



Tracing out the Sun's Magnetic Field

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MAGNETIC FIELD

- Dipole field
 - Active region loops that are not flaring approximate a potential field
- Constant flux condition
 - $\Phi = B \cdot A$
 - B decreases and A increases as distance from the sun's surface increases
 - Loops should be thicker at the top and thinner at the footpoints
 - However, this has not been observed
- Why is this?

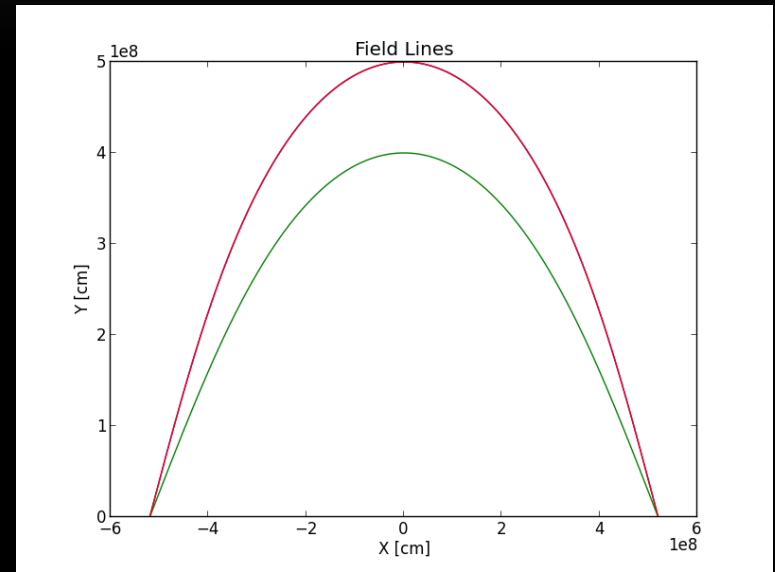
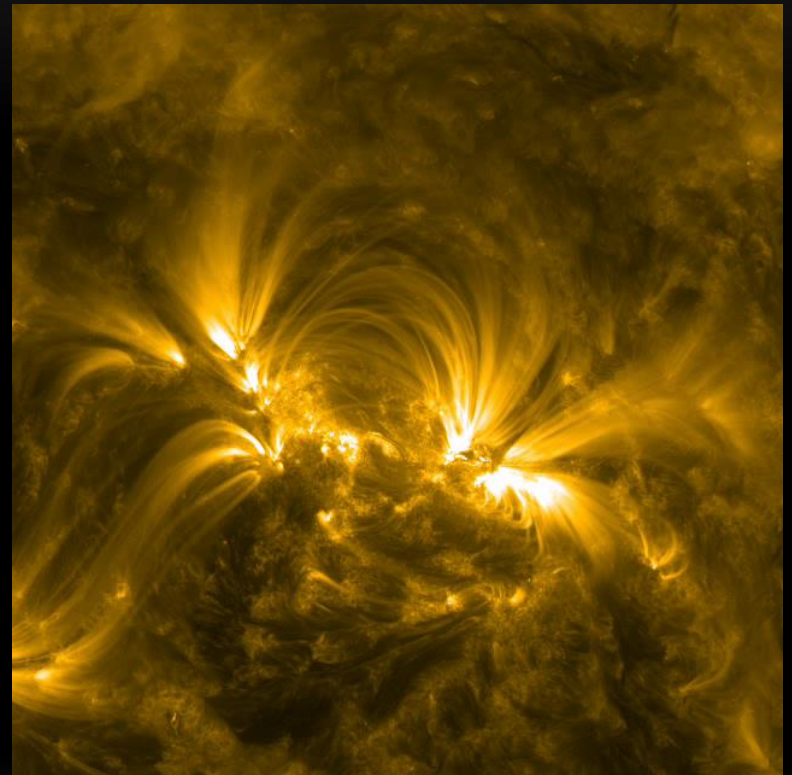


Image courtesy of Trae Winter

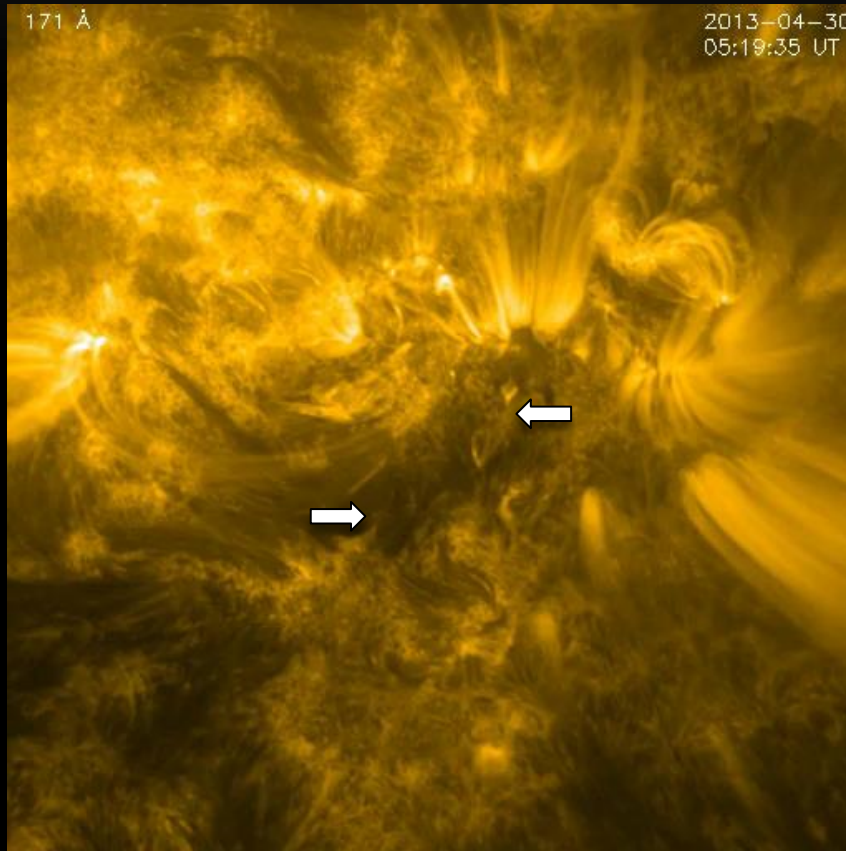
LOOPS

- Generally static, continuous structures with uniform brightness and width
- Thought to trace out magnetic field lines
- Mass and energy flow easily along field lines, but not across the lines



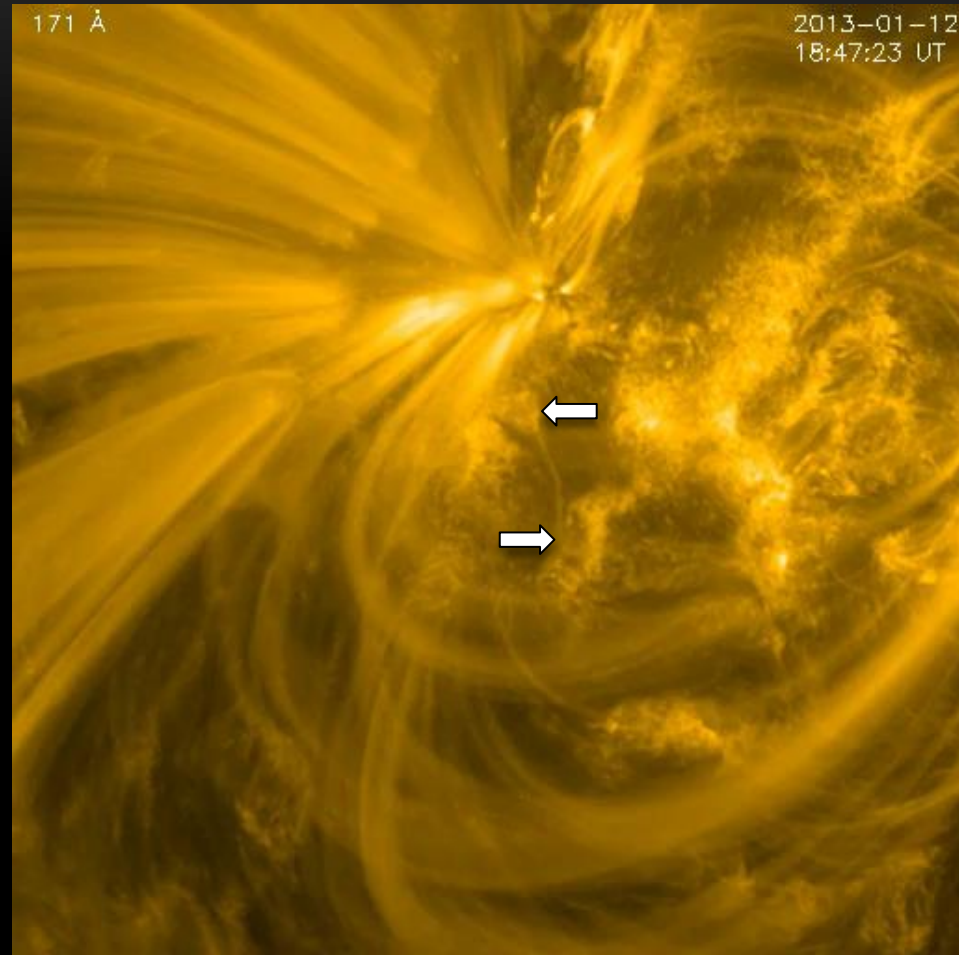
BLOBS

Blob 0519



- Dynamic structures
- An intensity that travels from one position to another
- Appear to change as a function of position

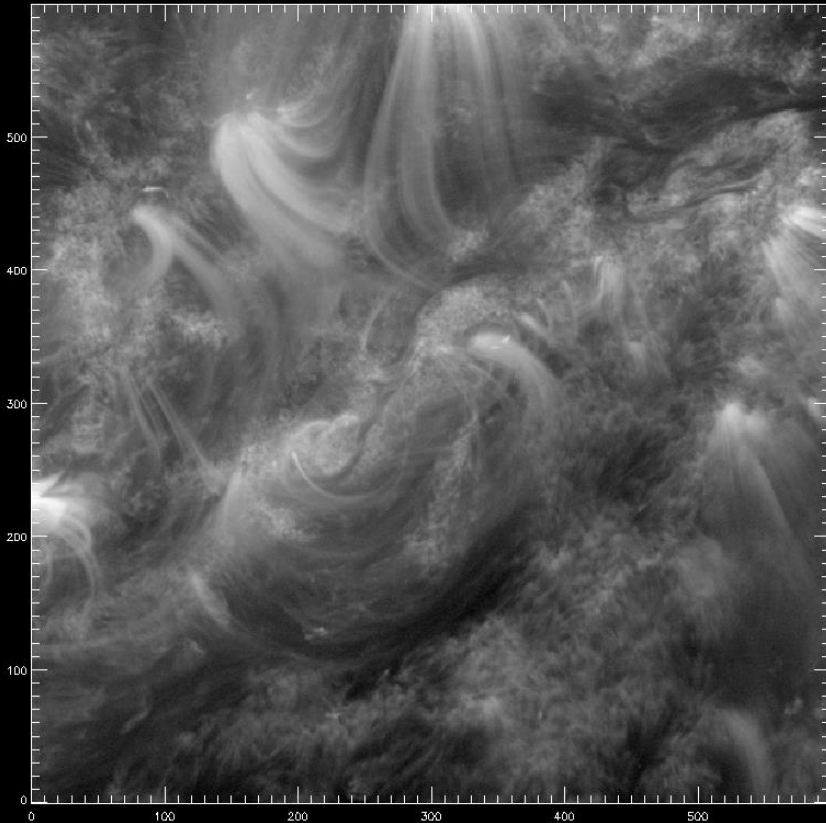
Blob 1847



GOALS

- Two Goals:
 - Find if blobs do actually change shape in order to understand more about magnetic field structure
 - Ascertain the sources and causes of the blobs – is there a different type of heating or magnetic field?
- Initial expectations: because magnetic field expands with height to fill volume, loops should appear thicker at their tops

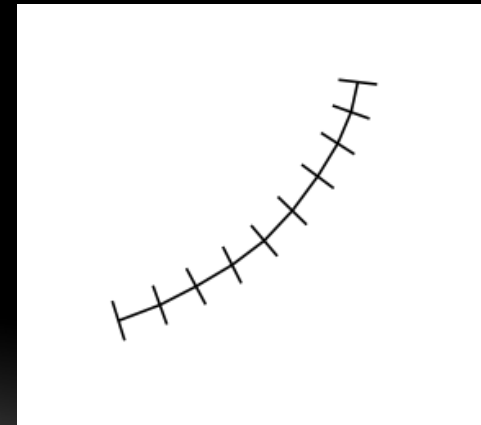
PREPARING DATA



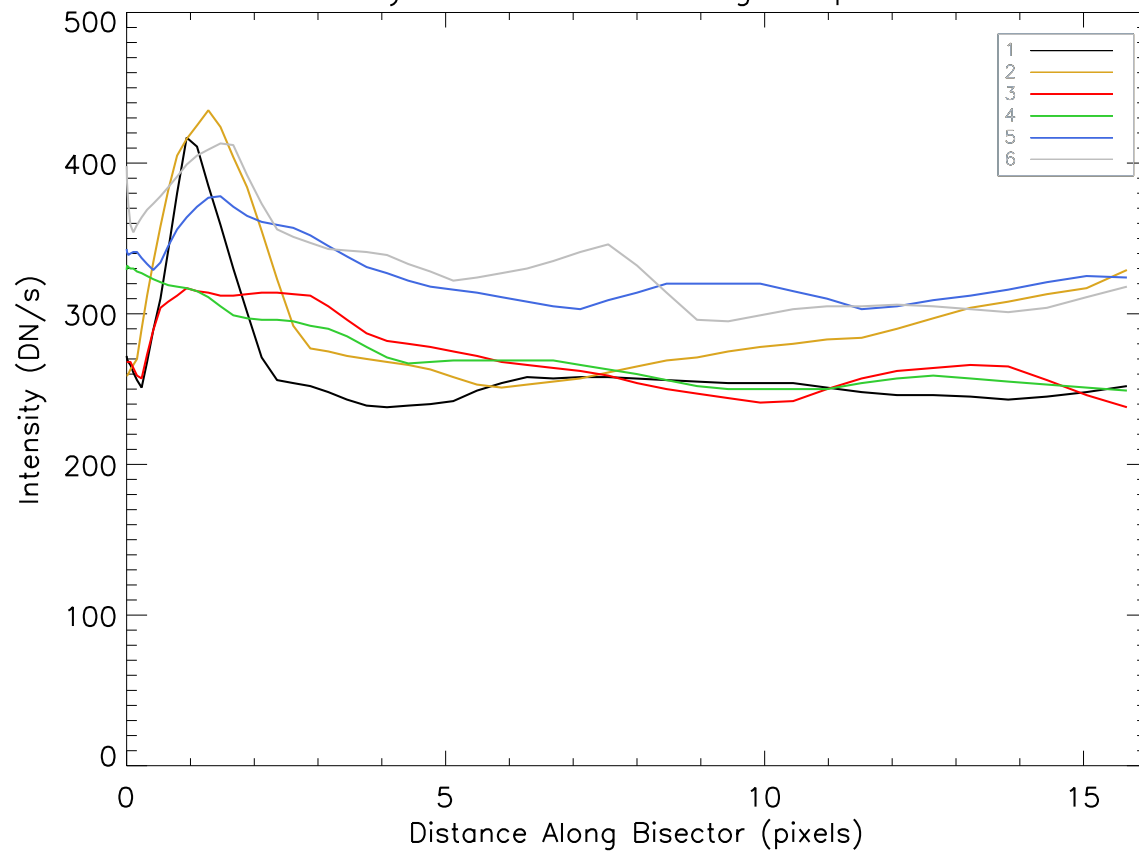
- Diffraction and scattering of light spreads light from a point source into a pattern called the point spread function (PSF)
- Deconvolution involves removing the effect of the PSF in order to create a clearer image
- Prepping involves aligning and derotating the images
- Necessary steps in order to obtain the clearest image possible for analysis

MEASUREMENTS

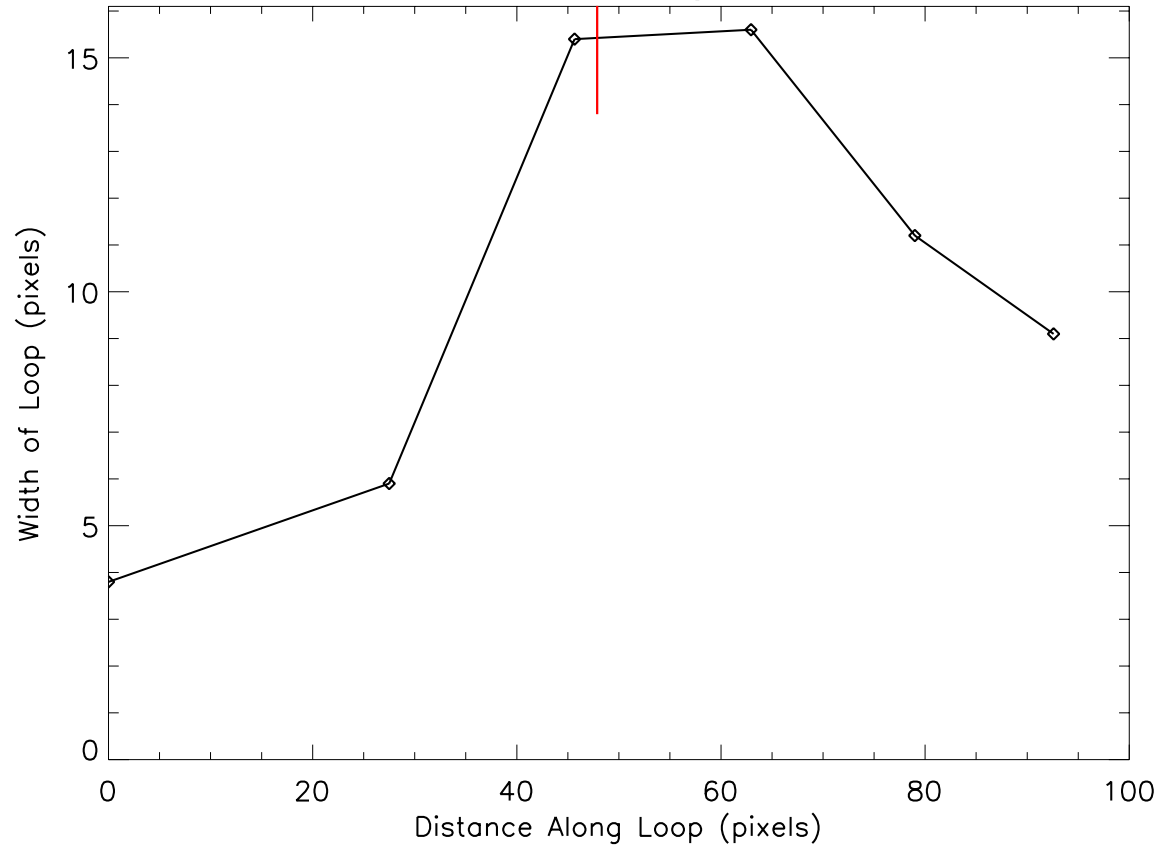
- Defined loops manually using stacks of images and movies
- Created perpendicular bisectors along each section of the loop
- Measured brightness along each bisector
- Measured full-width-at-half-maximum to determine width of loop
- Used maximum brightness as intensity
- Plotted width and intensity against distance along the loop



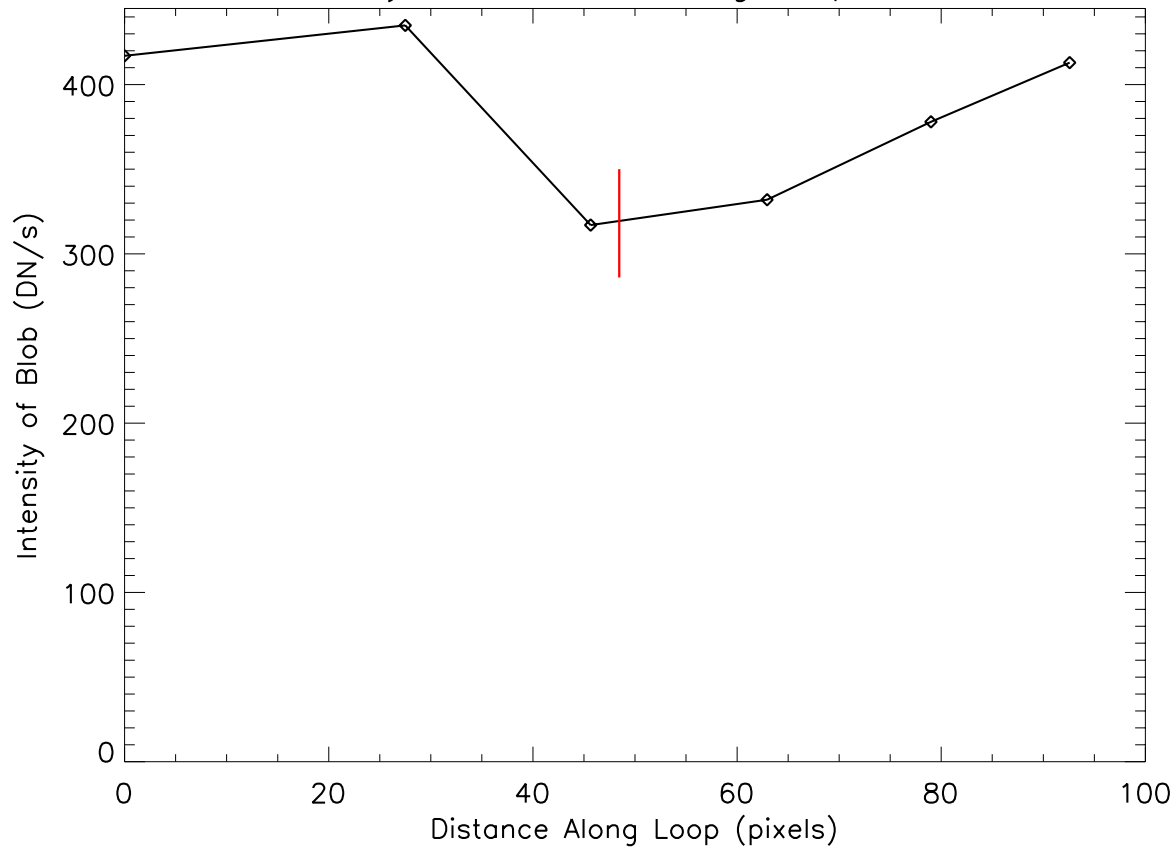
Intensity vs. Distance Along Loop - 0713



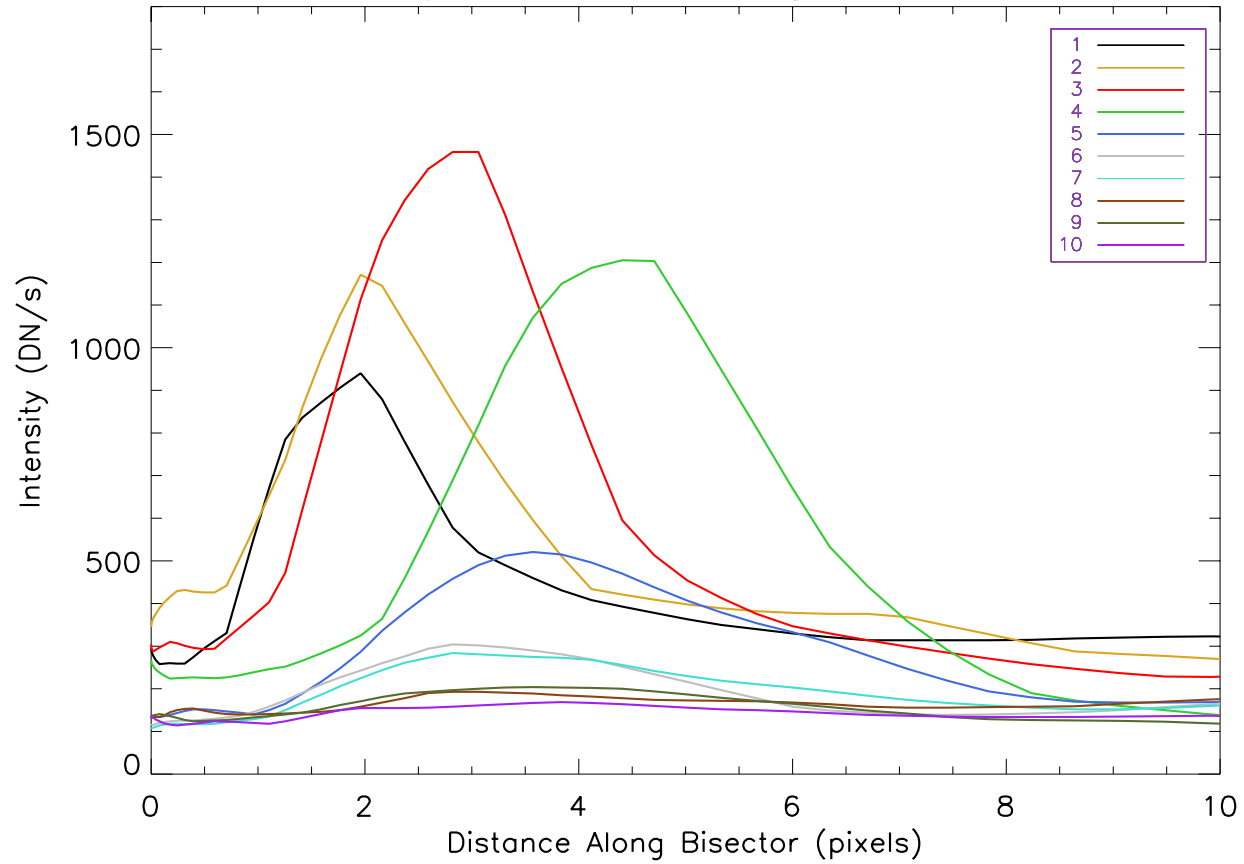
Width vs. Distance Along Loop – 0713



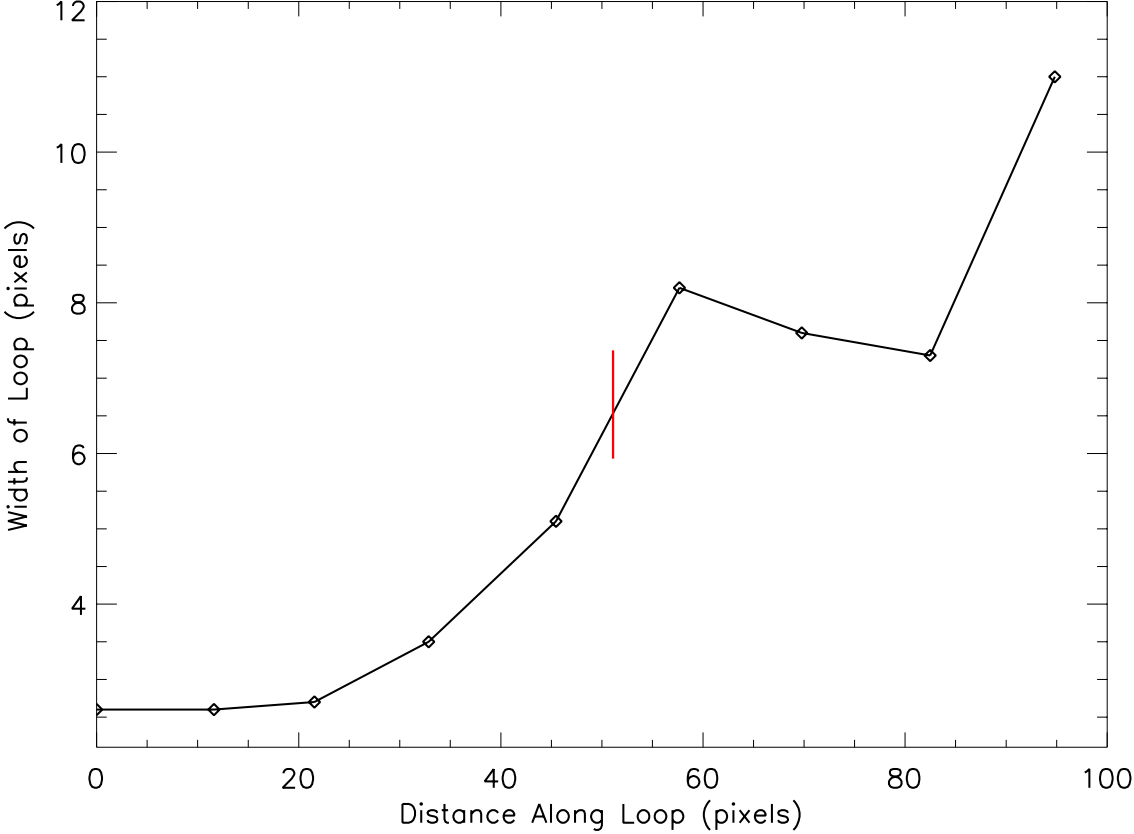
Intensity vs. Distance Along Loop - 0713



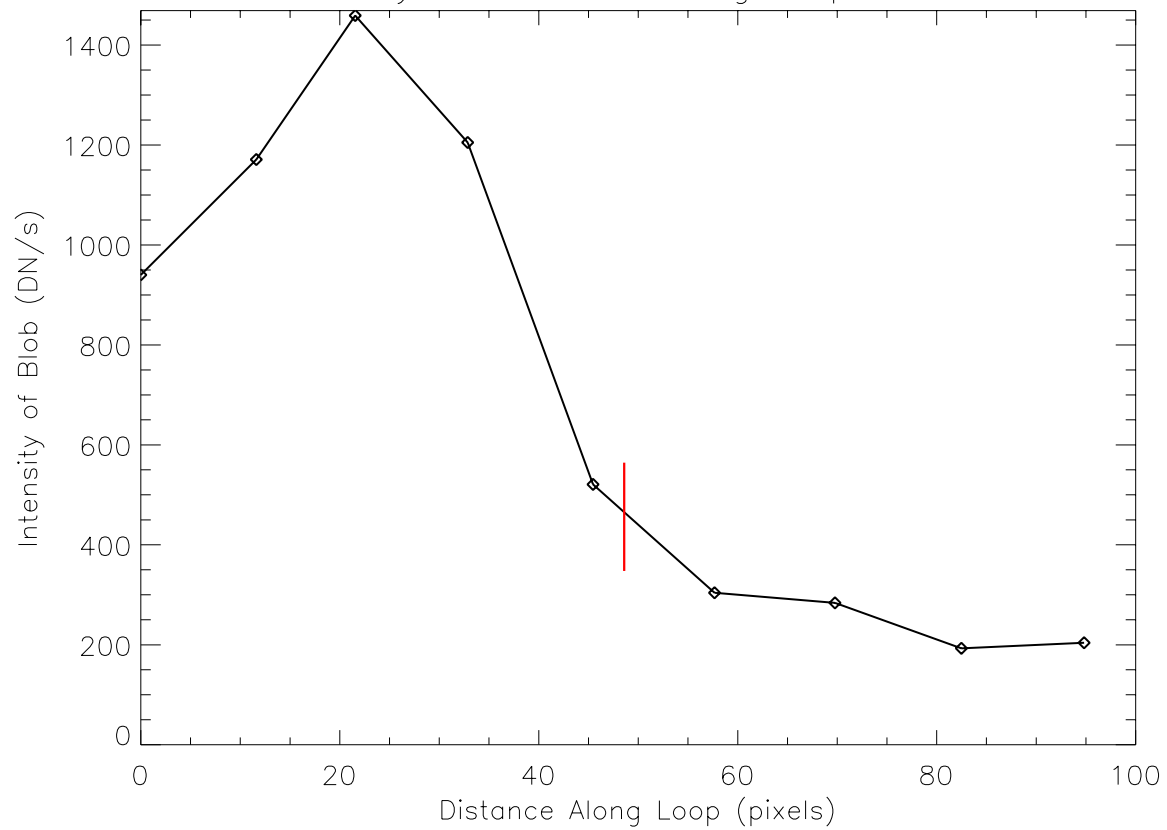
Intensity vs. Distance Along Loop – 0519



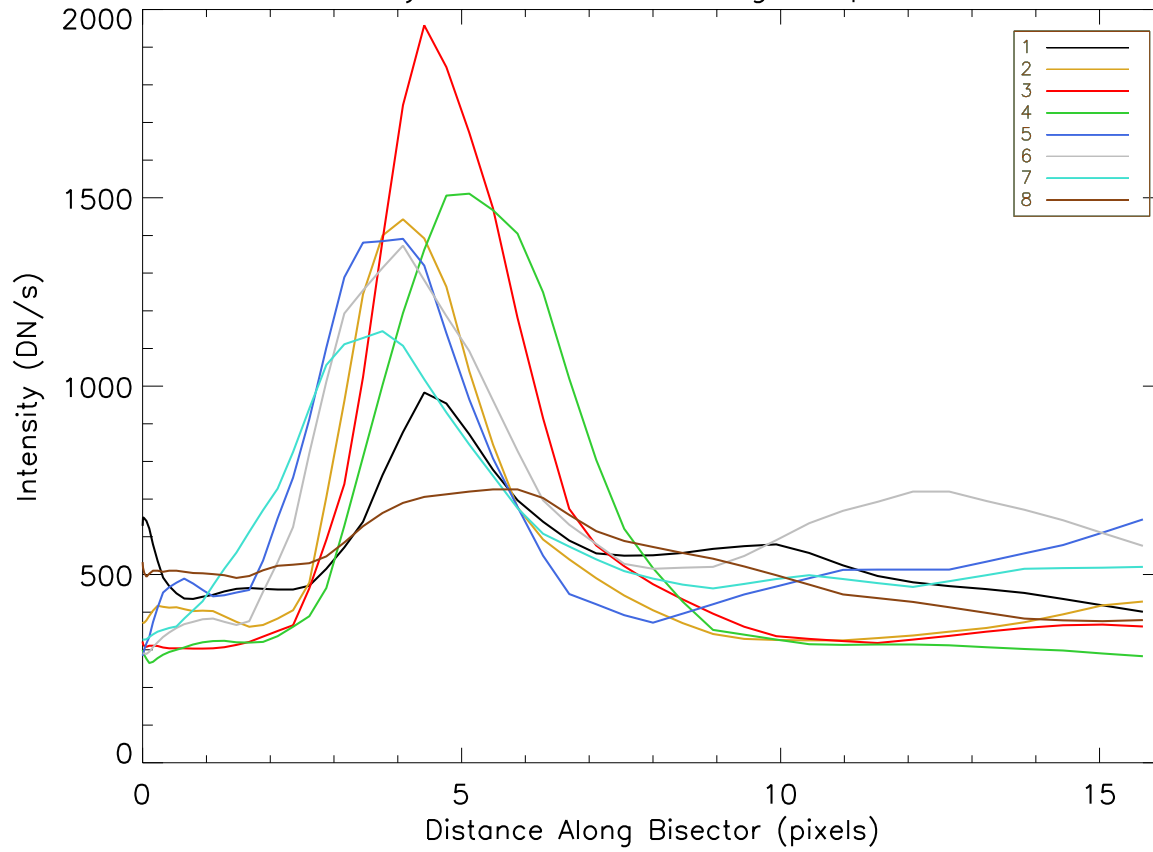
Width vs. Distance Along Loop - 0519



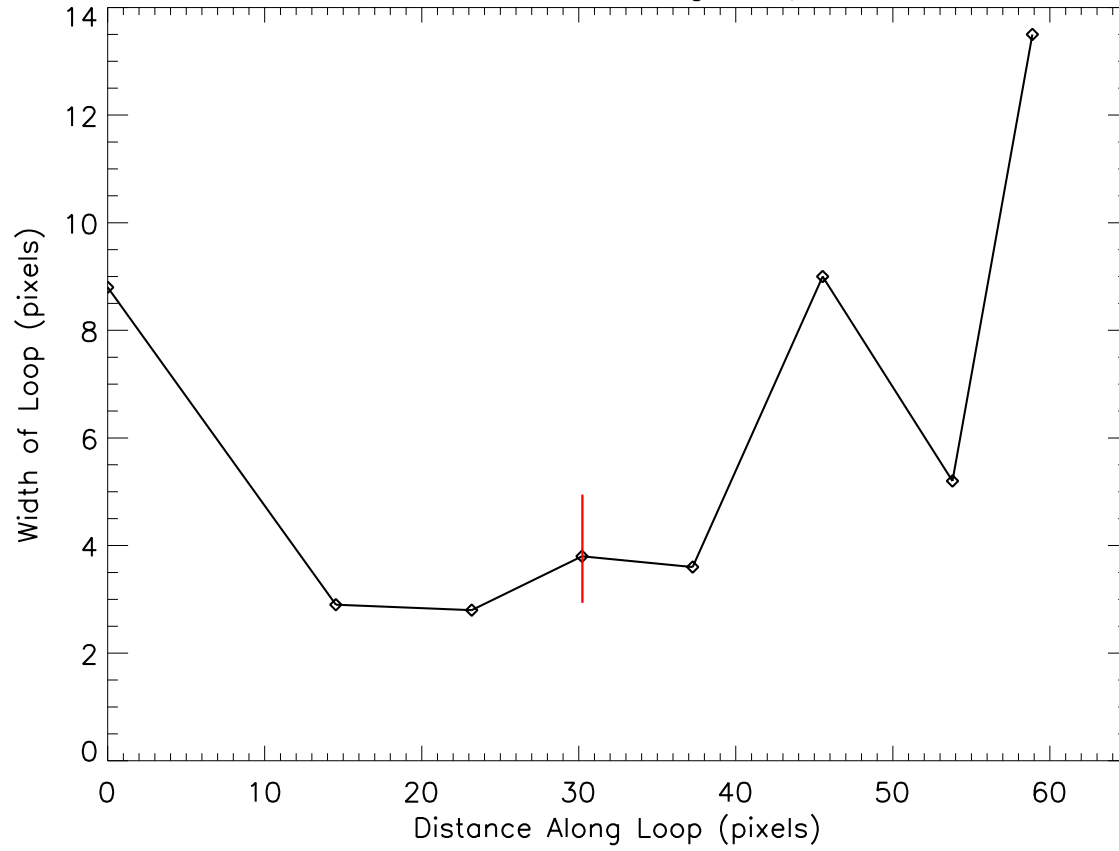
Intensity vs. Distance Along Loop - 0519



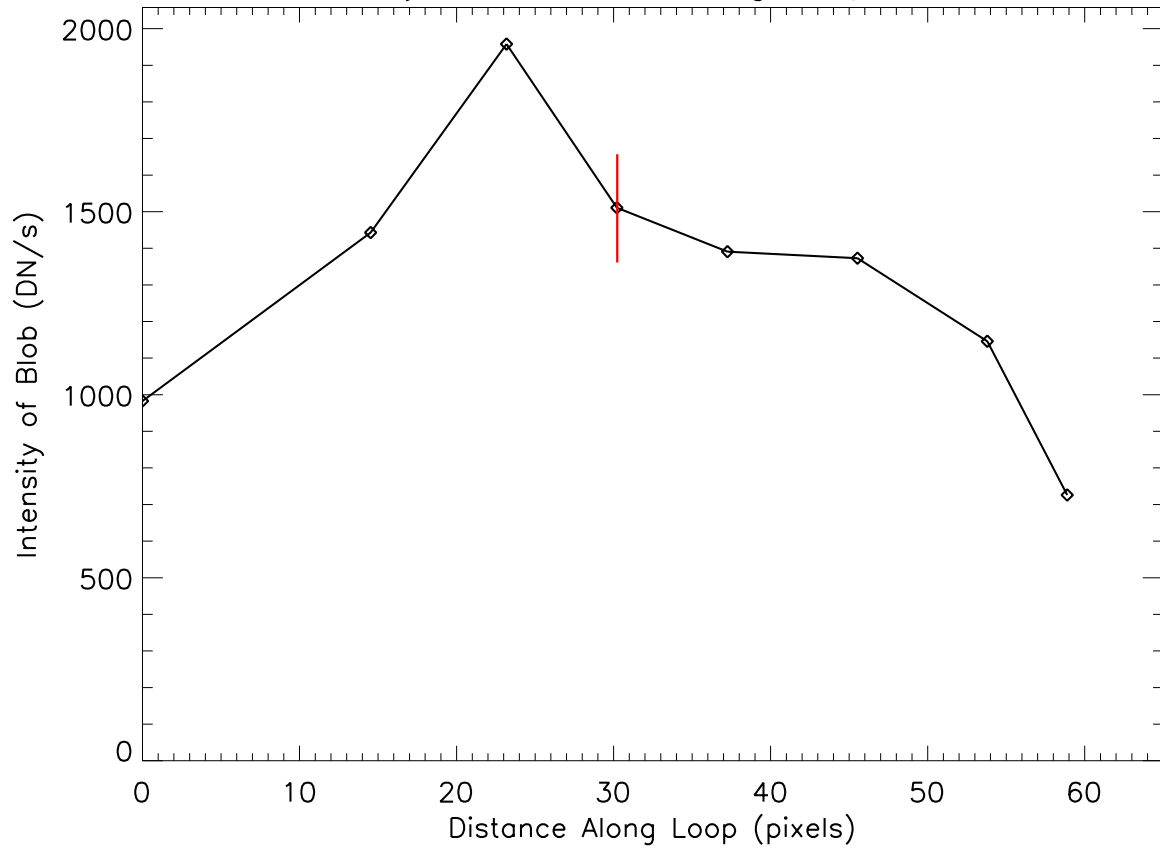
Intensity vs. Distance Along Loop – 1847



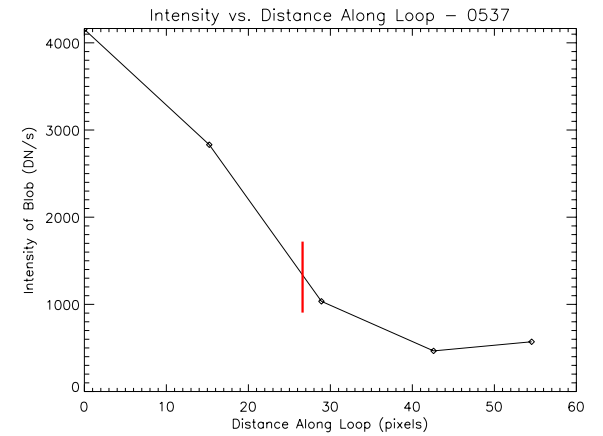
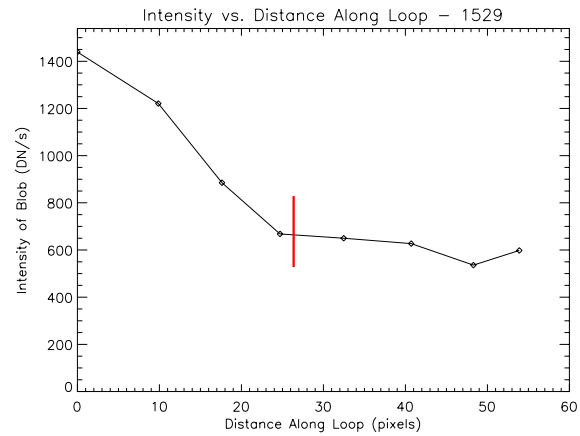
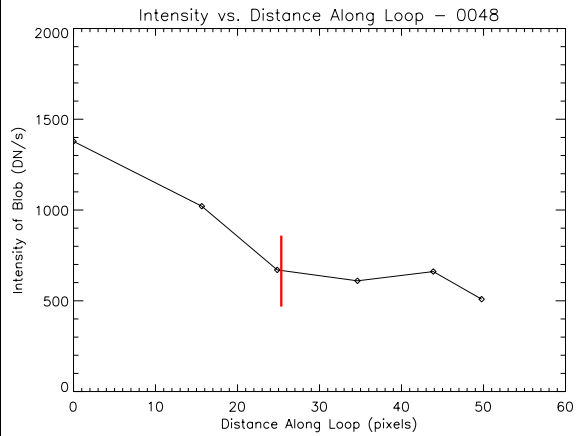
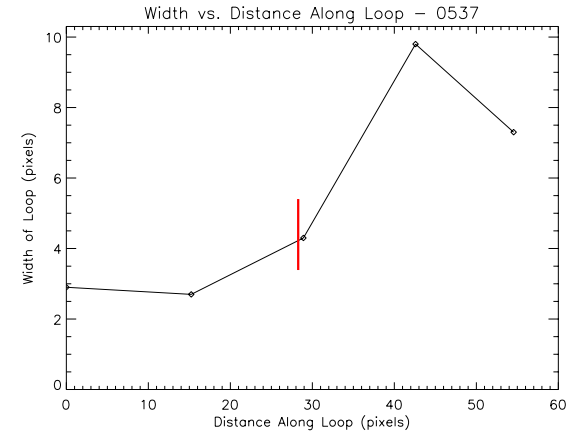
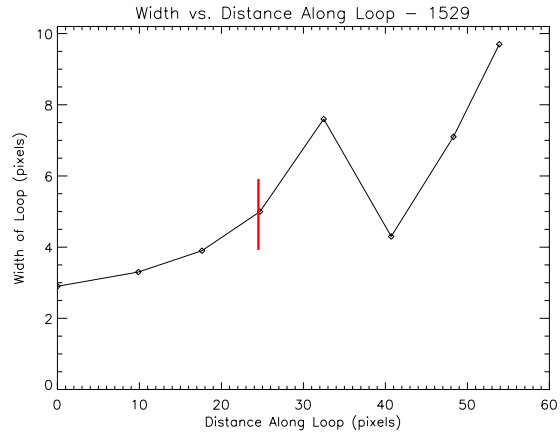
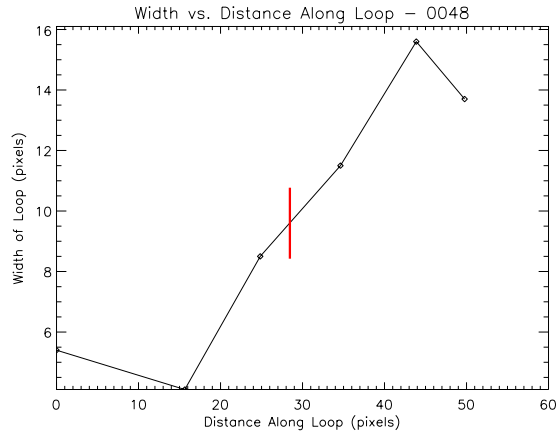
Width vs. Distance Along Loop - 1847



Intensity vs. Distance Along Loop – 1847



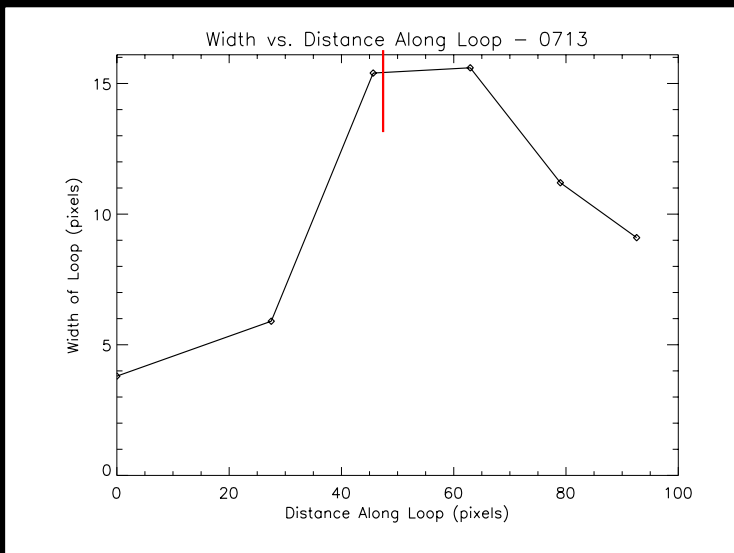
WIDTH AND INTENSITY CORRELATION



SUMMARY

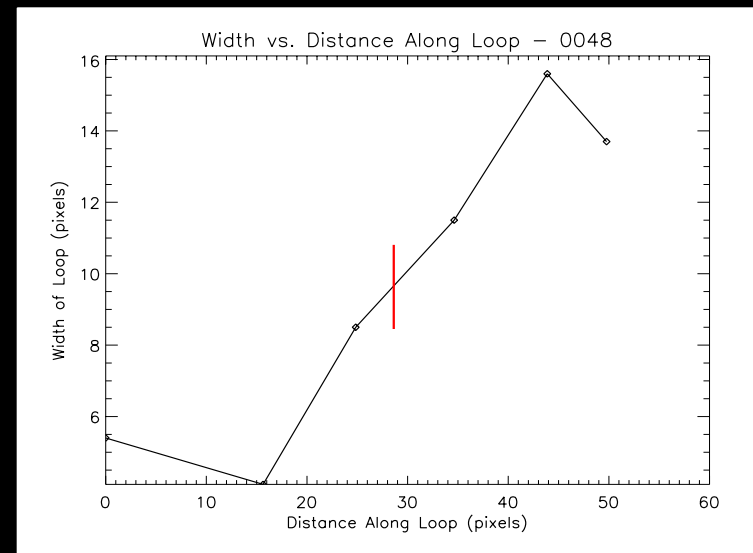
- 4 loops wider at center:

- 0713, 0519, 0505, 1529



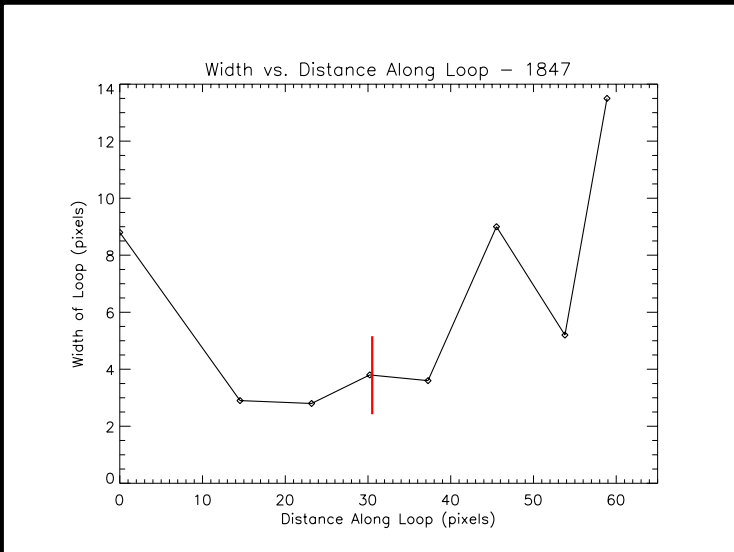
- 3 asymmetric loops:

- 0048, 0537, 2123

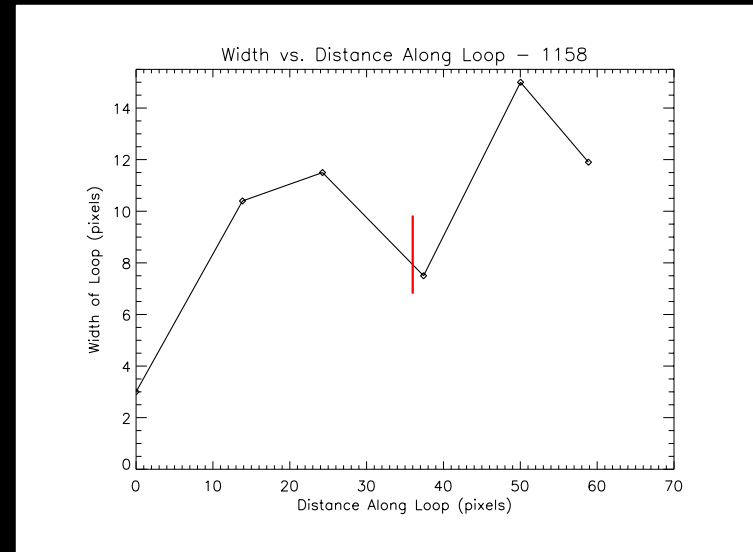


SUMMARY

- 4 do not conform to any category:
 - 1602, 1242, 1847, 1044



- 1 cannot be handled by this analysis:
 - 1158



CONCLUSIONS

- Several loops demonstrated a greater thickness at their center
 - Loops do, in fact, demonstrate a thickening near their tops, as predicted but not previously shown
 - Clear correlation between intensity and width
 - Several loops thicker on right side (endpoint): due to arbitrary choice of startpoint and endpoints
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FUTURE QUESTIONS AND RESEARCH

- Measure mass and velocity of blobs to find kinetic energy
 - Determine a lower bound for energy required to eject a blob from the surface of the sun
 - Conduct observations in different wavelengths: is there a temperature change along the loop?
 - Analyze more loops in order to confirm or refute the above results
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QUESTIONS?