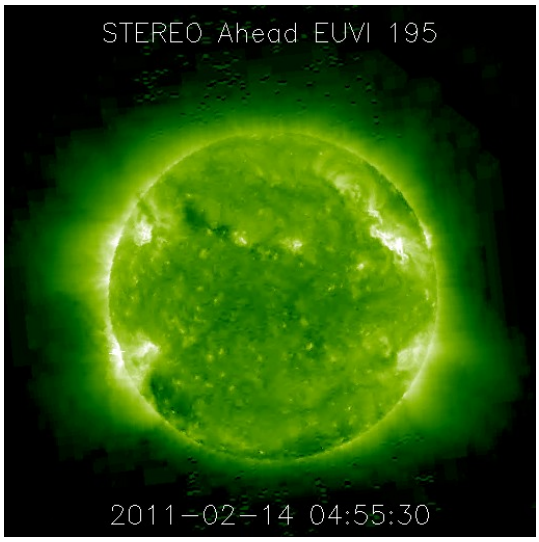
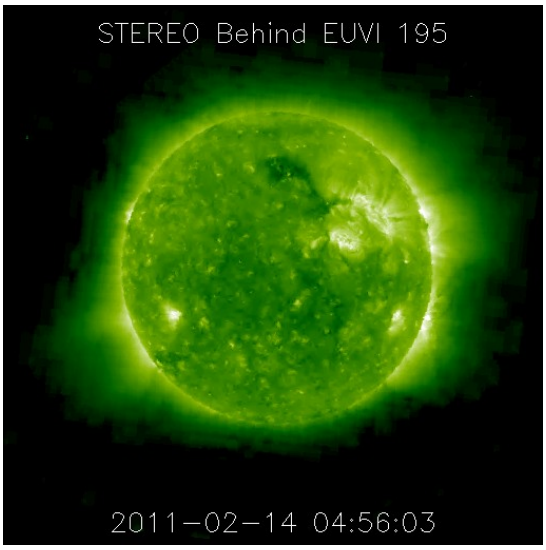
STEREO Spacecraft give 360^{o} Solar View





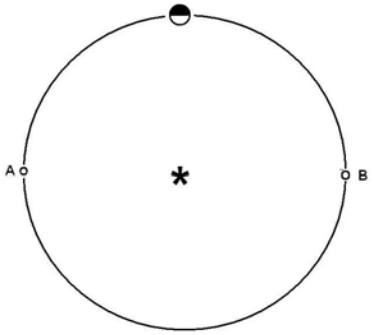
This remarkable pair of images of the sun was taken on February 14, 2011 by NASA's STEREO A (left) and B (right) spacecraft. The spacecraft are close to Earth's orbit, however as viewed looking down on Earth's orbit with the sun at the center, STEREO-A is 90-degrees counter-clockwise of Earth's orbit location, and STEREO-B is 90-degrees clockwise. This means that when the two images above are combined, the entire 360-degree span of the solar surface can be seen at the same time, making this an historical moment for Humanity.

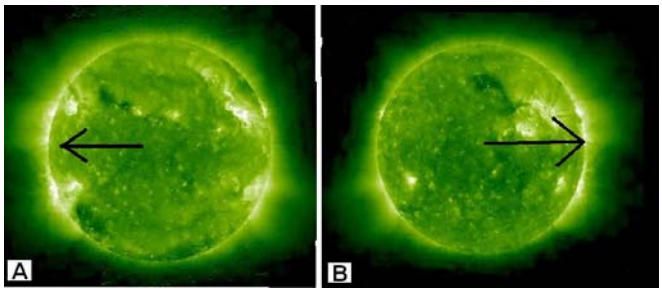
Problem 1 – From the information in the text, draw a diagram that shows the location of the sun, Earth's orbital path (assume it is a circle, whose plane passes through the equator of the sun) and the locations of the STEREO spacecraft. In each of the two images, draw an arrow that points in the direction of Earth.

Problem 2 – The images were taken in the light of iron atoms heated to 1.1 million degrees. The bright (white) features are solar 'active regions' that correspond to the locations of sunspots. At the time the images were taken, what active regions in the above images: A) Could be observed from Earth? B) Could not be observed from Earth?

Problem 3 – Relative to the location of Earth in its orbit, the STEREO-A and B spacecraft move 22 degrees farther from Earth each year. On your diagram from Problem 1, about what will be the positions of the spacecraft along Earth's orbit in February of A) 2013? B) 2015? C) 2017? and D) 2022?

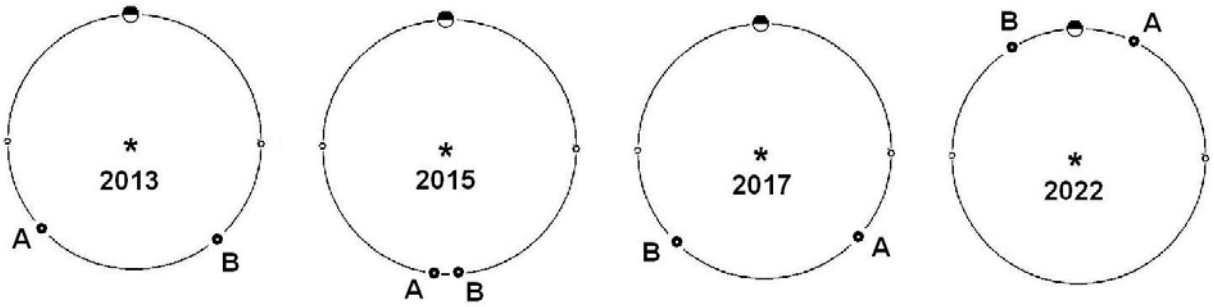
Problem 1 – From the information in the text, draw a diagram that shows the location of the sun, Earth's orbital path (assume it is a circle whose plane passes through the equator of the sun) and the locations of the STEREO spacecraft. In each of the two images, draw an arrow that points in the direction of Earth.





Problem 2 – The images were taken in the light of iron atoms heated to 1.1 million degrees. The bright (white) features are solar 'active regions' that correspond to the locations of sunspots. At the time the images were taken, what active regions in the above images: A) Could be observed from Earth? B) Could not be observed from Earth? **Answer A) Features on the left half of Image A and the right half of Image B. B) Features on the right half of Image A and the left half of Image B.**

Problem 3 – Relative to the location of Earth in its orbit, the STEREO-A and B spacecraft move 22 degrees farther from Earth each year. On your diagram from Problem 1, about what will be the positions of the spacecraft along Earth's orbit in February of A) 2013? B) 2015? C) 2017? and D) 2022? Answer: **If the satellites move 22 degrees along Earth's orbit each year, then for A) 2013, Spacecraft A will be (2013 - 2011) x 22 = 44 degrees counter-clockwise of its February 2011 position. Spacecraft B will be 44 degrees clockwise of its February 2011 position. B) For 2015, Spacecraft A = (2015 - 2011) x 22 = 88 degrees CCW; Spacecraft B = (2015 - 2011) x 22 = 88 degrees CW C) For 2017, Spacecraft A = (2017 - 2011) x 22 = 132 degrees CCW; Spacecraft B = (2017 - 2011) x 22 = 132 degrees CW; For 2022, Spacecraft A = (2022 - 2011) x 22 = 242 degrees CCW; Spacecraft B = (2022 - 2011) x 22 = 242 degrees CW. See diagram below**: - Angles approximate at this scale



Note: The spacecraft were launched in October 2006, so the time for the spacecraft to drift back to earth's vicinity will be 360/22 = 16 1/3 years after October 2006 or about February 2023.