



Solar Limb Prominence CAtcher & Tracker

— SLIPCAT

Yuming Wang¹

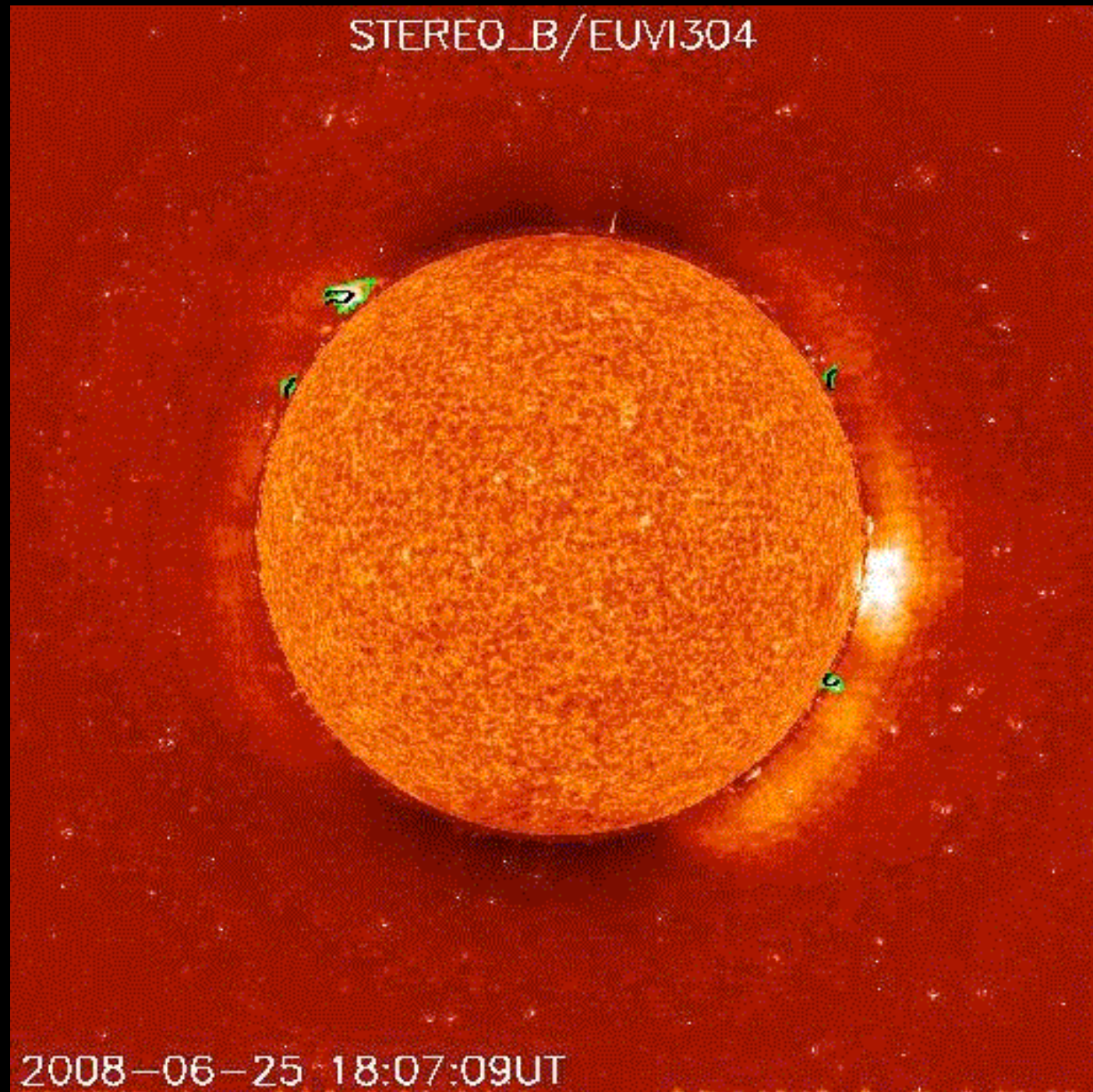
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VA 22030, USA**

2010.03.23 Dublin, Ireland

STEREO_B/EUVI304



2008-06-25 18:07:09UT

Welcome to Space Physics Division of USTC - Mozilla Firefox
文件(F) 编辑(E) 查看(V) 历史(S) 书签(B) 工具(T) 帮助(H)
http://space.ustc.edu.cn/dreams/slipcat/?mode=1

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http://space.ustc.edu.cn/dreams/slipcat/?ym=200806&instr_id=stb

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http://space.ustc.edu.cn/dreams/slipcat/details.php?instrid=stb&id=20080625_180709_STB_105_048&start=20080625_180709&end=20080626_034709

Plots of the prominence Appearing from 2008-06-25 18:07:09 UT around position angle of 48 degrees

Figures: [ave.ps](#) [sep01.ps](#) [sep02.ps](#) [sep03.ps](#) [sep04.ps](#) [sep05.ps](#) [sep06.ps](#) ([data](#), [description](#))

Control Panel:
Start Pause
Slower Faster
Prev. Next
-10 +10
Reverse Rewind
Zoom: 100%

STEREO_B/EUVI304
20080625_180709_STB_105_048_AVE
 $v = 5.6334 \text{ km/s}$, $\alpha = 0.4532 \text{ m/s}^2$
Heliocentric Distance of Centroid (R_s)
Start Time (25-Jun-08 17:59:27)
2008-06-25 19:17:09UT
Frame: Displaying 8 of 60, 12 frames/sec
Download as a mpeg gif movie

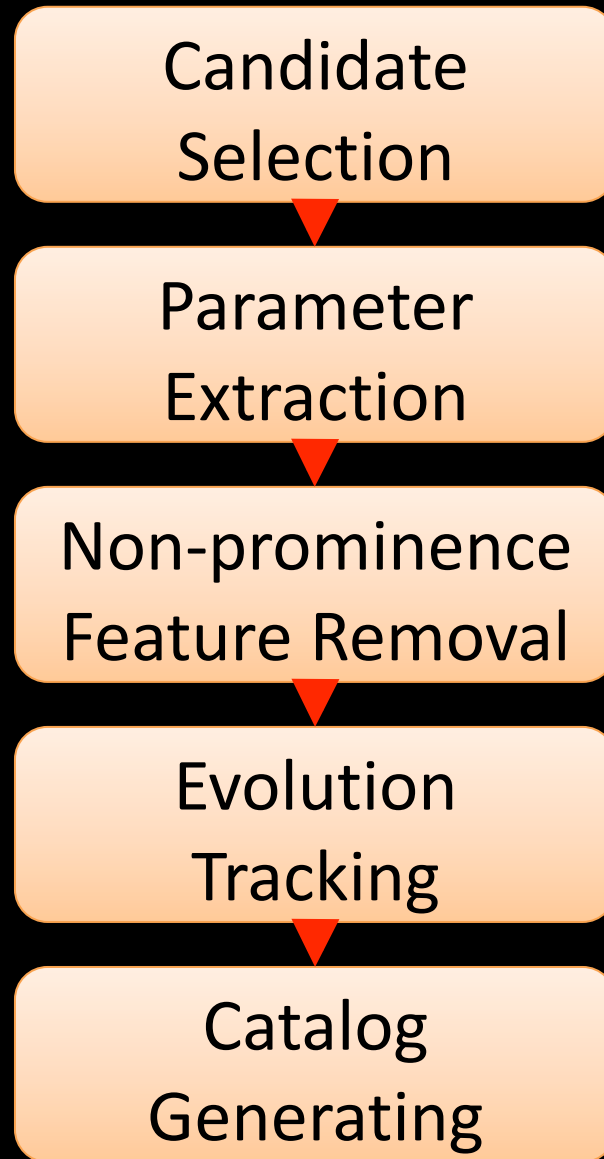
SLIPCAT is an automated system developed by the [team](#) at University of Science and Technology of China (USTC).
完成

<http://space.ustc.edu.cn/dreams/slipcat/>

Outline

1. How did we accomplish the system?
2. What do we have from the system?

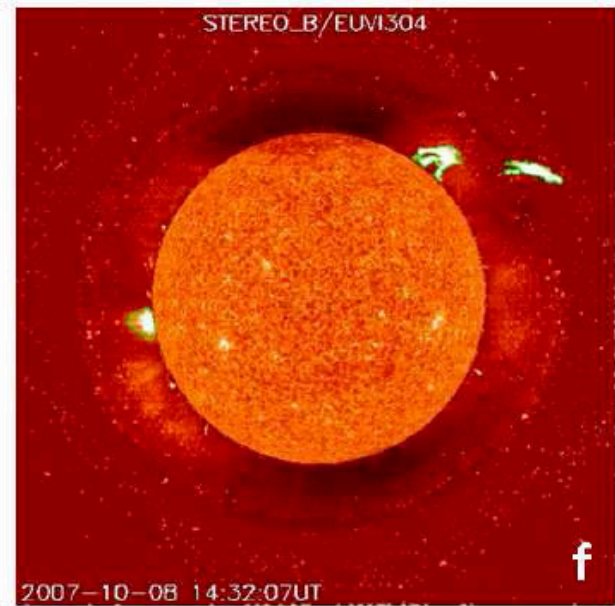
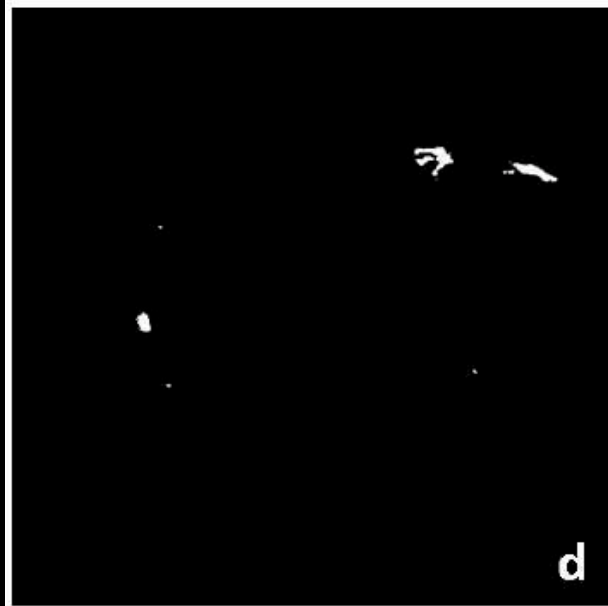
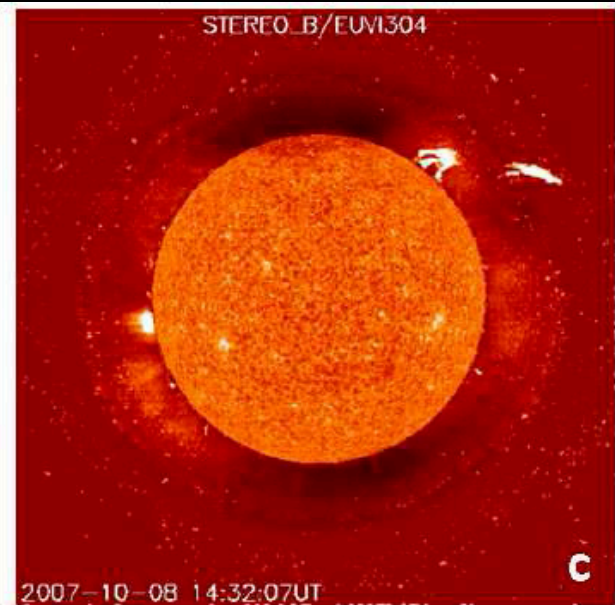
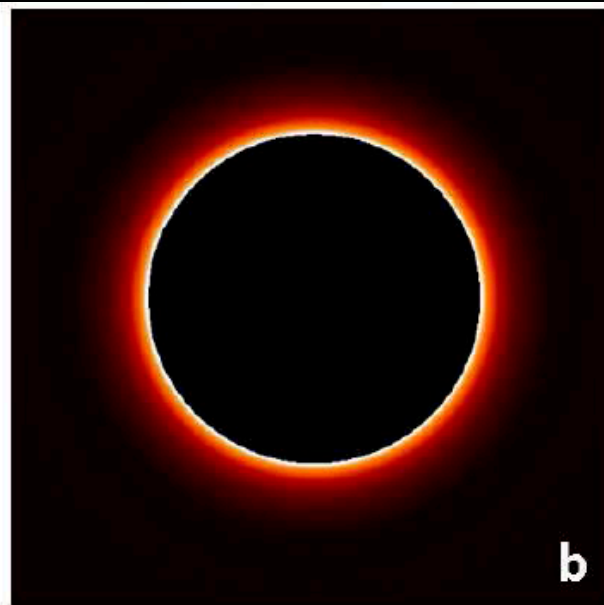
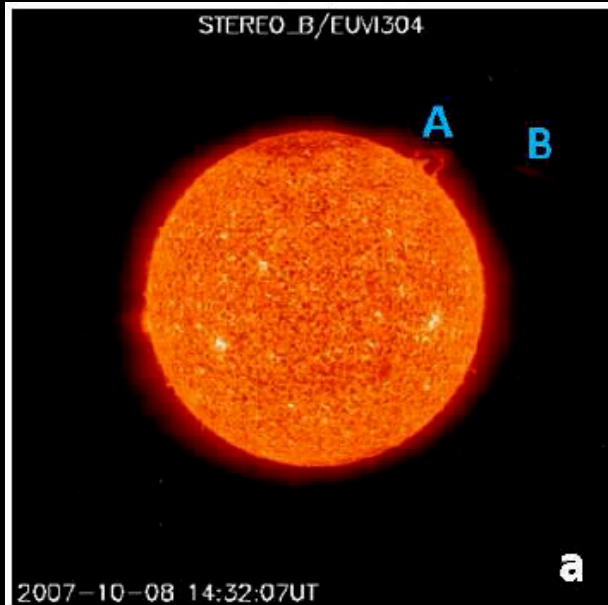
1. How did we accomplish the system?



original

background

re-scaled



kernels

candidates

Candidate
Selection

Parameter
Extraction

Non-prominence
Feature Removal

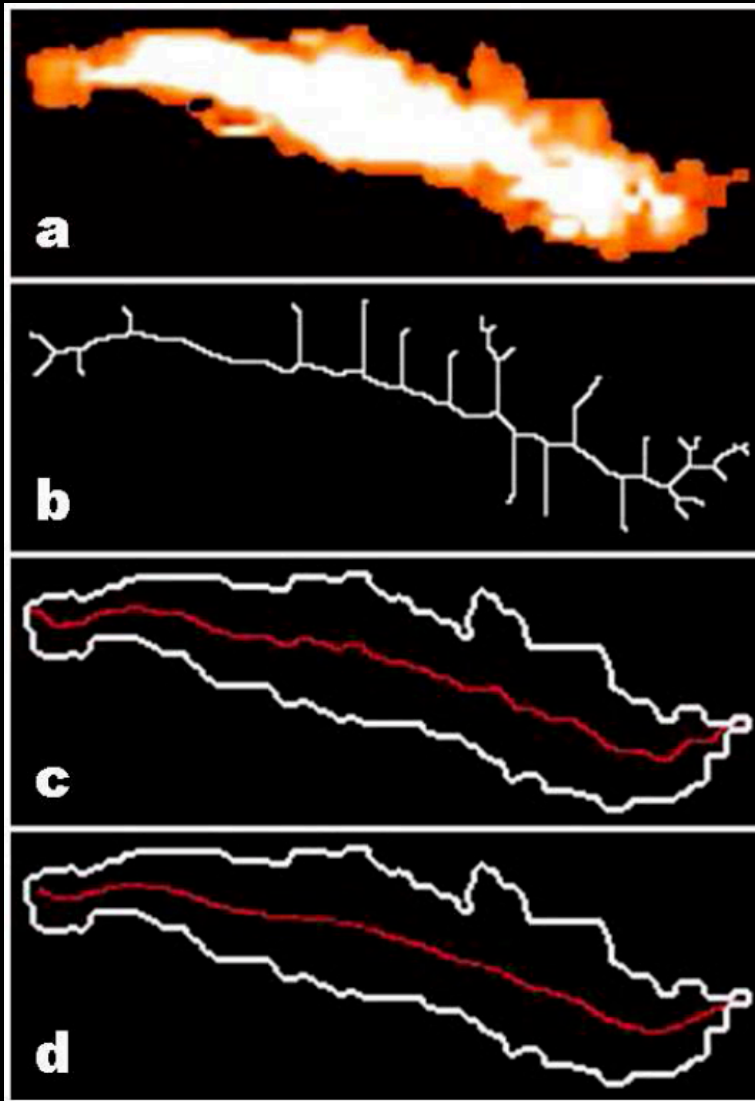
Evolution
Tracking

Catalog
Generating

Parameters Extracted

- **Boundary information**
- Centroid of brightness
- Span over radial and azimuthal directions
- Average brightness (F)
- Area (A)
- Length of spine (L)

Length of Spine



Original region

Skeleton by using
thin operator

Spine by comparing
the length of each
branches

Spine smoothed

Candidate
Selection

Parameter
Extraction

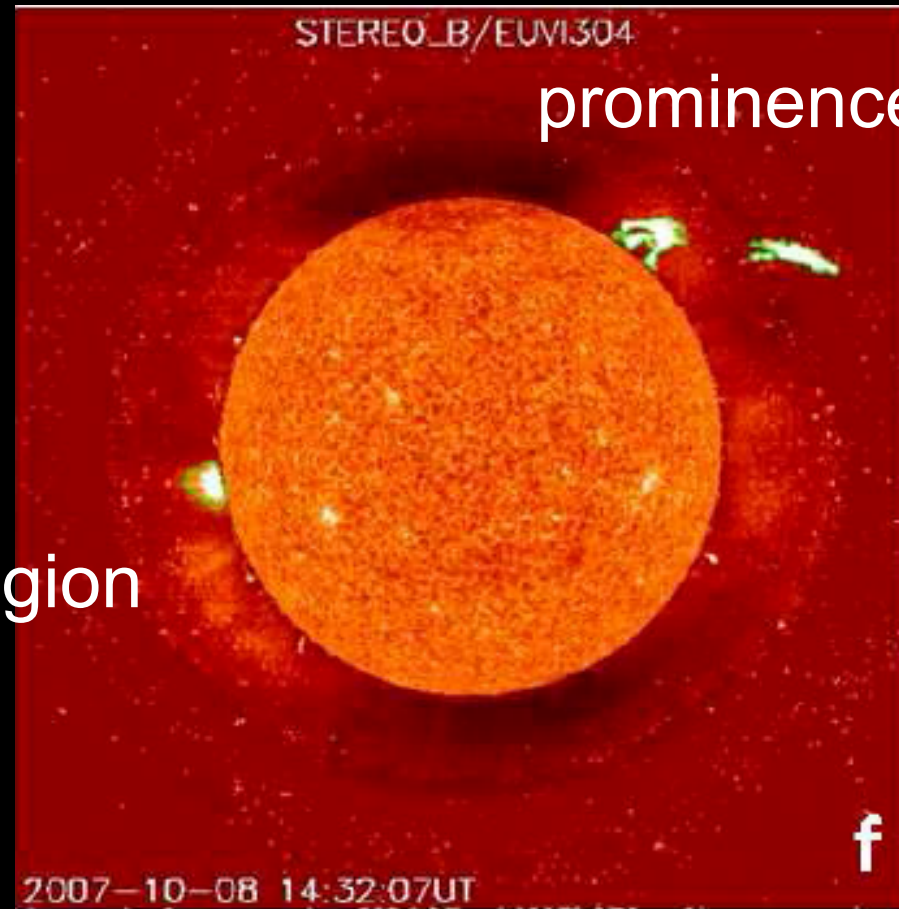
Non-prominence
Feature Removal

Evolution
Tracking

Catalog
Generating

Prominence has a different looking

Active region

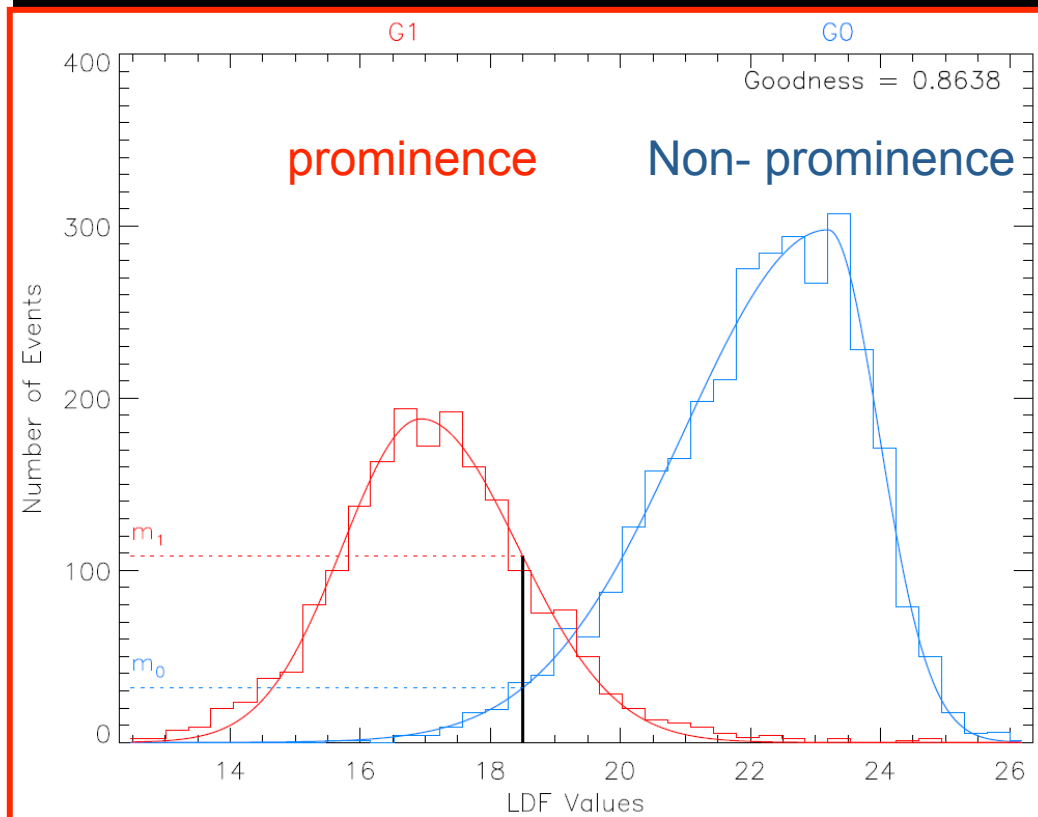


Linear Discriminant Analysis (LDA)

Fisher, 1936

- 3780 images, 5066 candidates, 2007/04 – 2009/10
- Linear discriminant function (LDF)

$$X = 1.460 \ln A + 1.103 \ln \frac{A}{L} - 0.491 \ln \chi_F^2$$



size elongation variation of F

$$\text{Likelihood} = \frac{m_1}{m_1 + m_2}$$

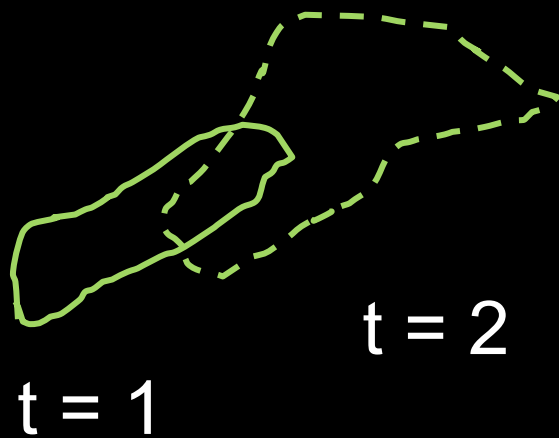
Candidate Selection

Parameter Extraction

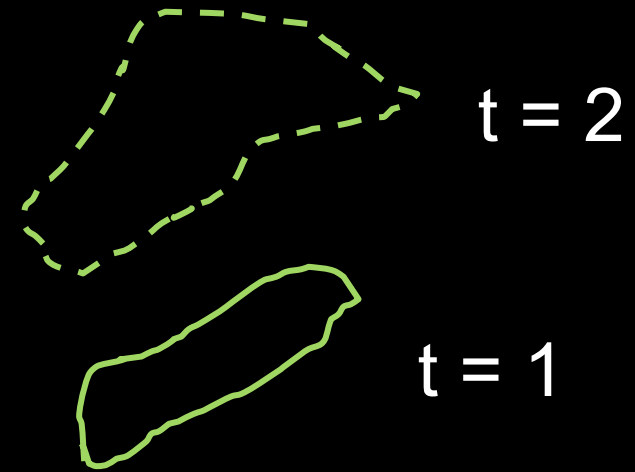
Non-prominence Feature Removal

Evolution Tracking

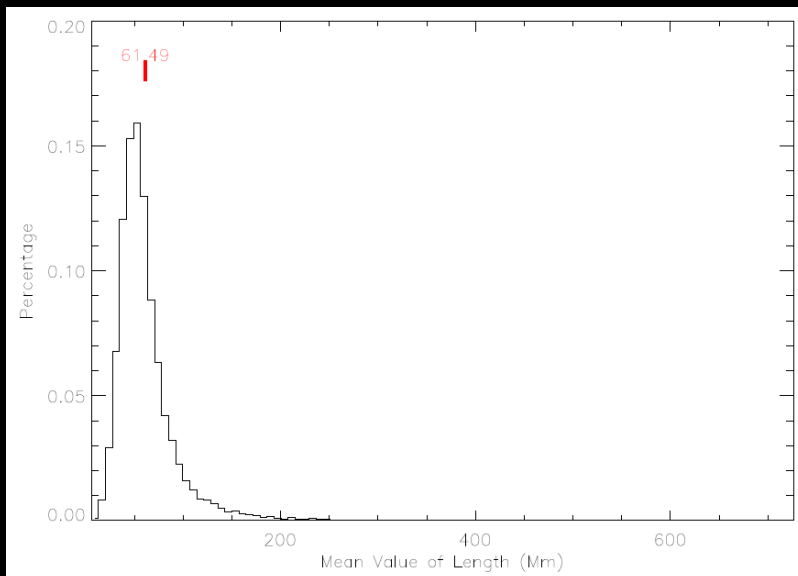
Catalog Generating



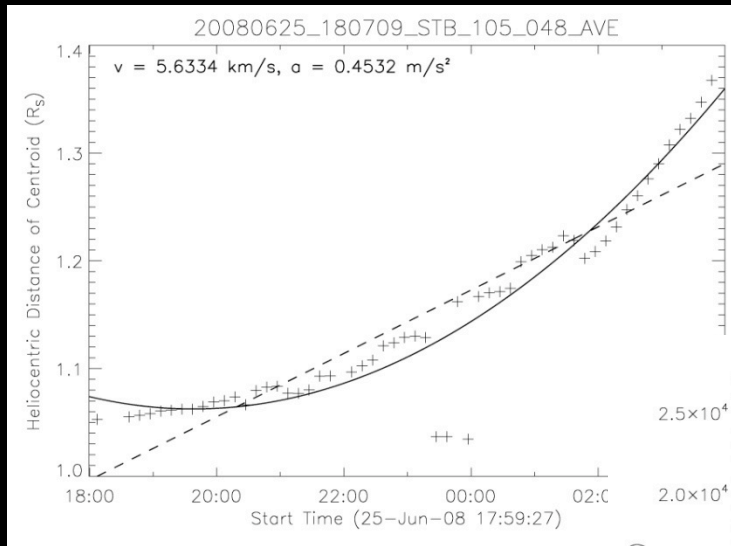
The same prominence



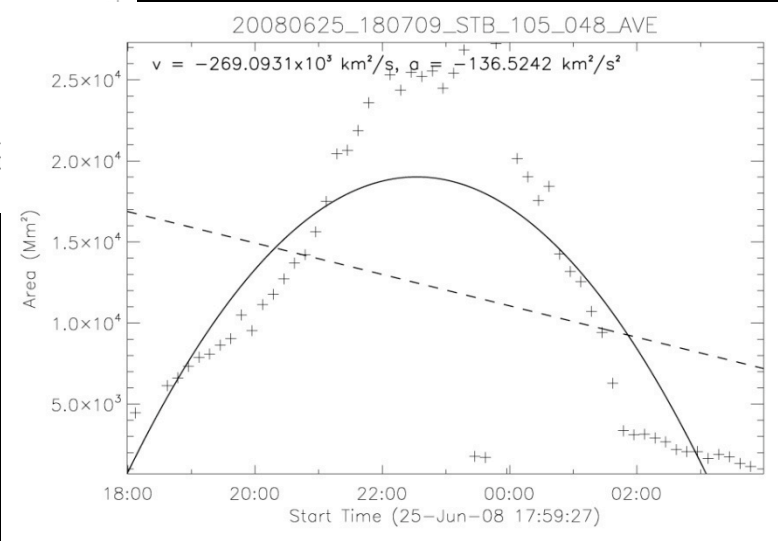
Two different prominences



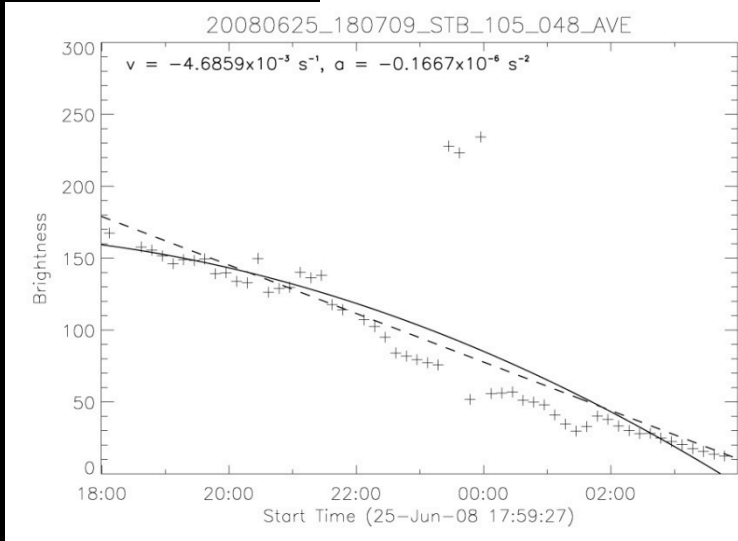
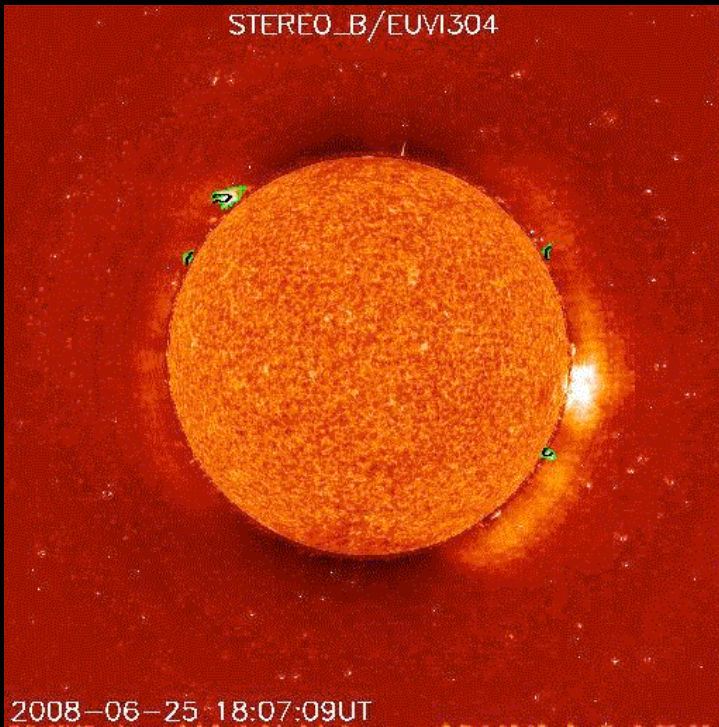
- Typical length ~ 60 Mm
- Typical speed ~ 4 km/s, occasionally > 100 km/s
- Cadence requirement:
15 min – 4 hrs



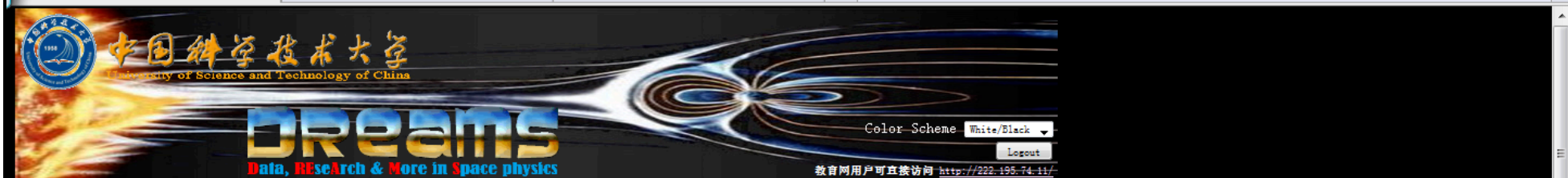
Distance of centroid



Area



Brightness



Hello, Yuming WANG. Last time you signed in from 202.38.64.248 at 2010-Mar-14 Sun 19:46 CST.

USTC-SPD SLIPCAT CMELOC SHM Feedbacks

中文版 Location: [Homepage](#) >> SLIPCAT [\[Blog\]](#)

Solar Limb Prominence Catcher & Tracker (SLIPCAT)

Monthly Catalogs ([Switch to Daily Movies](#))

Instrument:

2007	-	-	-	April	May	June	July	August	September	October	November	December
2008	January	February	March	April	May	June	July	August	September	October	November	December
2009	January	February	March	April	May	June	July	August	September	October	-	-

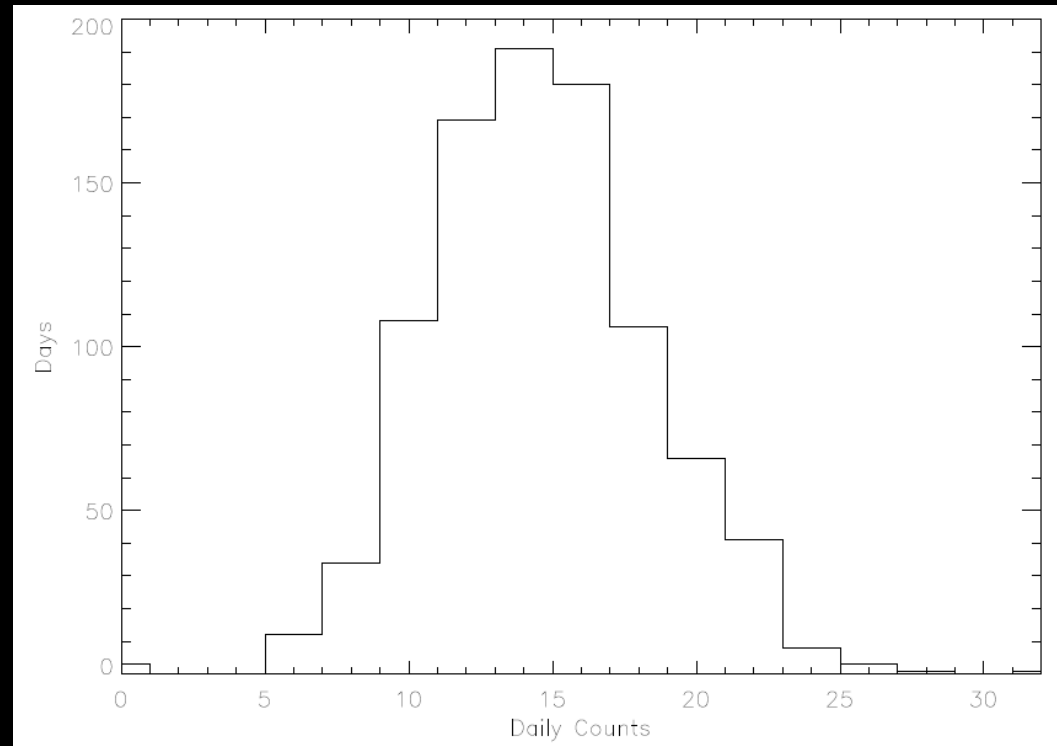
Parameters of the prominences of 2008-06 ([Description](#))

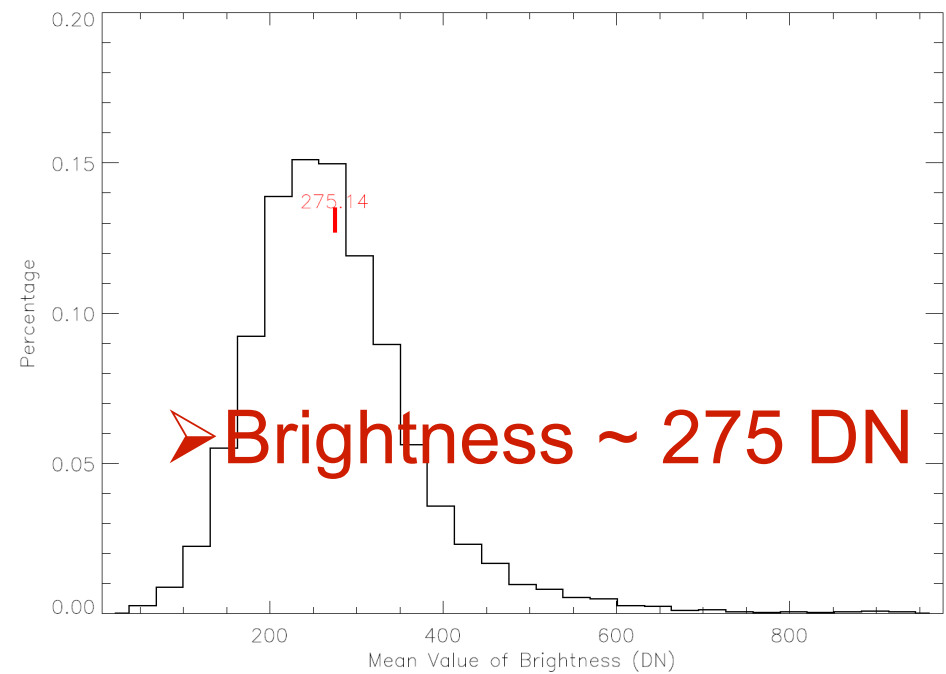
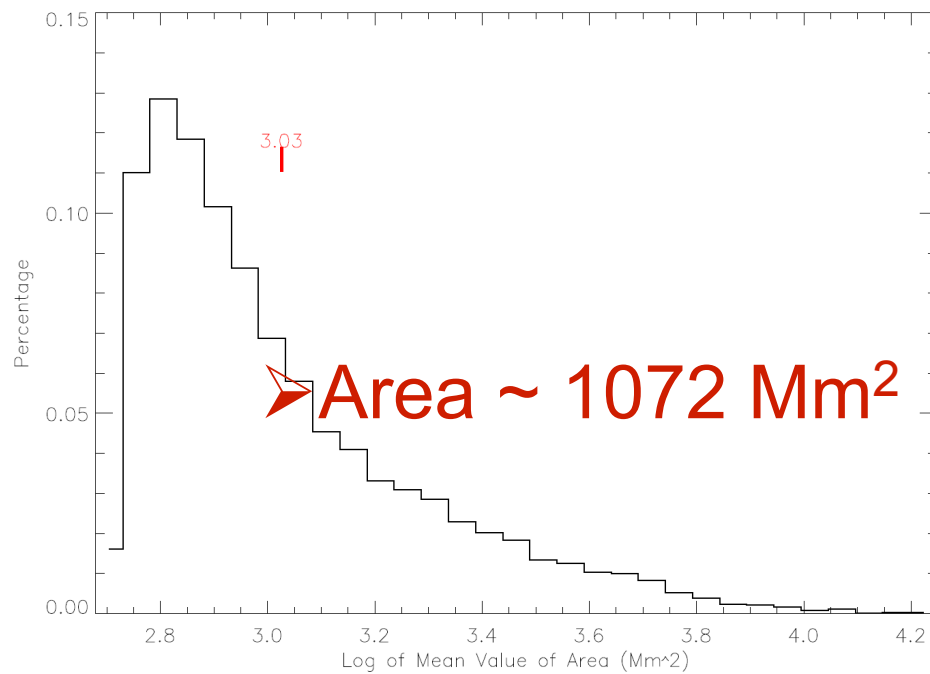
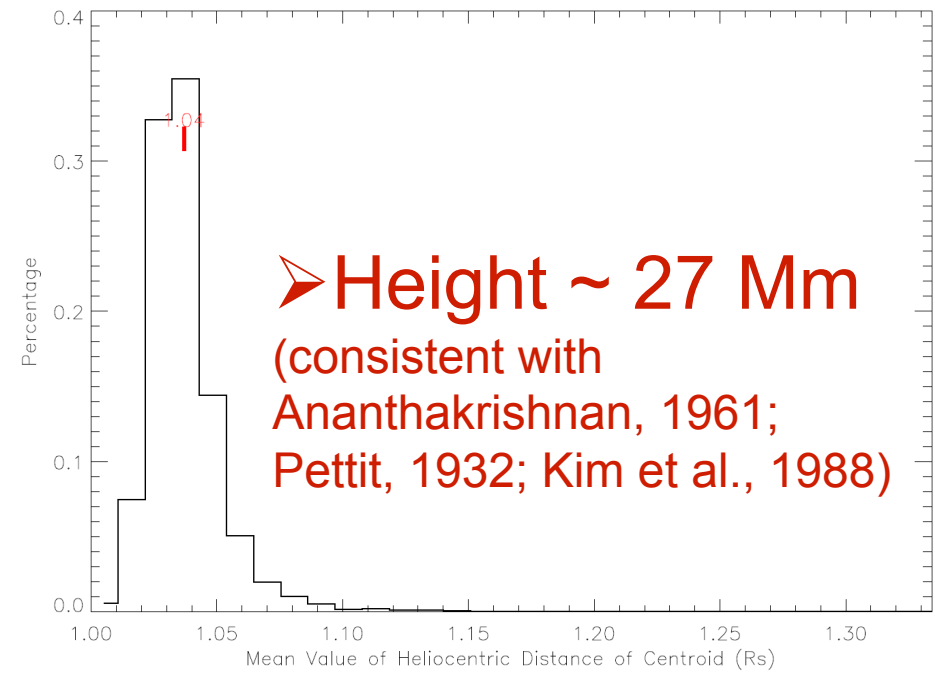
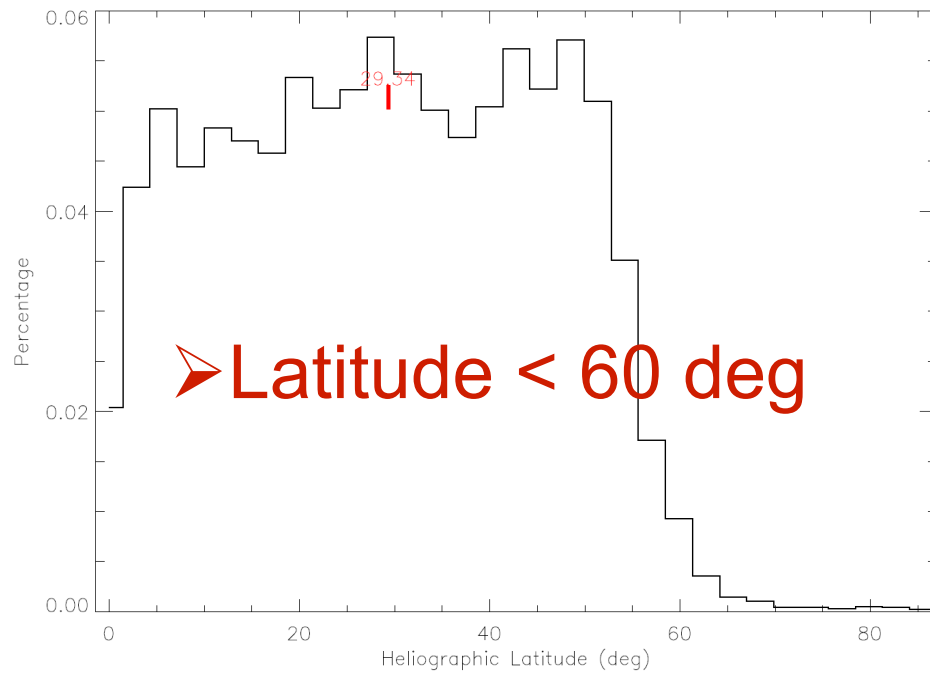
No.	Plots	Start	End	Duration	PA	HGLon	HGLat	P/	Frames	CL	r_cen					PA_cen					
											Mean	Min	Max	v	a	Mean	Min	Max	v	a	Mean
Units		UT		hours		deg					Rs			km/s	m/s ²	deg			arcsec/s	arcsec/s ²	
1		2008/05/26 06:56:58	06/04 23:56:58	233.00	320	65.34	49.86	25	1396	1	1.048	1.025	1.267	3.1870e-02	1.3815e-04	317.2	279.1	322.6	-5.5870e-02	-2.2039e-07	1.114
2		2008/05/29 23:06:58	06/08 04:56:58	221.83	40	-114.81	49.90	12	1320	1	1.039	1.014	1.082	-1.2729e-02	6.8390e-05	42.5	37.5	47.0	2.3871e-02	-5.8342e-08	1.090
3		2008/06/02	06/03	46.67	79	-114.94	11.45	2	259	1	1.064	1.023	1.154	4.1038e-01	6.3822e-03	72.9	69.1	79.2	-1.6032e-01	1.8347e-06	1.138

2. What do we have from the system?

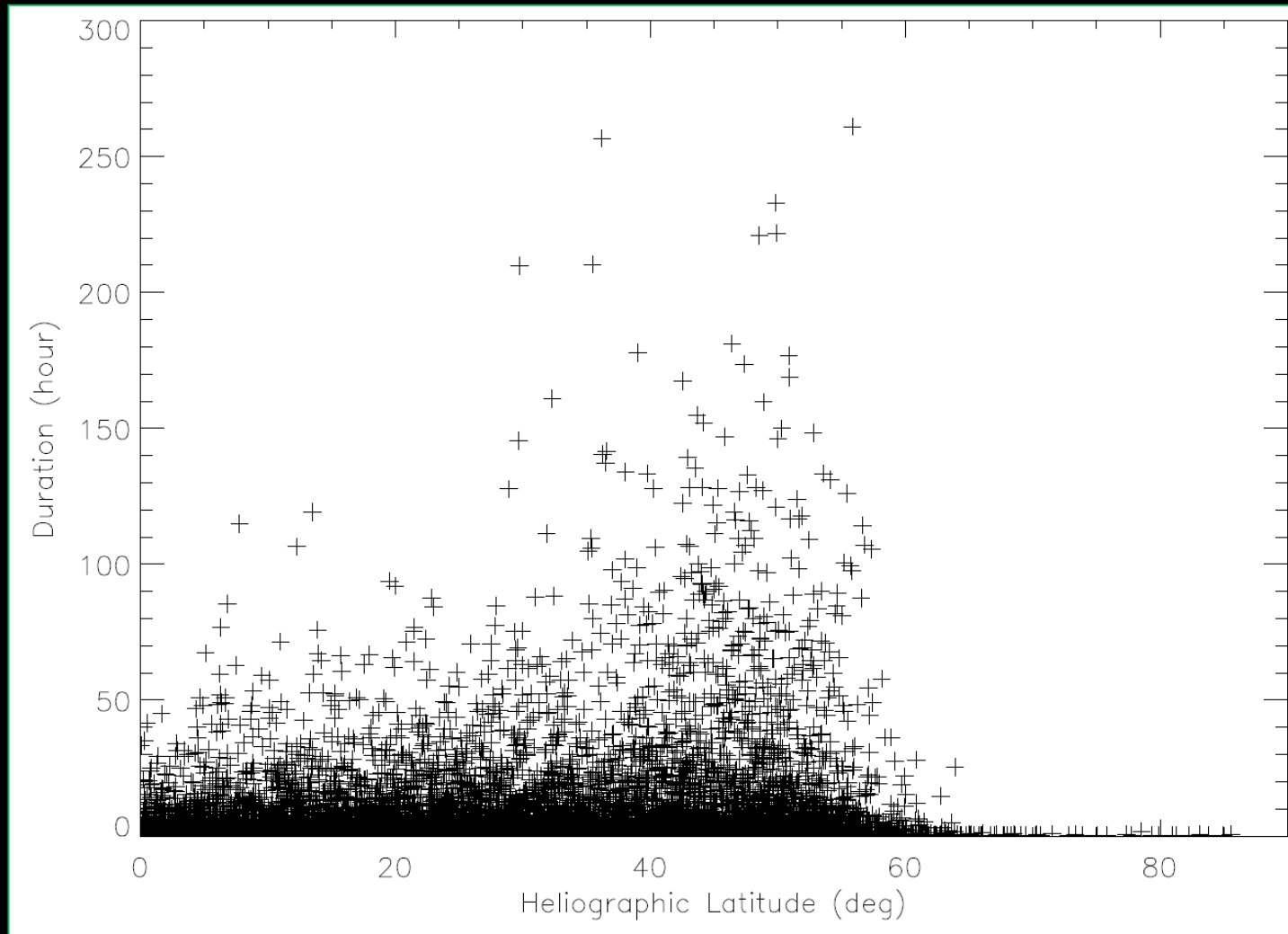
- An online catalog
- Preliminary statistical results
STEREO-B / SECCHI / EUVI 304
During 2007 April – 2009 October

9477 well-tracked
prominences

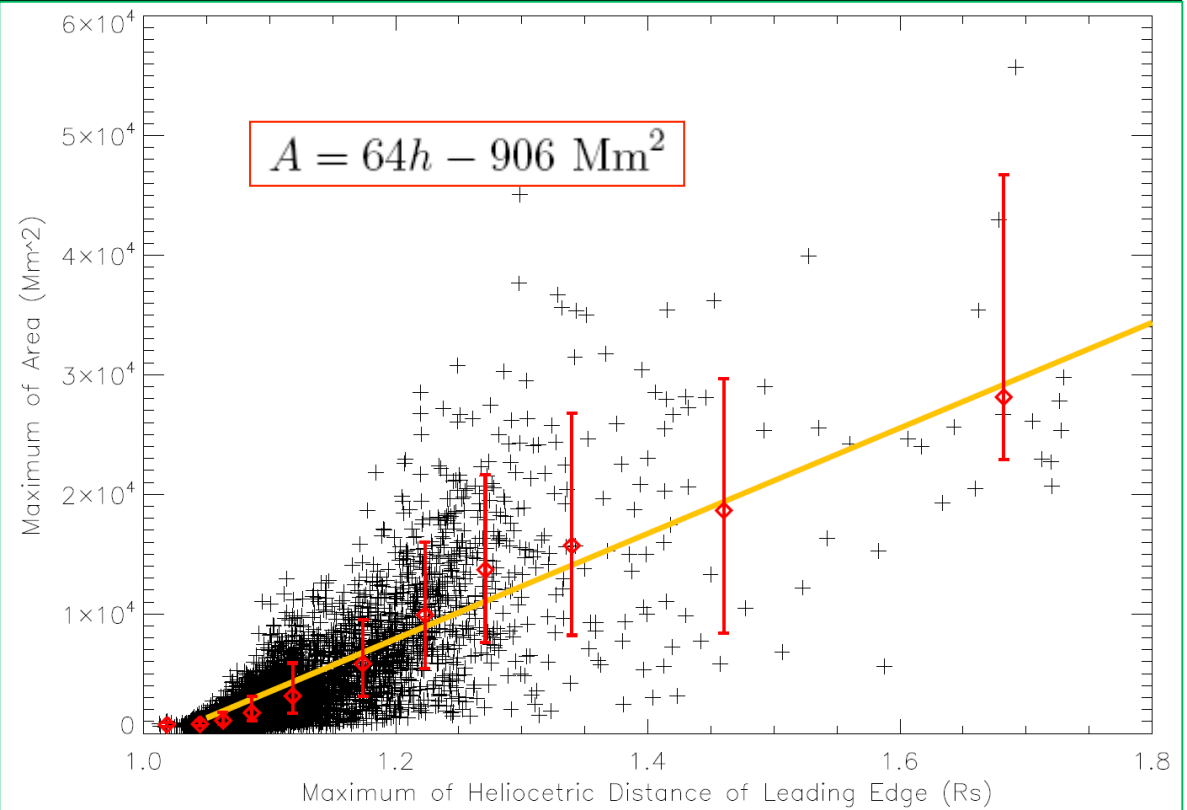
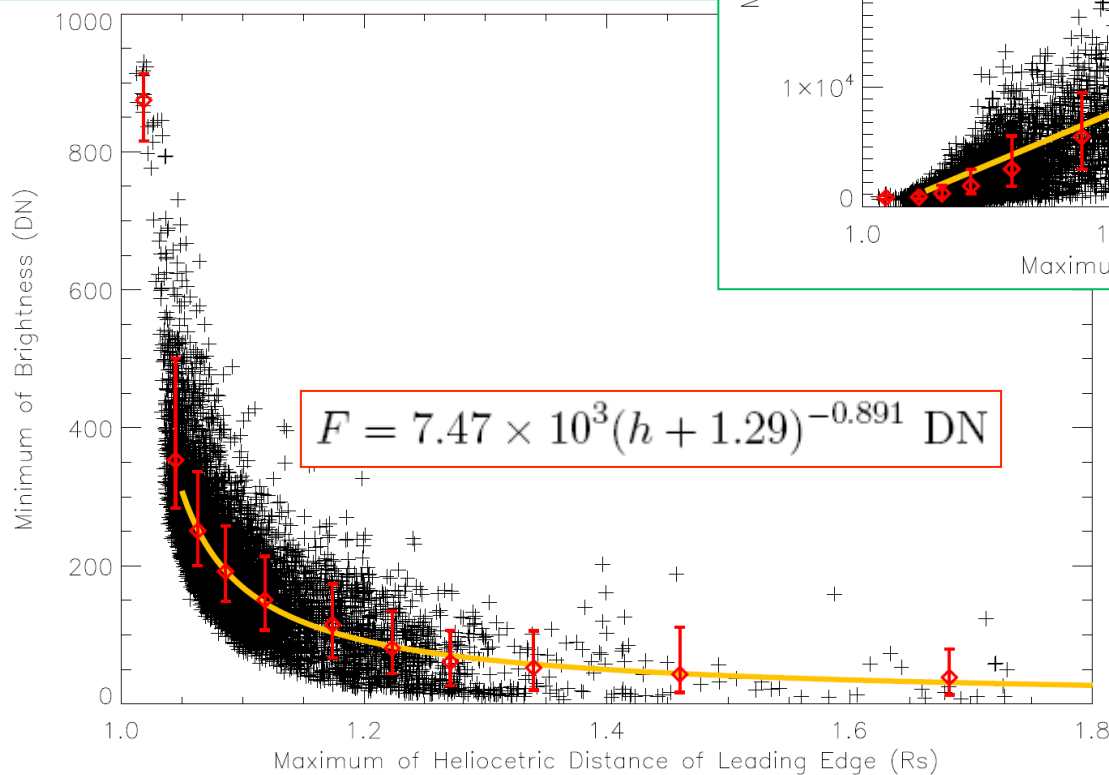




Long extended prominences arise between 30 and 60 deg

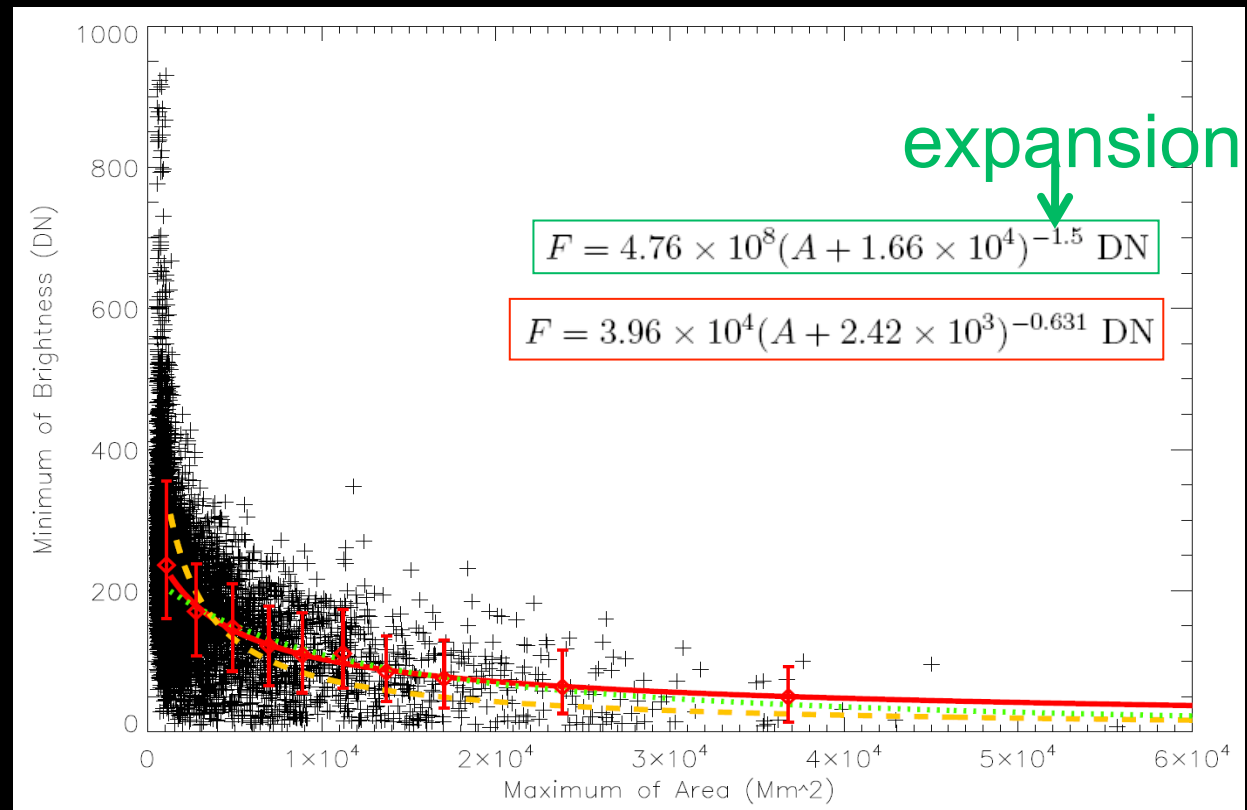


Correlations among distance, area, and brightness



The fading of prominences

- Thermal processes (e.g., Mouradian and Martres 1986; Ofman et al. 1998; Hanaoka and Shinkawa 1999)
- Dynamic processes (e.g., Rusin and Rybansky 1982; Bemporad 2009)
 - Mass loss
 - Expansion



Expansion is one of the major causes

Summary

- SLIPCAT has the capability to recognize and track solar limb prominences.
- A catalog of STEREO-B prominences has been generated.
- It is a useful tool to study prominences and relevant phenomena with personal bias reduced.
- It could be used in the pipeline of data product of SDO or other missions.

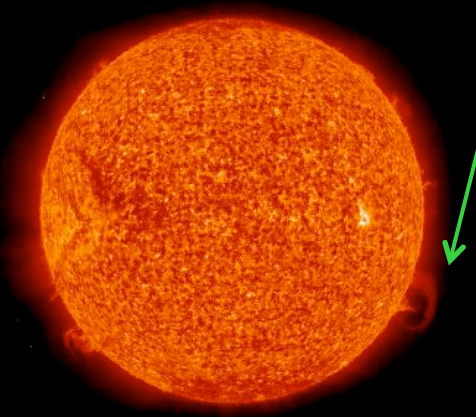
Wang et al., ApJ, submitted, 2010

Visit <http://space.ustc.edu.cn/dreams/slipcat/> for more details

An application in 3D reconstruction of prominences

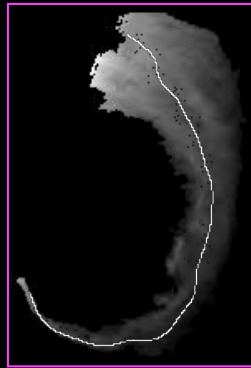
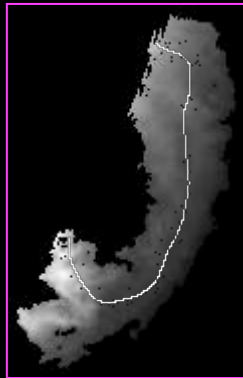
EUM304_A

EUM304_B



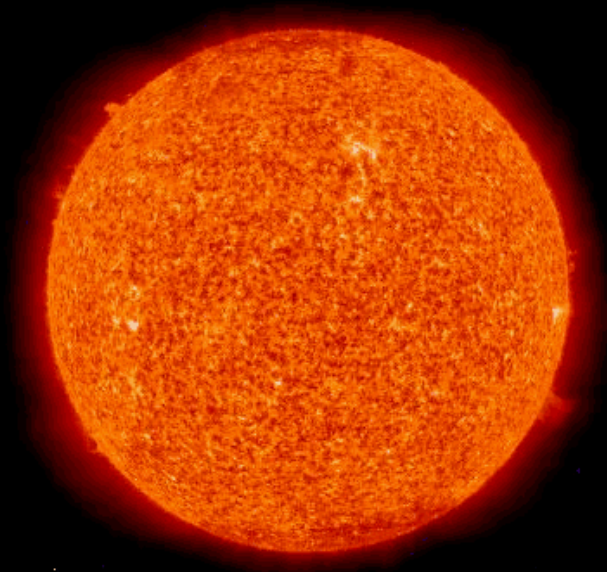
2008-02-27T22:46:15.027

2008-02-27T22:46:32.656



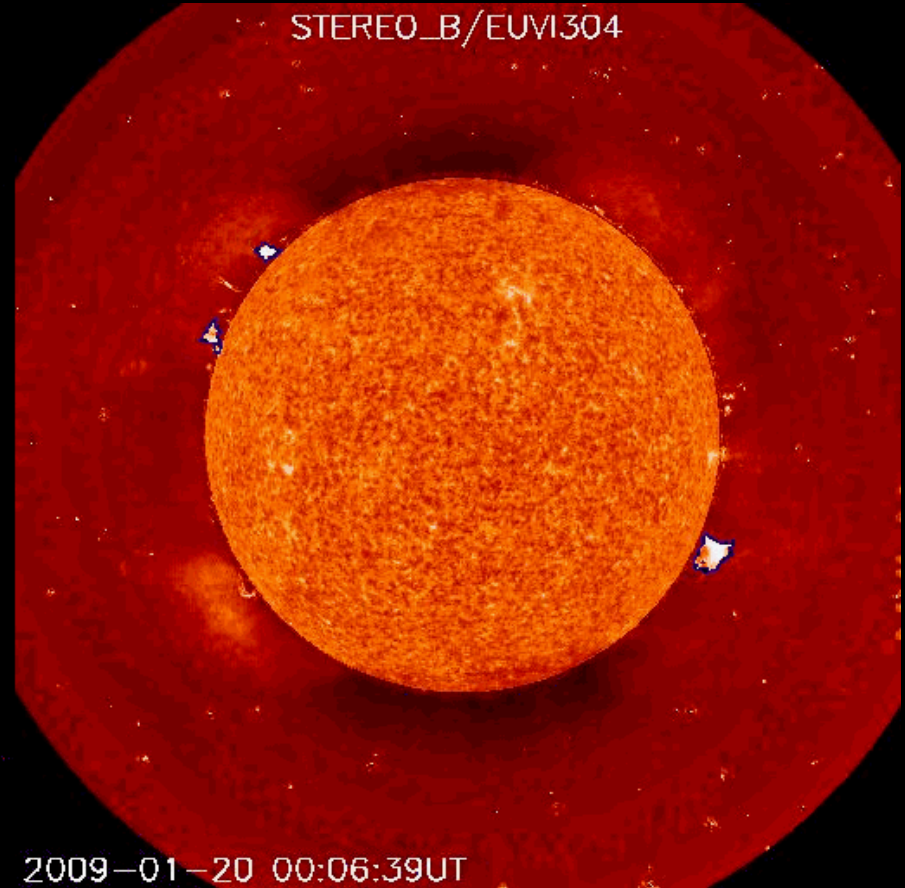
Thanks

STEREO_B/EUVI304



2009-01-20 00:06:39UT

STEREO_B/EUVI304



2009-01-20 00:06:39UT

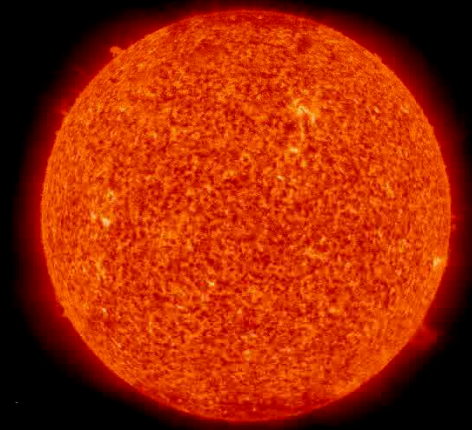
1. Why do we need an automated system & why do we use the EUV 304 emission line?

➤ Extract useful information from abundant of data

- Explosive growth of data:
STEREO 10 min; SDO 10 sec
- Increase research efficiency

➤ Minimize manual intervention

- Unbiased parameters
- Objective results



➤ The only one uninterruptedly imagining the Sun

- A complete database

➤ High time resolution

- Allow to track prominence's evolution

➤ No well-established online catalog for limb prominences

- A complementary to other catalogs

On-disk features: Gao et al., 2002; Shih & Kowalski, 2003;

Fuller et al., 2005; Zharkova et al., 2005; Bernasconi et al., 2005

Limb-features: Foullon & Verwichte, 2006

➤ Minimized projection effect

Candidate
Selection

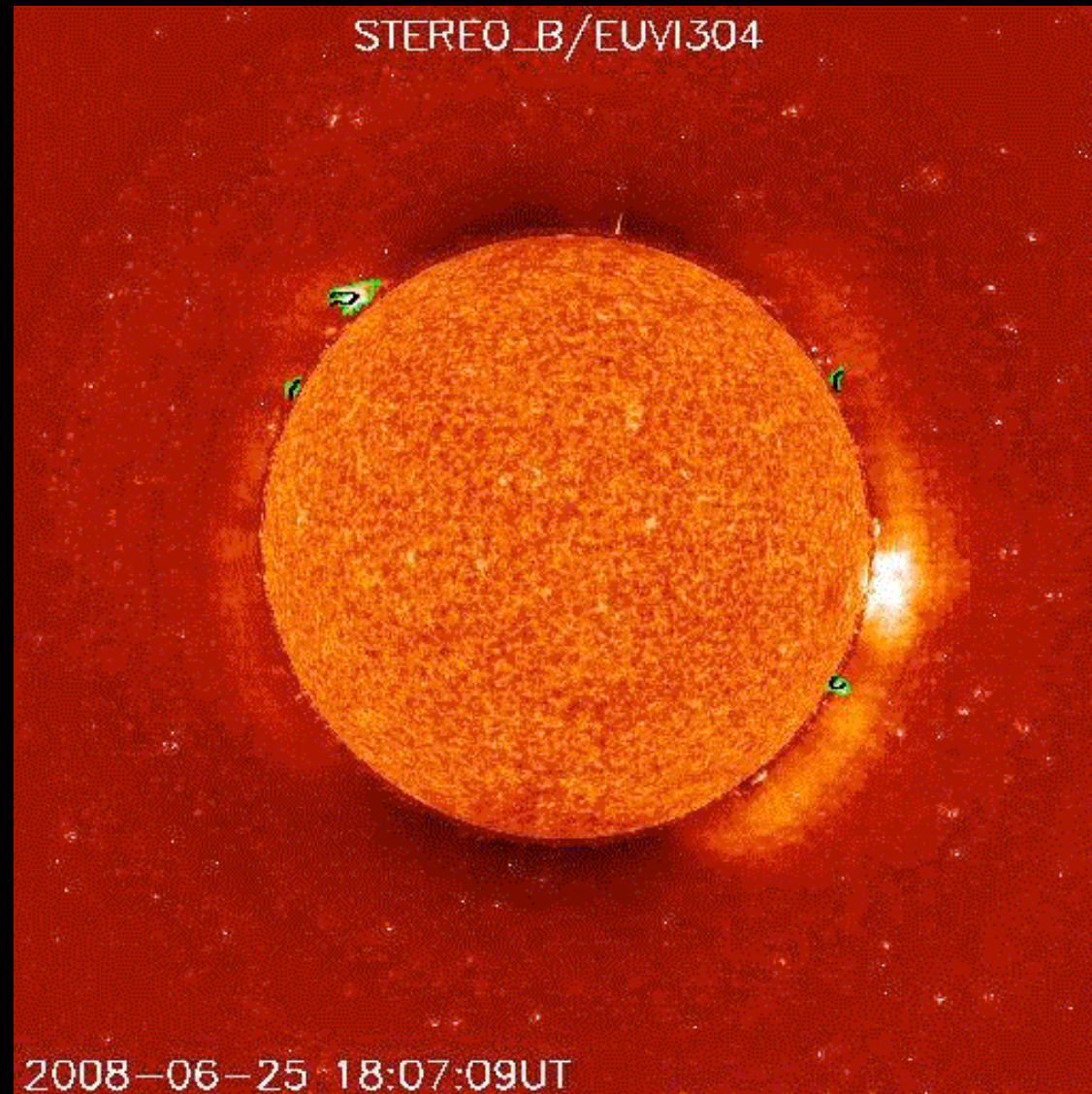
Parameter
Extraction

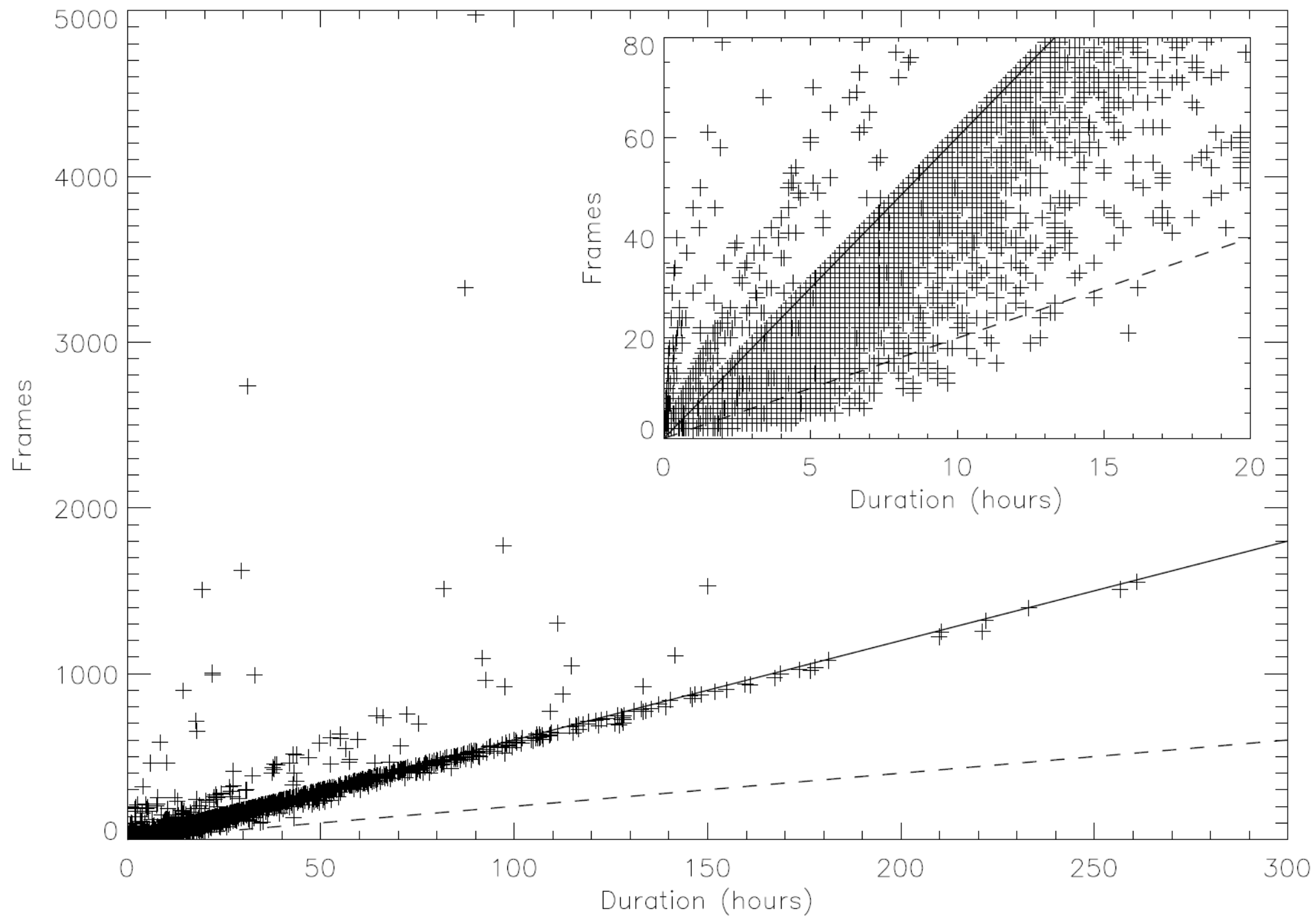
Non-prominence
Feature Removal

Evolution
Tracking

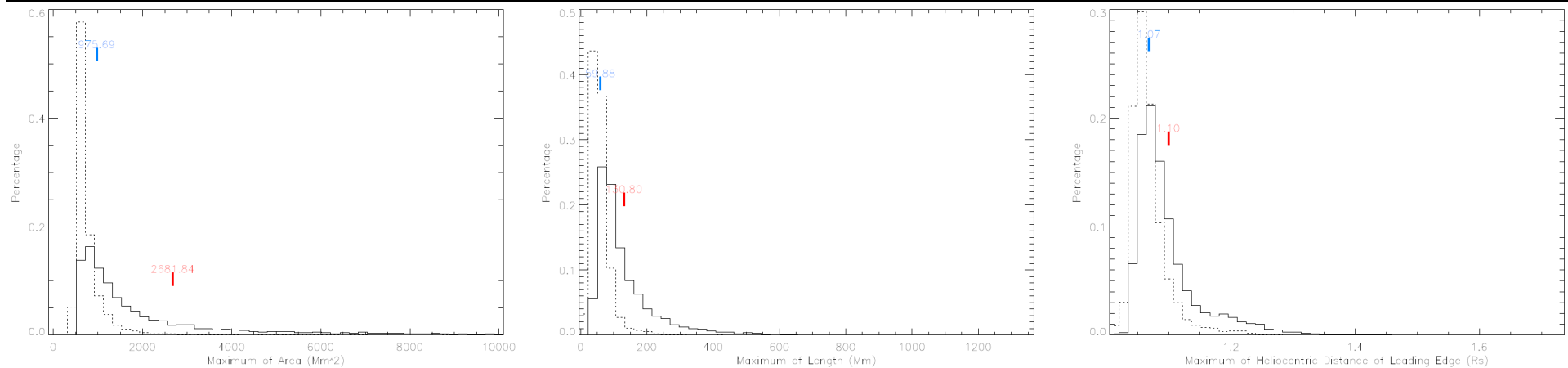
Catalog
Generating

A case showing the limb filaments recognized by SLIPCAT





Poorly-tracked prominences are generally small and low



Has the capability to recognize small ones

