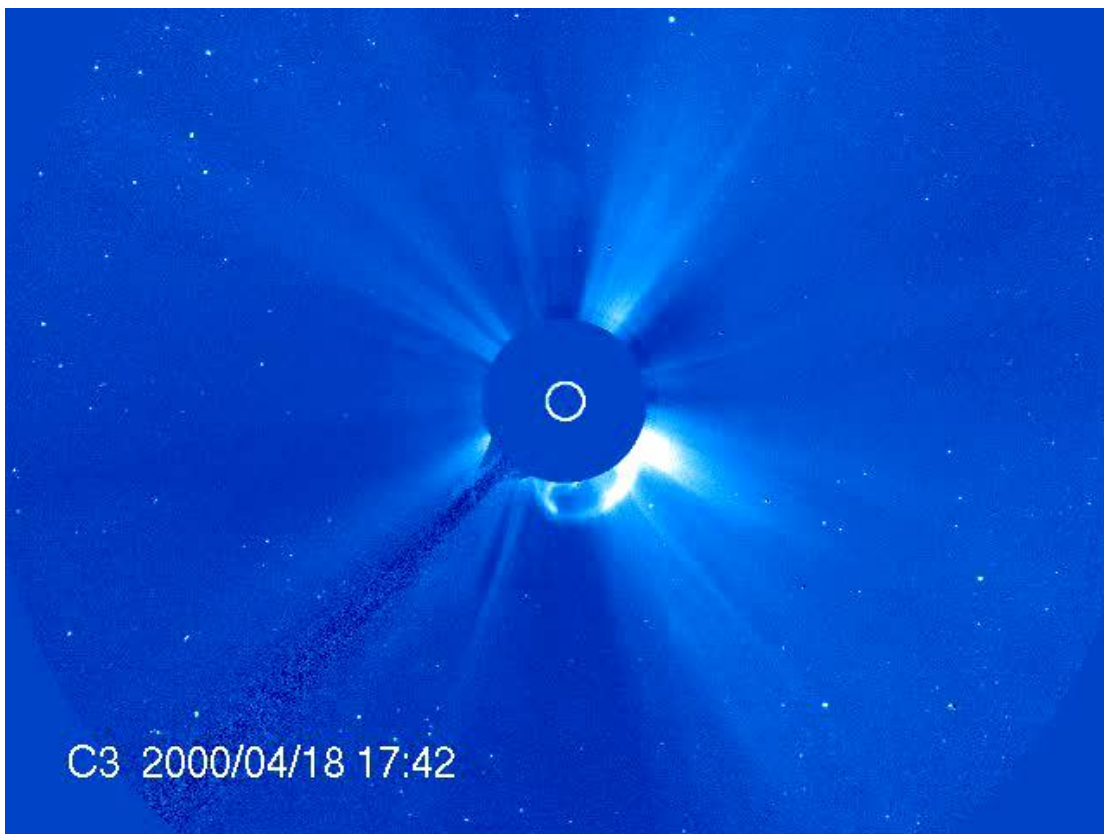
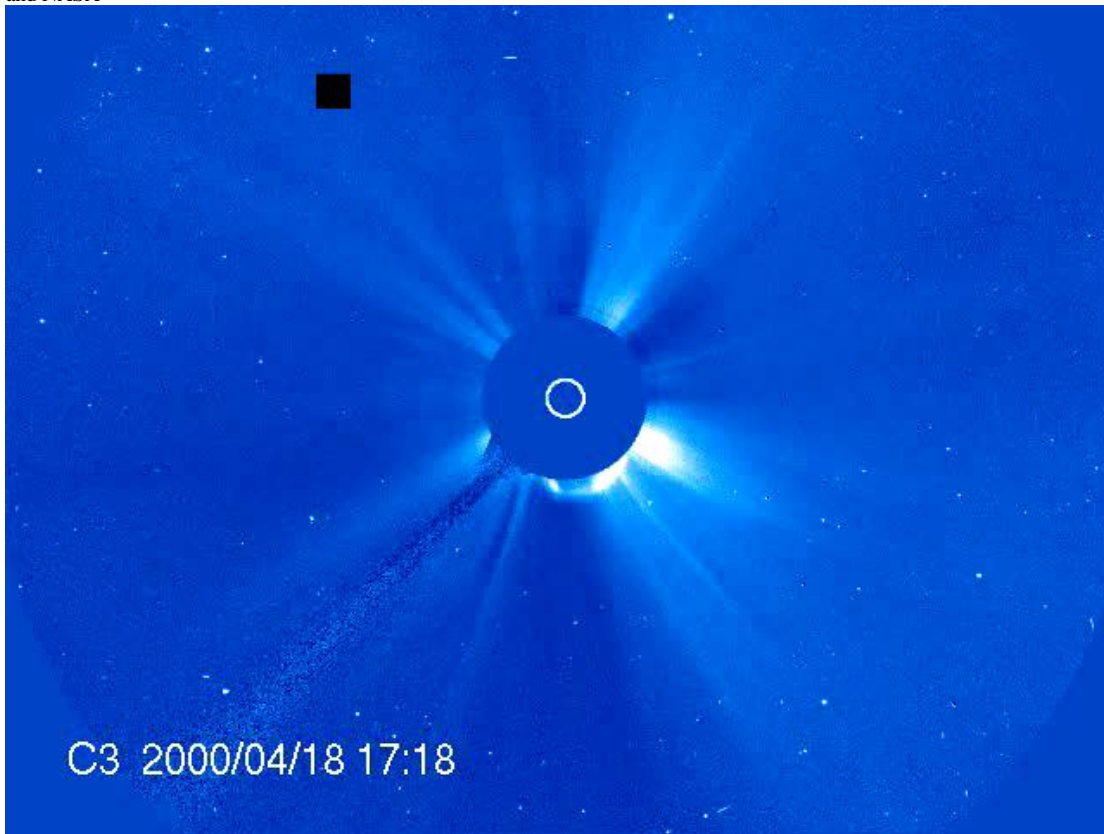
¹ This activity is based on "Sun-Centered Physics," a set of lesson plans developed by Linda Knisely.

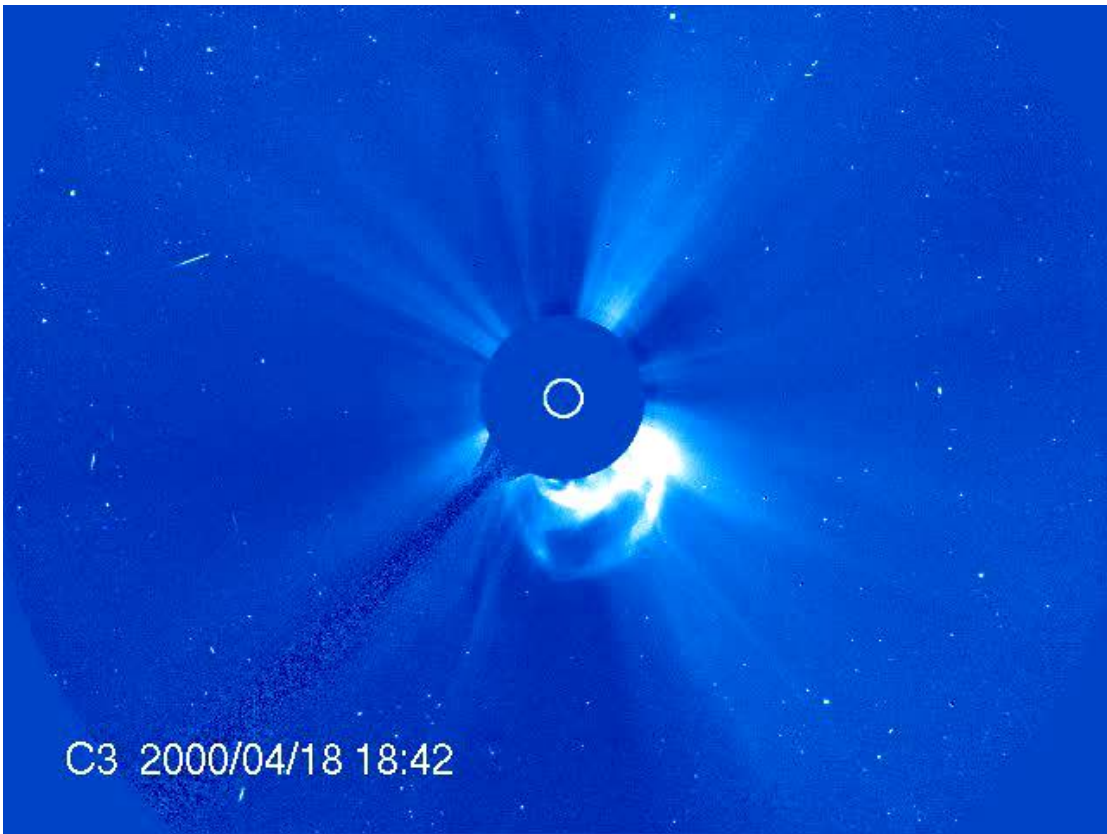
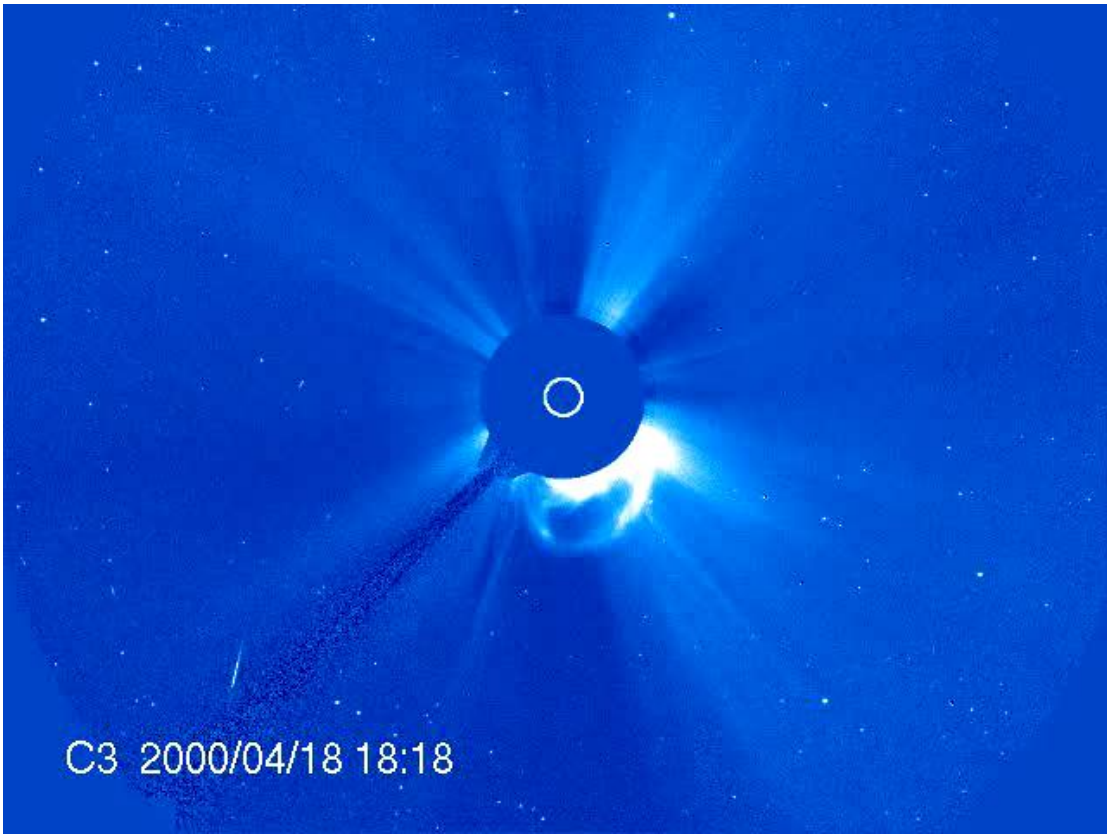
Questions:

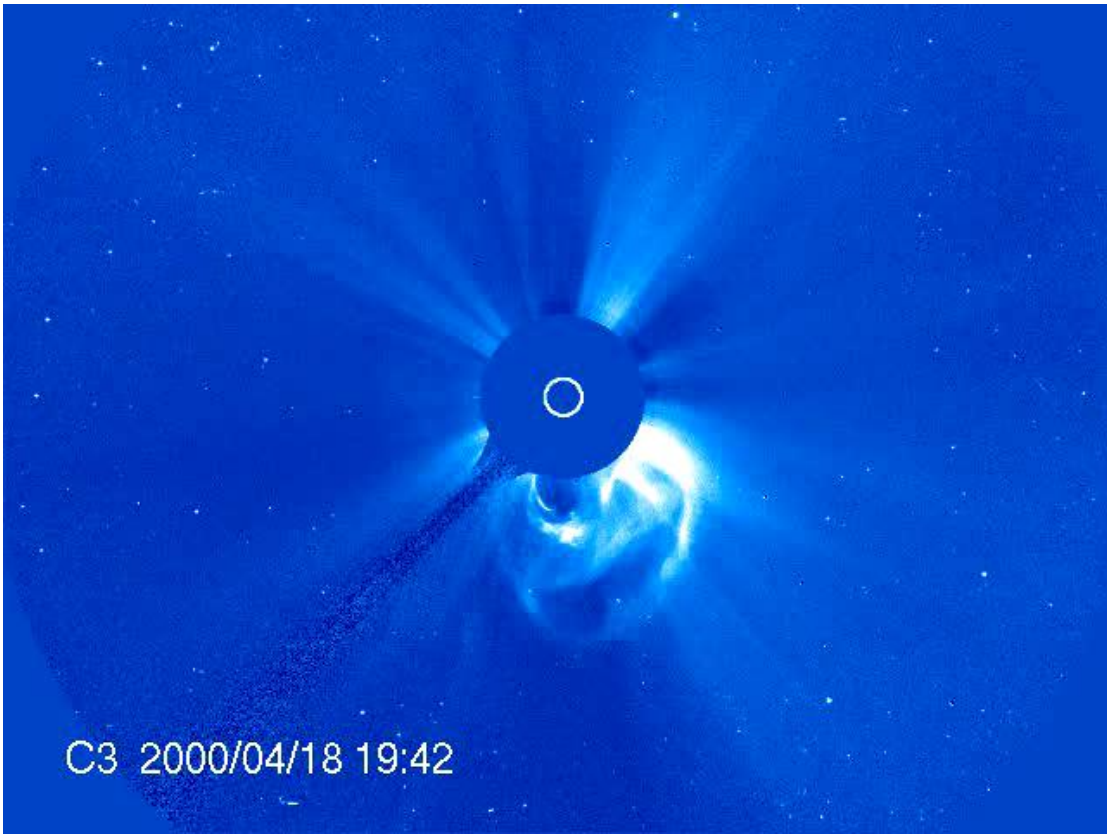
1. Are you familiar with any object that moves at the calculated average velocity?
2. Select one of the average velocity values and describe what it really means. (For example, a car traveling at 25 mi/h really means that every hour the car travels 25 mi)
3. At your selected average velocity, calculate the time it would take the CME material to reach the earth.
4. How consistent were the velocities within each set? If they were changing, what could this mean about the motion of the CME near the sun?
5. How confident are you with the velocity values you determined on each slide? What are the sources of error within your procedure?
6. Was there experimental consistency in the values determined from one set of slides to the other? Would you feel comfortable making a statement concerning the velocity of CME's leaving the sun? Explain.
7. The earth is approximately 100 solar diameters from the sun. Estimate the fraction of this distance the leading edge of the CME has reached in the final slides.

SET 1

All of the following images are courtesy of SOHO/LASCO consortium. SOHO is a project of international cooperation between ESA and NASA







SET 2

