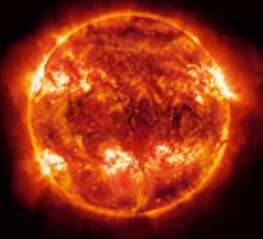


A Comparison Between Magnetic Charge Topology and Local Correlation Tracking of Solar Active Regions



Joanna Bridge

Montana State University Solar Physics REU Program

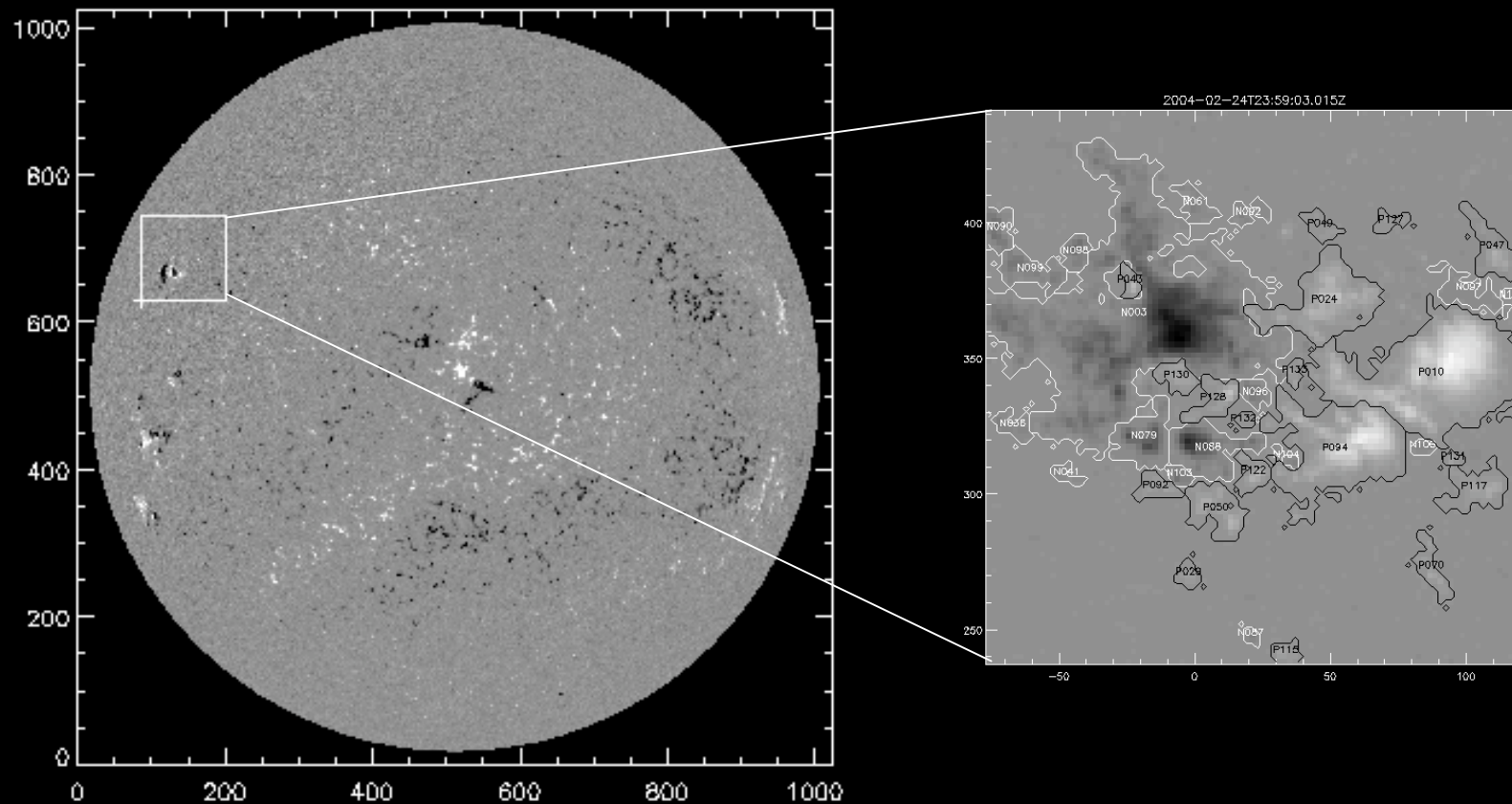
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Advisors: Lucas Tarr, Dr. Dana Longcope

Presentation Overview

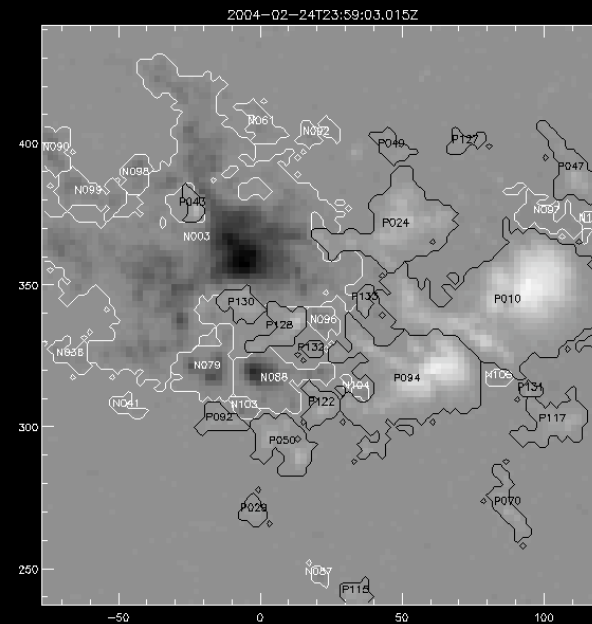
- Introduction to solar magnetic fields
- Developing an approach to partitioning and tracking active regions
- Current methods for tracking active region movement
- Comparing methodologies
- Conclusions and impacts of this research

Magnetograms depict line of sight solar magnetic fields

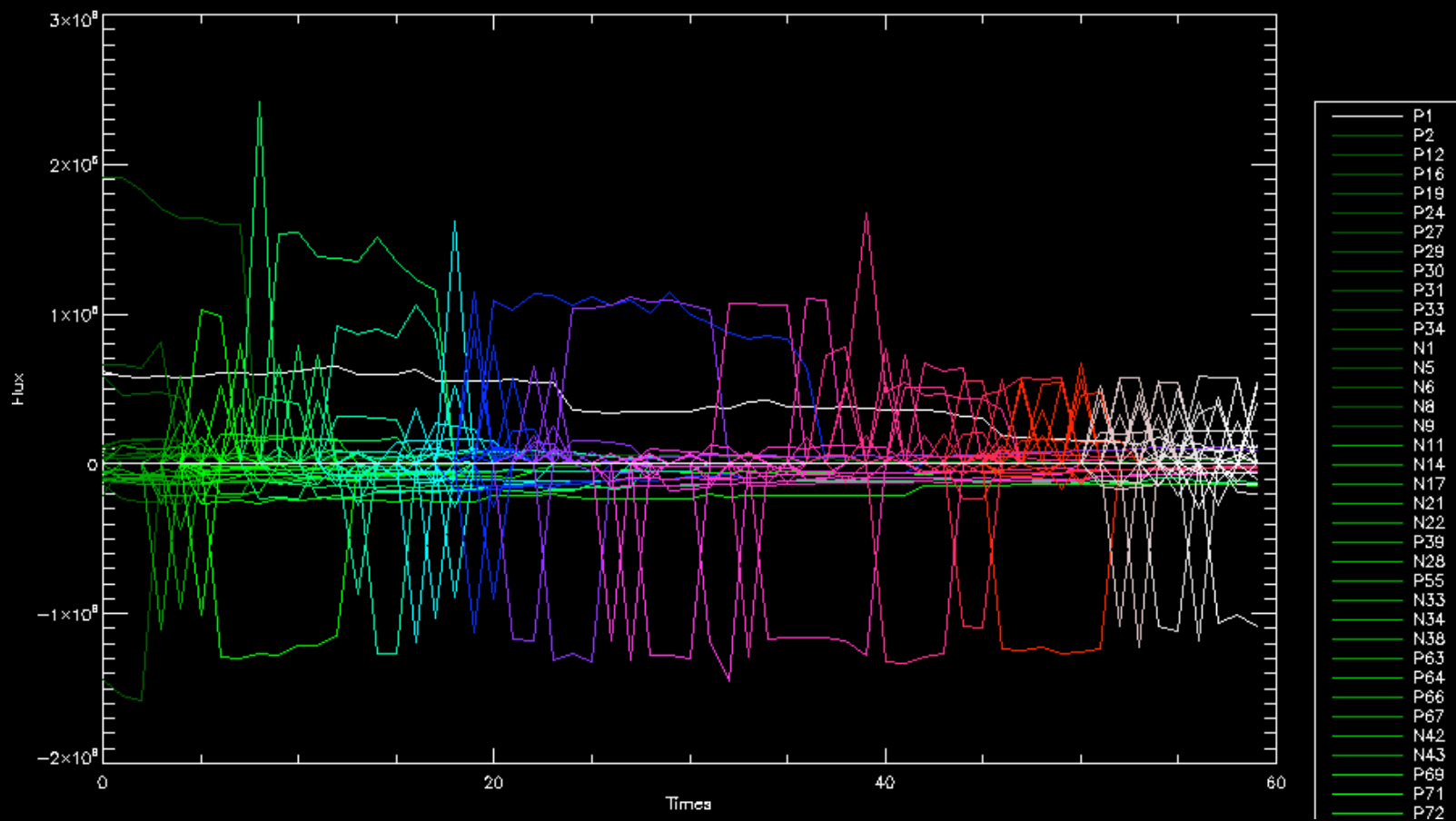


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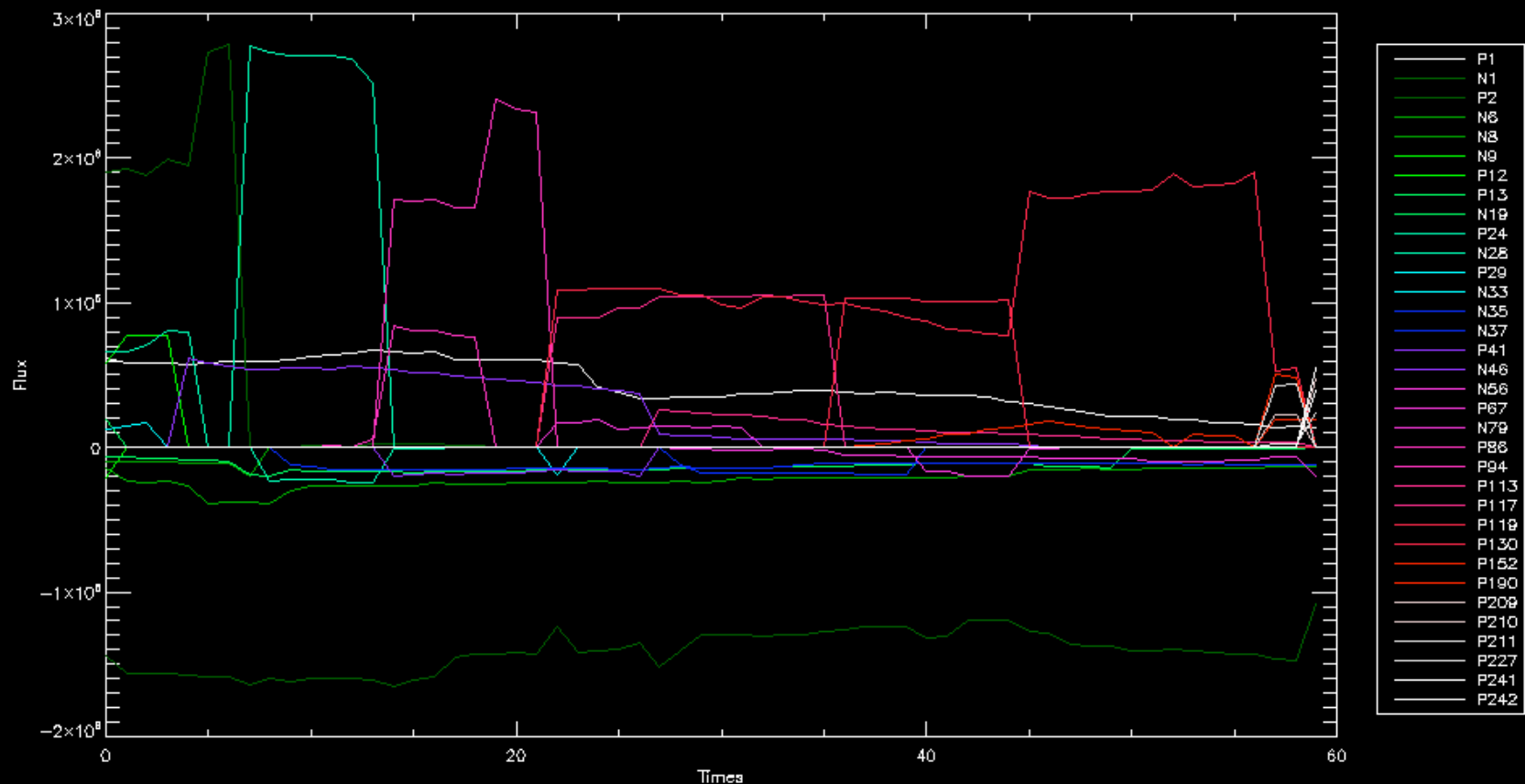
- MDI images were taken at 96 minute intervals
- To track active regions, a mask is created that partitions subregions of flux
- Potential problems:
 - Over several days, regions tend to disappear and reappear from time to time
 - Labels switch seemingly arbitrarily



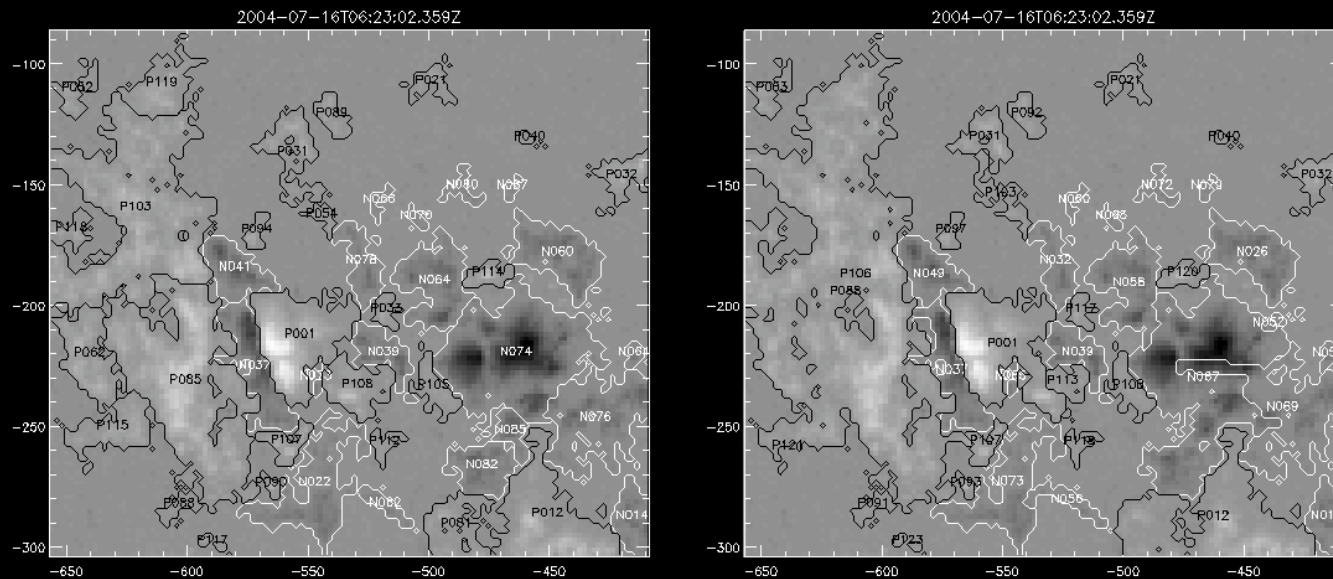
A reliable algorithm for pole consistency was developed



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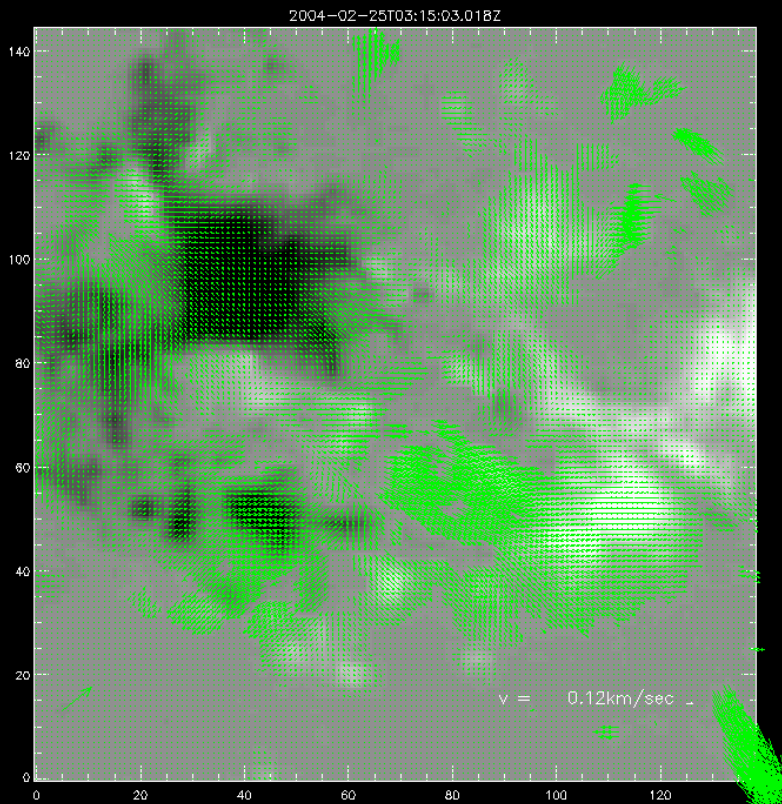


Three algorithms were used to smooth unruly data



- In the end, only two of the original three functions for cleaning up poles were retained
- Some hand-fixing of labels was required

Local Correlation Tracking (LCT) is the current method for tracking regions

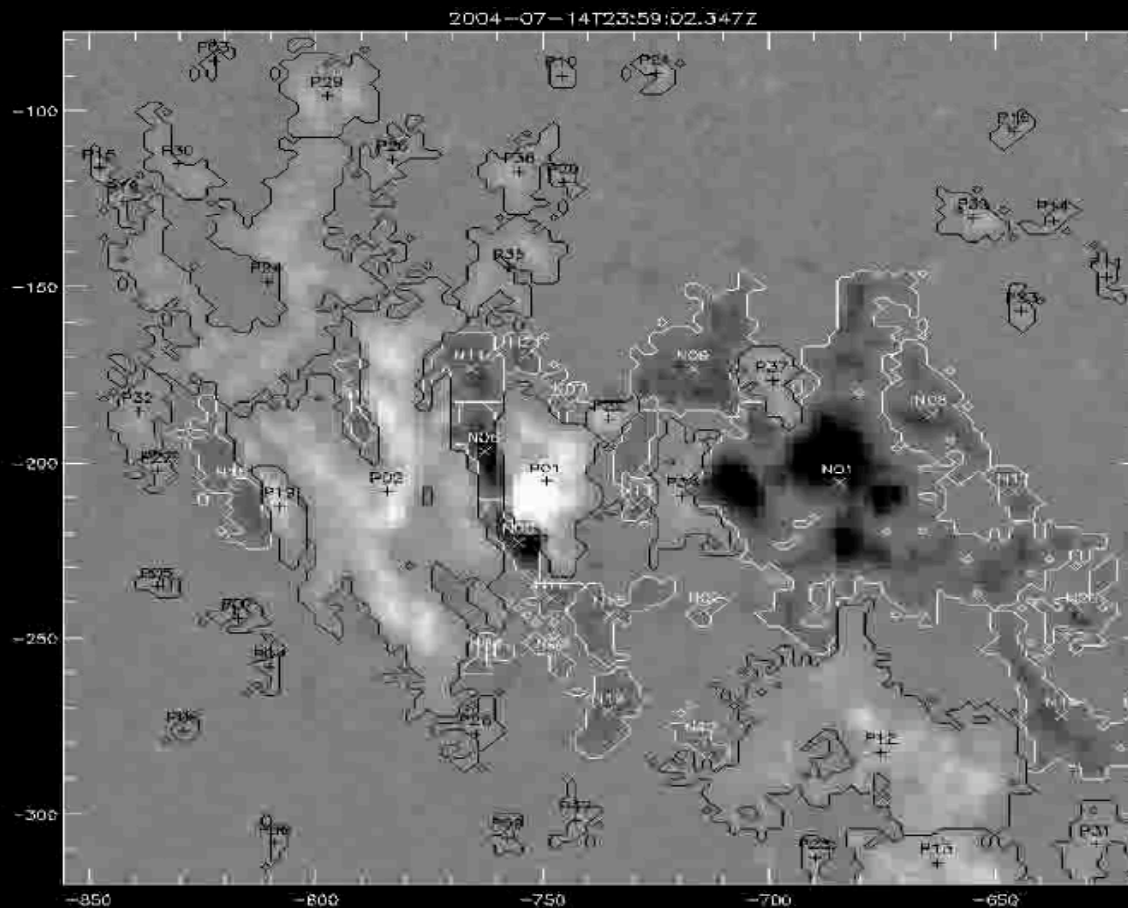


- LCT tracks movement of individual pixels of magnetograms to determine velocities
- Potential problems:
 - Underestimation of areas of stronger flux
 - Overemphasis on weaker flux regions

Creating the mask currently relies on LCT

- Mask regions have commonly been generated starting with the final LCT velocity fields and advecting back to the initial mask
- Using this mask to analyze the effectiveness of LCT begs the question since the mask was found using LCT to begin with
- Our method for creating the mask depends entirely on tessellation algorithms instead of LCT, allowing for both analysis of LCT and our method

Magnetic Charge Topology (MCT) tracks source movement

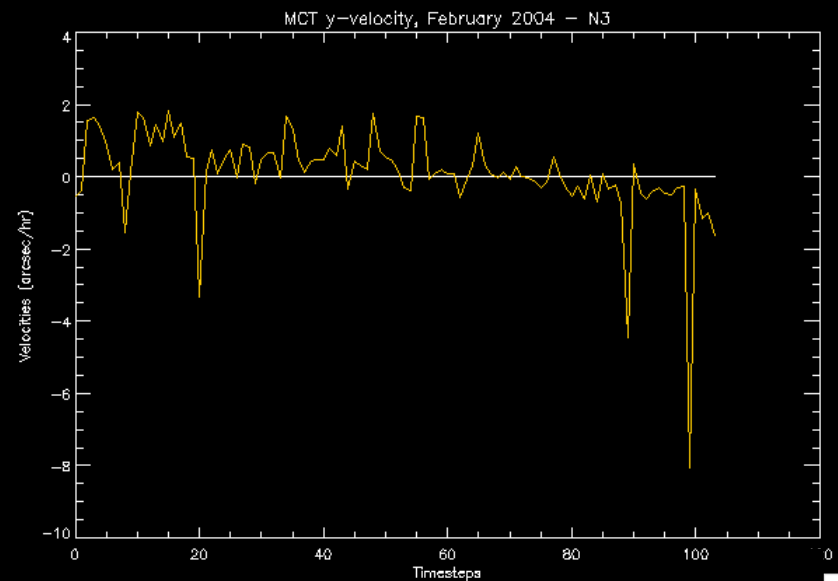
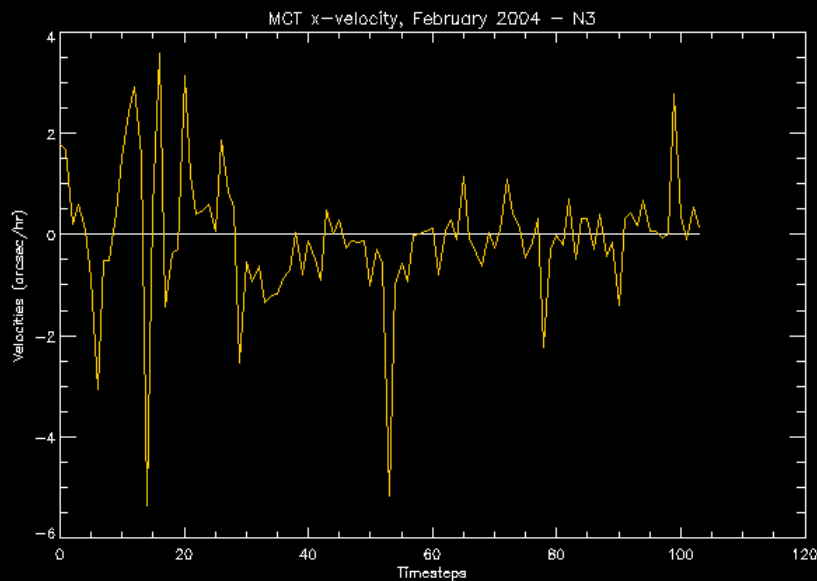


- MCT is used to approximate the flux regions as flux-weighted centroids
- The mask is generated from these sources

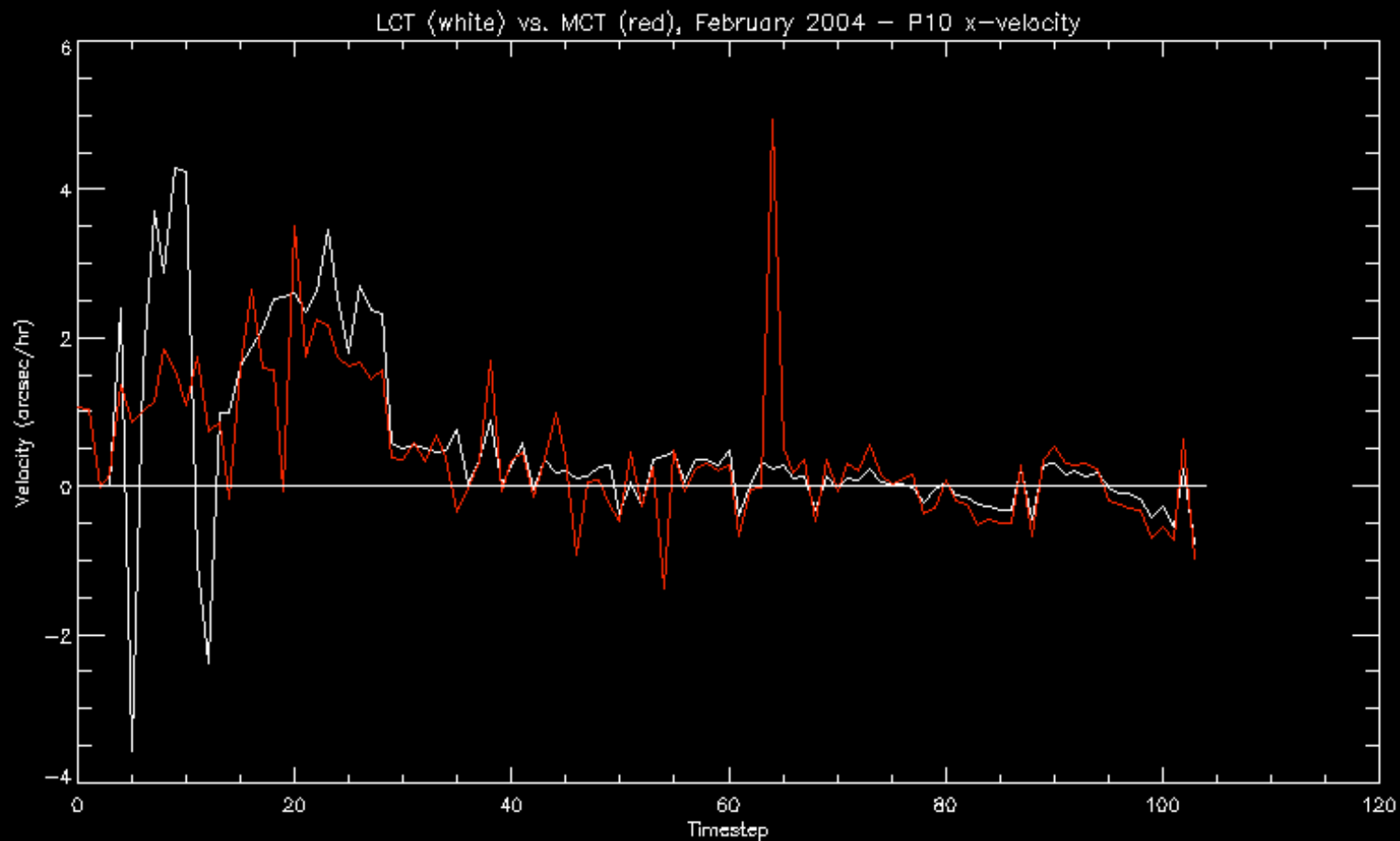
Velocities can be determined by tracking pole movement

- Centroid velocities:

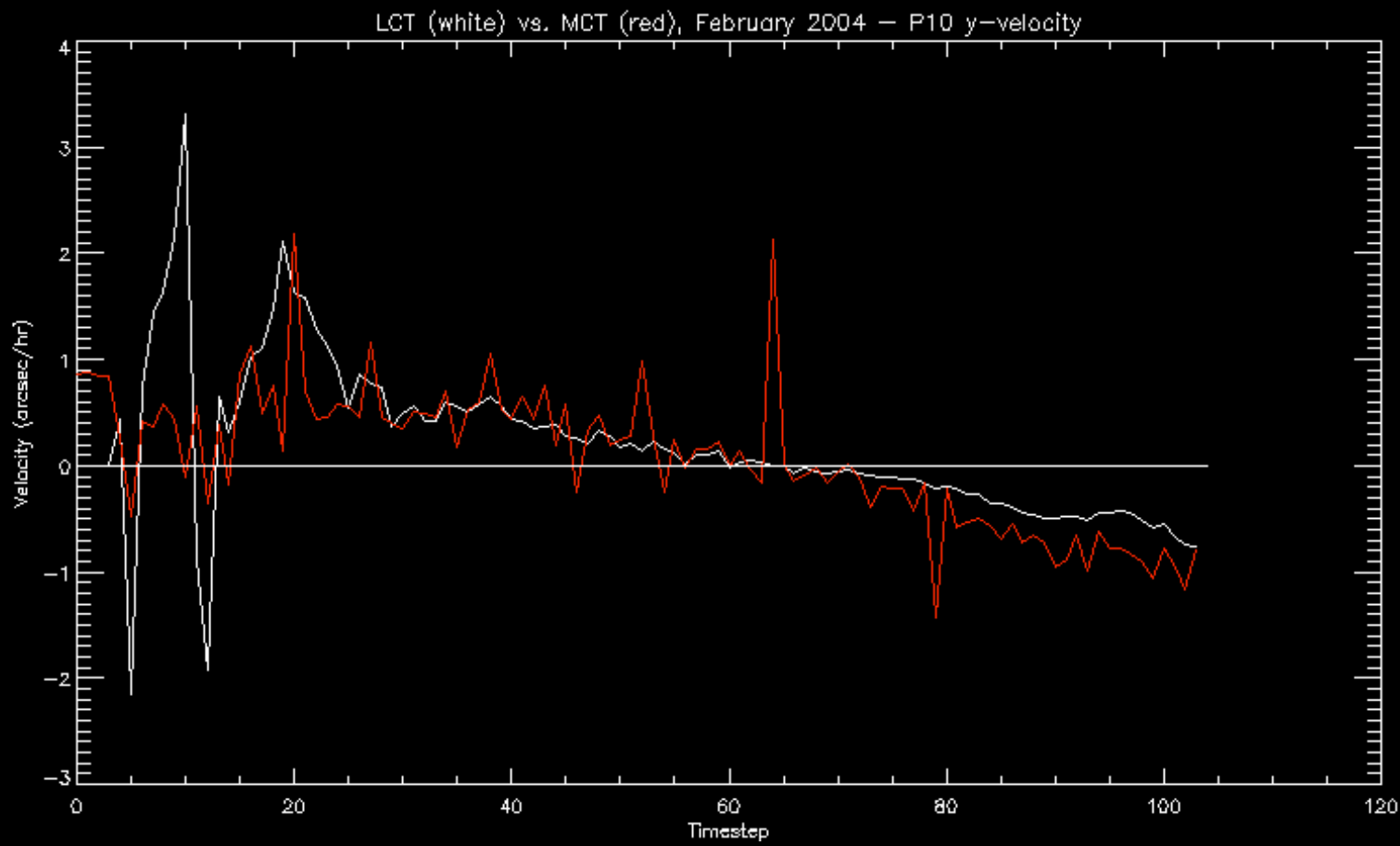
$$[x(i+1) - x(i)] / [time(i+1) - time(i)]$$



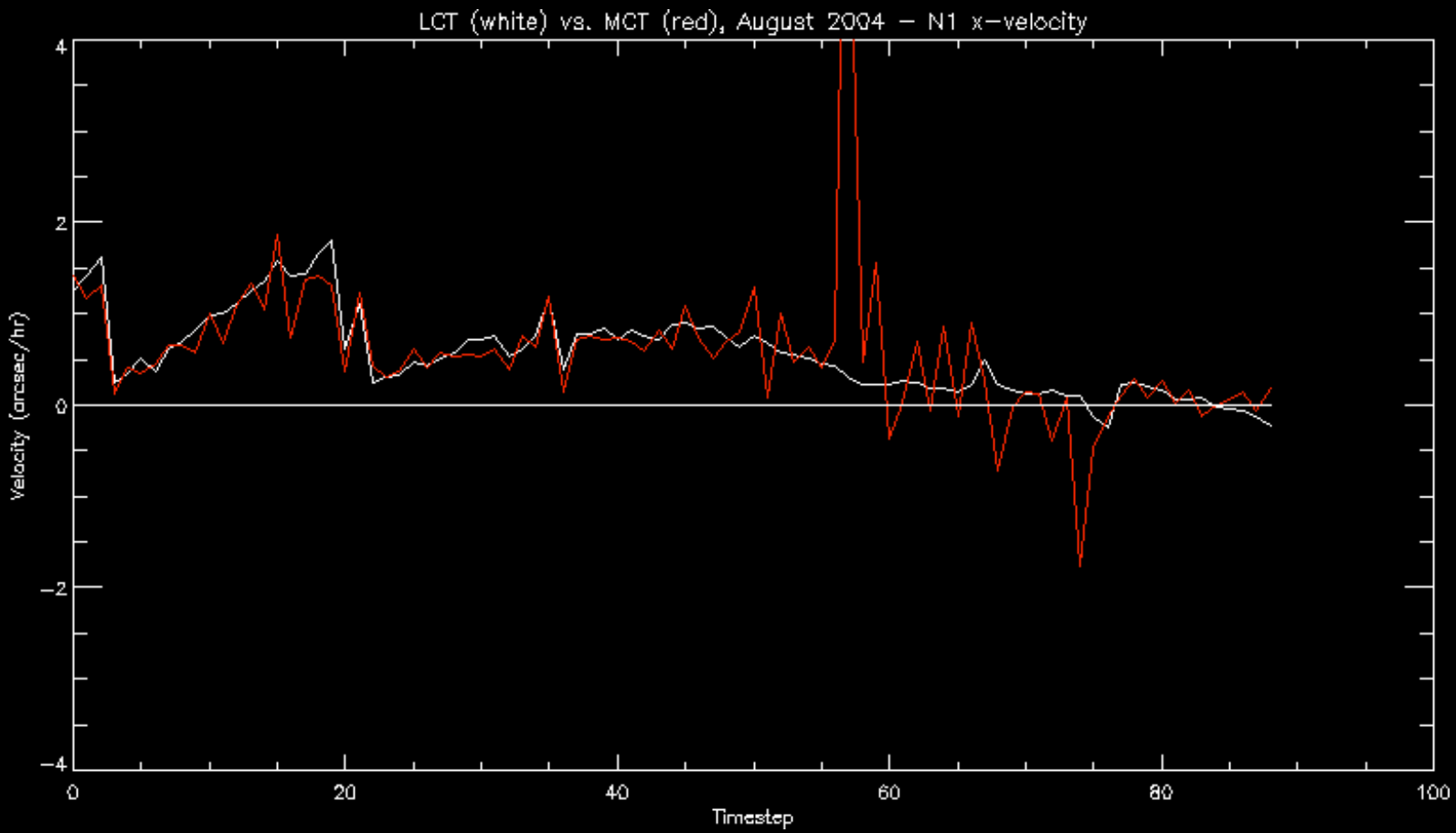
Comparison between MCT and LCT showed a high degree of correlation



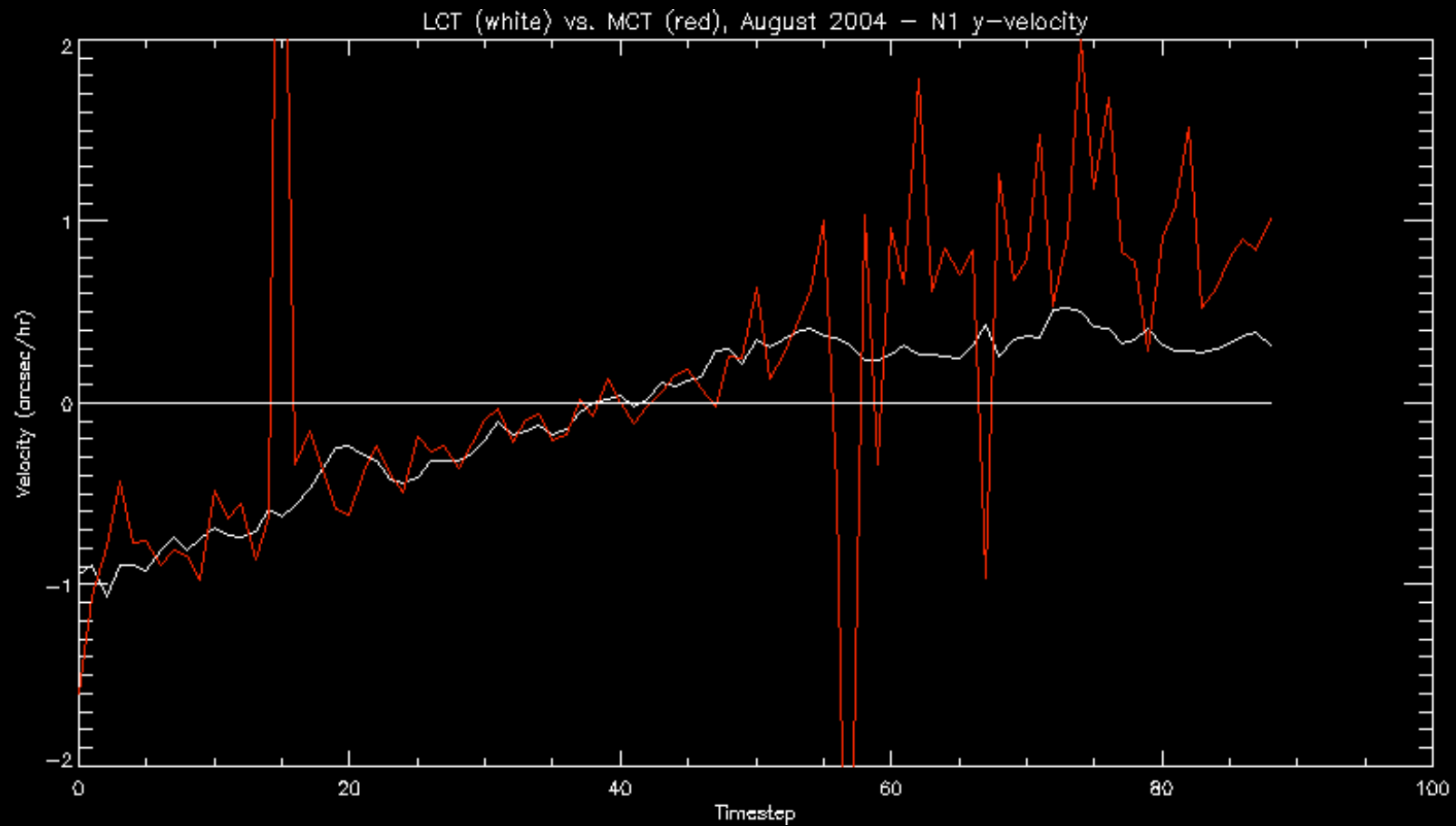
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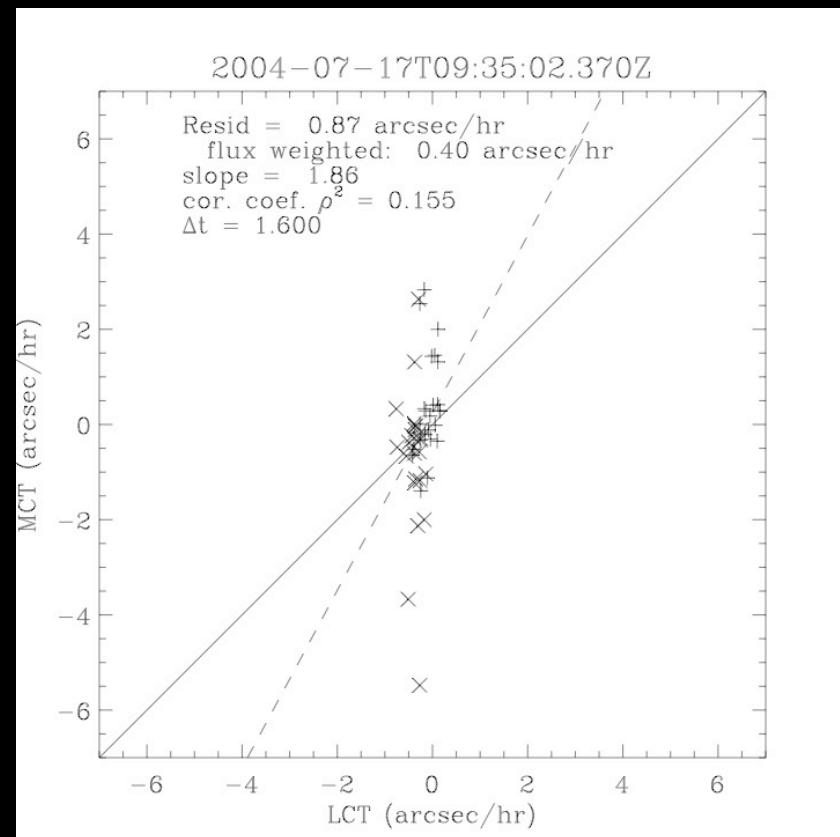
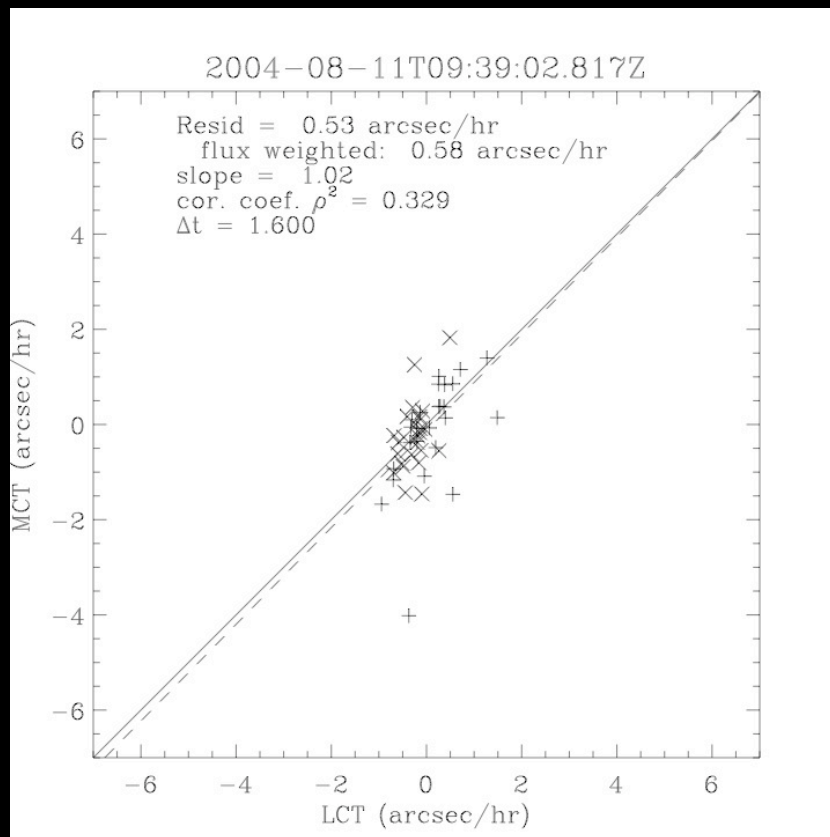
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Comparison between MCT and LCT showed a high degree of correlation



Further analysis confirms this agreement between the two methods



Conclusions/Impacts

- Finding a repeatable algorithm to create masks not using LCT is feasible and effective
- Comparison of LCT and MCT allows for confirmation of the validity of both methods
- Where MCT does not match LCT, there is a reasonable explanation for it
- Tracking movement of active regions comes into play in energy storage and helicity calculations

Thank you!

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