# The Evolution of Eruptive Filaments at Great Distances


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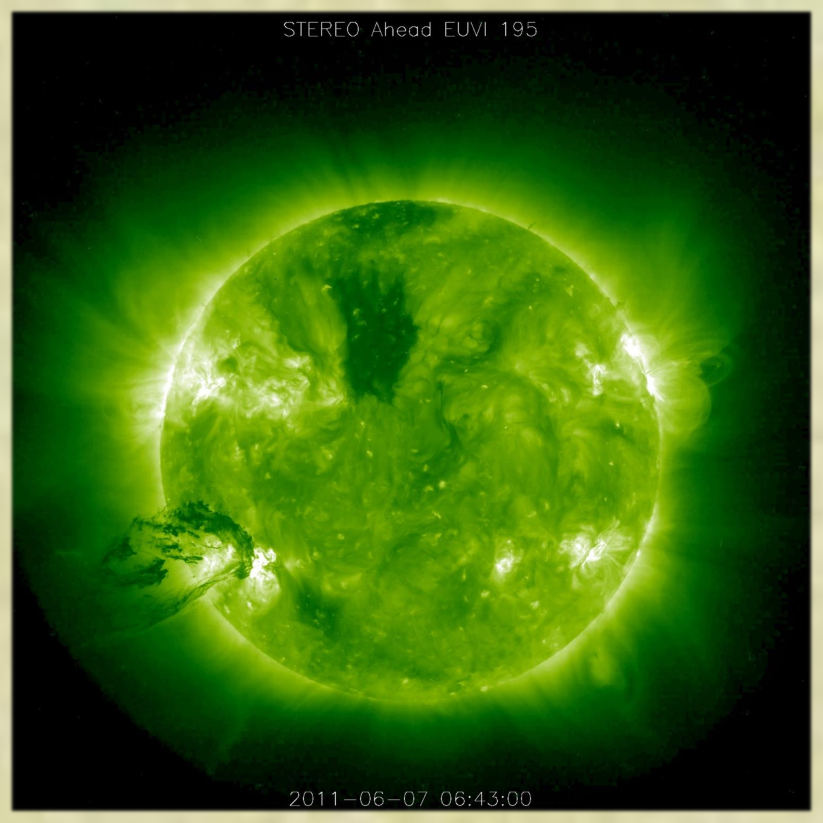



Figure 1. EUVI (STEREO-A) image of filament lifting off from the sun

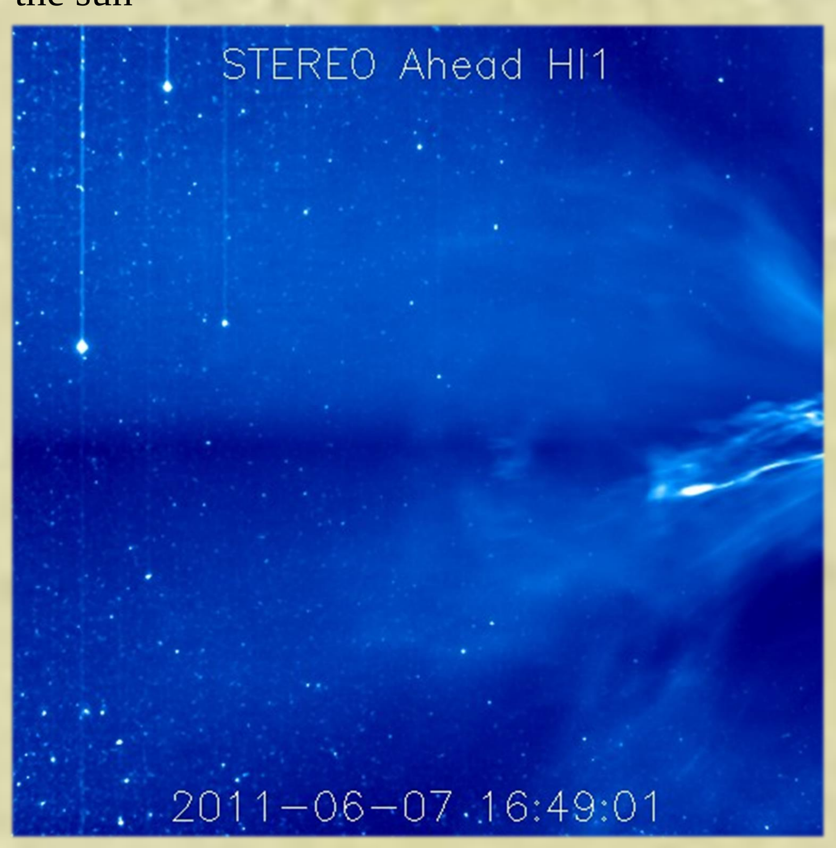



Figure 2. Heliospheric Imager-1 (HI-1) (STEREO A) of filament

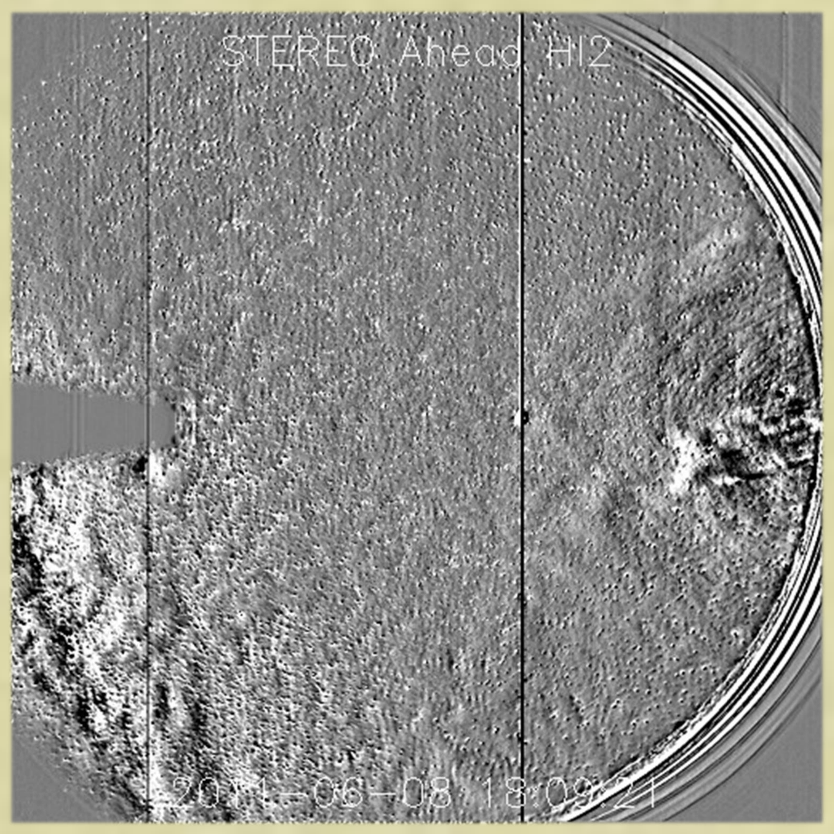



Figure 3. Heliospheric Imager-2 (HI-2) (STEREO-A) of filament

### INTRODUCTION

Eruptive filaments (EF) are cool, dense clumps of plasma erupted from the solar corona. They constitute the rear-most portion of a classic coronal mass ejection (CME). While filaments are well-understood on the surface of the sun, very little is known about them once they have erupted.

At around seven solar radii the brightness of a CME becomes dominated by Thomson Scattering (Howard 2015), so solar images in HI-1 and HI-2 can be analyzed to attain the mass trends of an EF over large distances from the sun.

$$dI = \left\{ \frac{B_{\odot} \sigma_t \pi r_{\odot}^2}{R^4} \right\} \left[ \frac{\sin^4(\chi)(1+\cos^2(\chi))}{\sin^2(\varepsilon)\,\sin^2(\varepsilon+\chi)} \right] dN_e$$

Howard & DeForest 2012

*where $\chi$ defines the scattering angle ($\pi/2 + \xi - \varepsilon$) of light, $\varepsilon$ describes the elongation angle, and $\xi$ is the angle from the sky plane to the measured point.*

Thomson scattering describes the elastic collision between a photon and a free electron which in turn emits light.

### METHODOLOGY

Heliospheric Images were imported into a graphics editing software package and each pixel that constituted the filament was keyed. The individual brightness value of each pixel was then converted to its respective mass before being summed together. (Howard 2015).

To account for some uncertainty in the solar images, each frame was measured with two degrees of strictness for the bright pixels making up the filament.

### RESULTS

Unlike its associated CME, the brightness of the filament decreases further from the sun. Because the brightness is dominated by Thomson scattering at these distances, this is interpreted to be a decrease in the mass of the filament.

### DISCUSSION

While the leading plasma edge of the CME accretes material from the surrounding solar wind, its filament steadily losing mass as the distance from the sun increases (figure 6).

This effect cannot be caused by the interference of Hα emission, which is prevalent closer to the sun. Hα's contribution to the total detected polarized light is overwhelmed by Thomson scattered light at distances of about seven solar radii. Instead, the filament material seems to disperse across the field lines through an unknown mechanism. (Howard, 2015)


### ACKNOWLEDGEMENTS

Funding for this project was supplied by NSF through the REU program in Solar and Space Physics at the University of Colorado, Boulder. I would also like to thank Tim Howard, my project mentor, and the Southwest Research Institute.

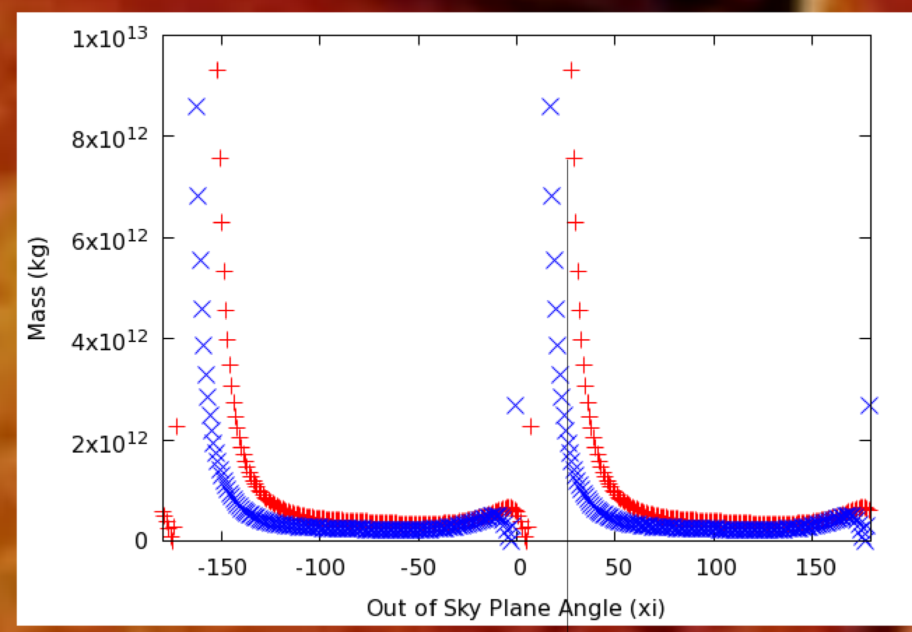




Figure 5. Intersection of STEREO-A and STEREO-B gives true position and mass of the filament. Plot of mass from angle of the sky taken from the HI1 image at 06/08/2011 00:00:49 UT, measured at 30 degrees relative to the Earth

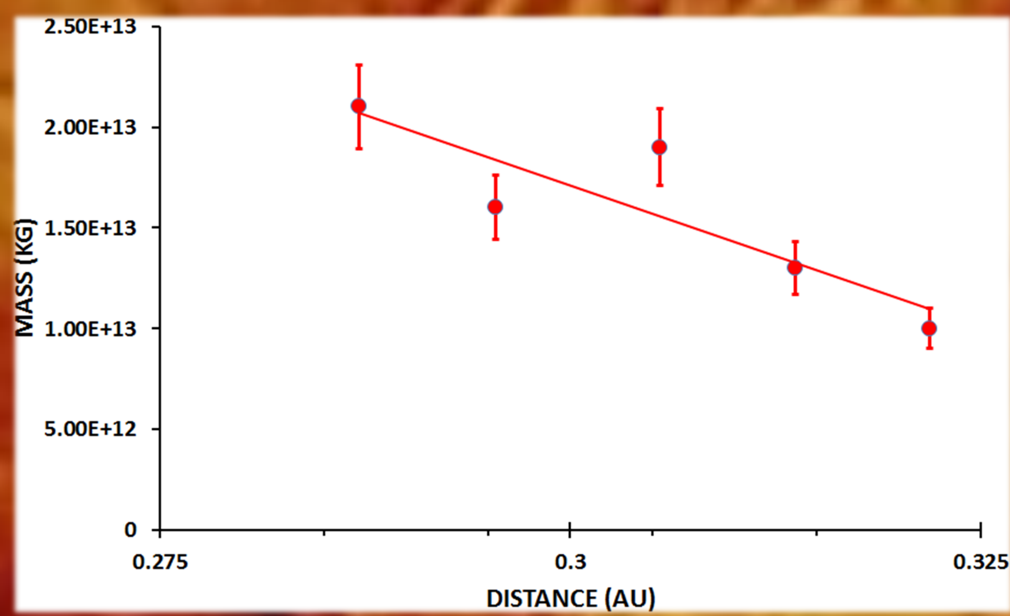
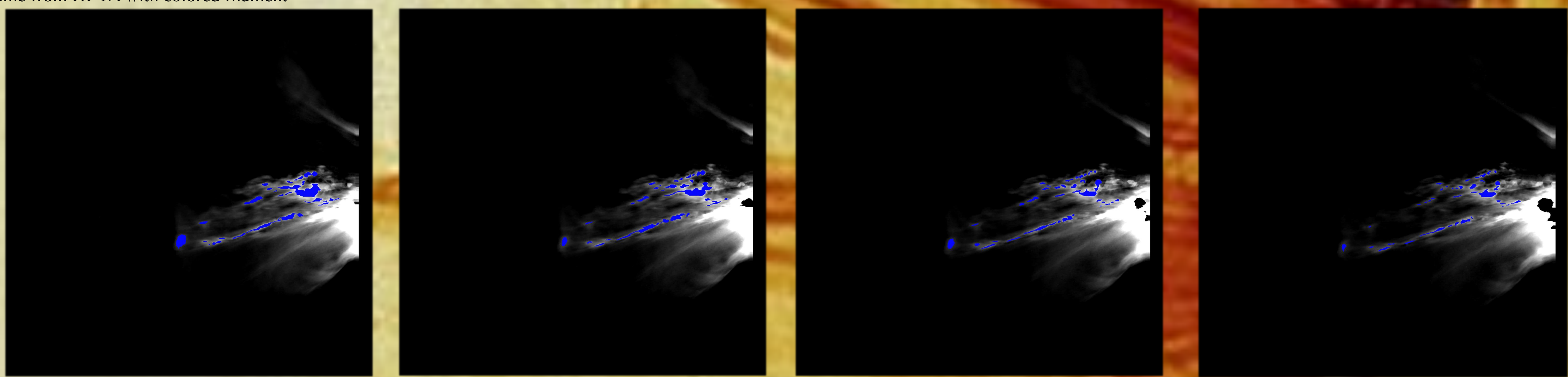



Figure 6. Mass of filament decreases with distances from the sun (seen through the dimming of the Thomson scattered light), measured of at an angle out of the sky plane of 30 degrees

Figure 4. Keyed frame from HI-1A with colored filament



06/08/2011 03:29 UT

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