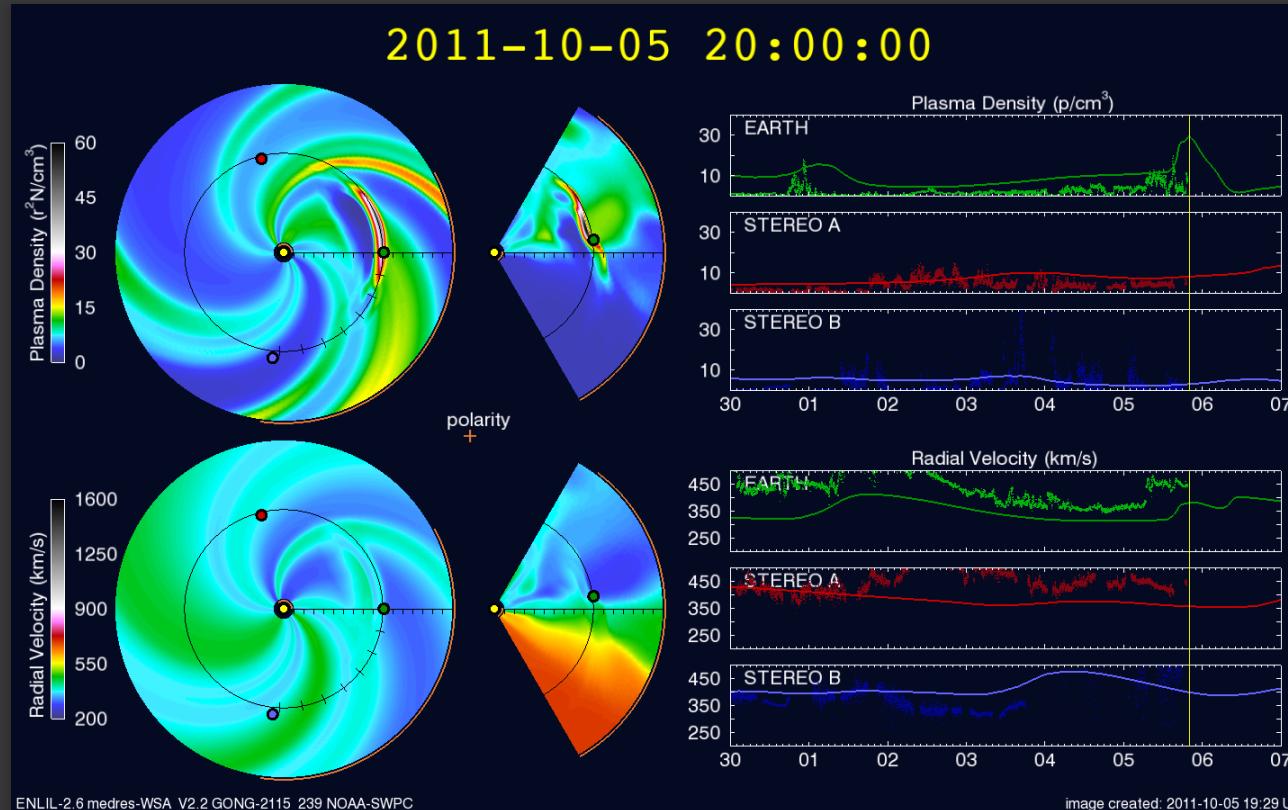


# WSA-Enlil in Operations at the National Weather Service: Experiences, Results and Developments

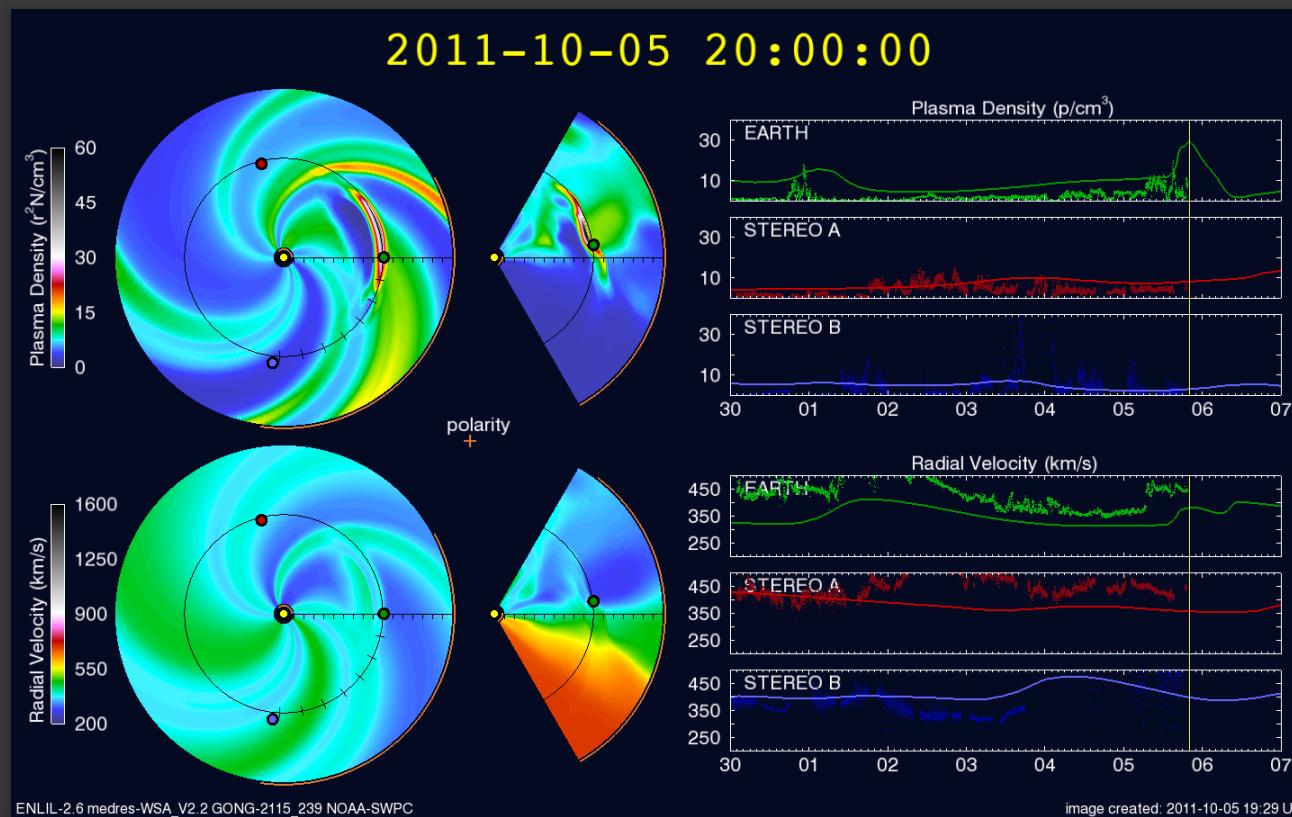
George Millward (CU/NOAA)

Vic Pizzo, Doug Biesecker (NOAA), Curt de Koning (CU/NOAA)



# WSA-Enlil in Operations at the National Weather Service: Transition to Operations

George Millward (CU/NOAA)  
Vic Pizzo, Doug Biesecker (NOAA), Curt de Koning (CU/NOAA)



# Transition to Operations

Transition to Operations

# VALLEY OF DEATH

# Transition to Operations

## VALLEY OF DEATH



Transition to Operations

# VALLEY OF DEATH

Transition to Operations

# RUBBER HITS THE ROAD

# Transition to Operations

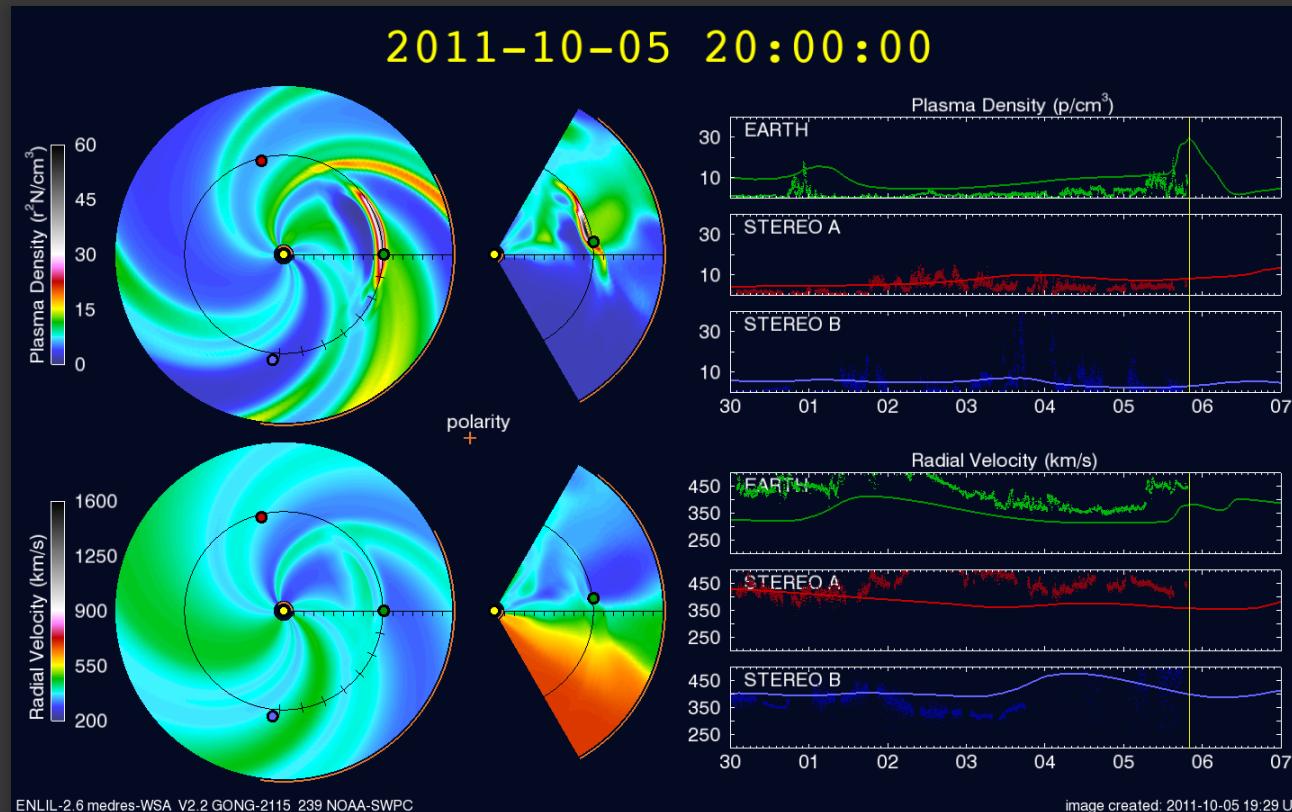
## RUBBER HITS THE ROAD



# WSA-Enlil in Operations at the National Weather Service: Experiences, Results and Developments

George Millward (CU/NOAA)

Vic Pizzo, Doug Biesecker (NOAA), Curt de Koning (CU/NOAA)



# Intended Space Weather Benefits

- Provide improved warning of Co-rotating Interacting Regions (CIRs)

General “situational awareness”

Time of arrival at Earth

Geomagnetic storm response

- Provide 1 to 4 days advance warning of oncoming CMEs

General “situational awareness”

Probability of an interaction with Earth (“direct hit very probable”, “possible glancing blow”)

Time of arrival at Earth (Aiming for accuracy of +/- 6 hours)

Storm intensity (Tricky, modeled CME has no information about B field magnitude or orientation)

Storm duration

- Pave the way for future space weather model transitions:

Geospace

Upper atmosphere / ionosphere

# WSA-Enlil at NWS: Timeline

- October 2009 : Begin Transitioning project

Design of WSA-Enlil CONOPS

Development / testing of CME ‘cone’ tools

Installation of WSA-Enlil on DEVCCS

Model run scripts / networking (etc.)

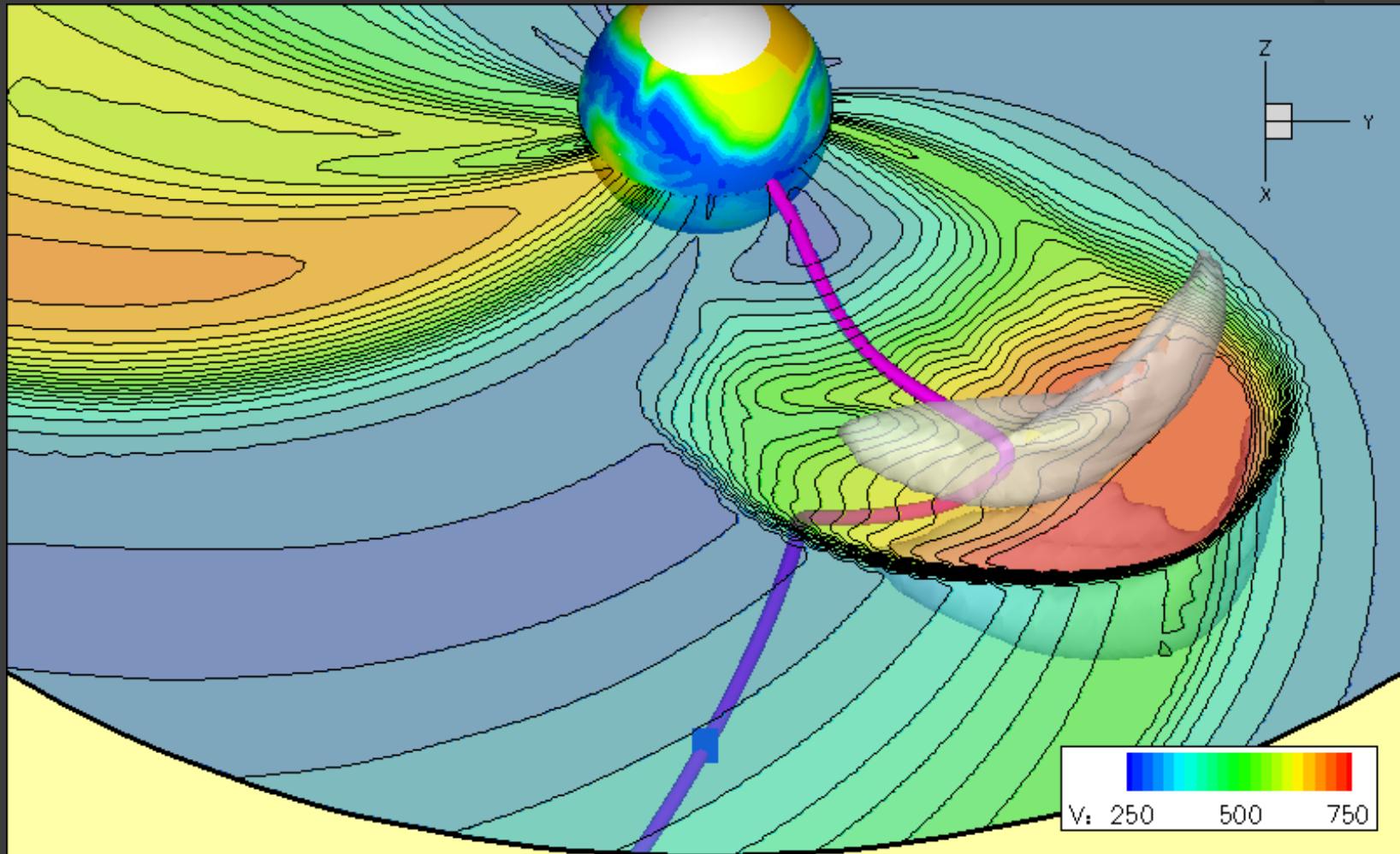
Development of Solar Predictions Interface (SPI)

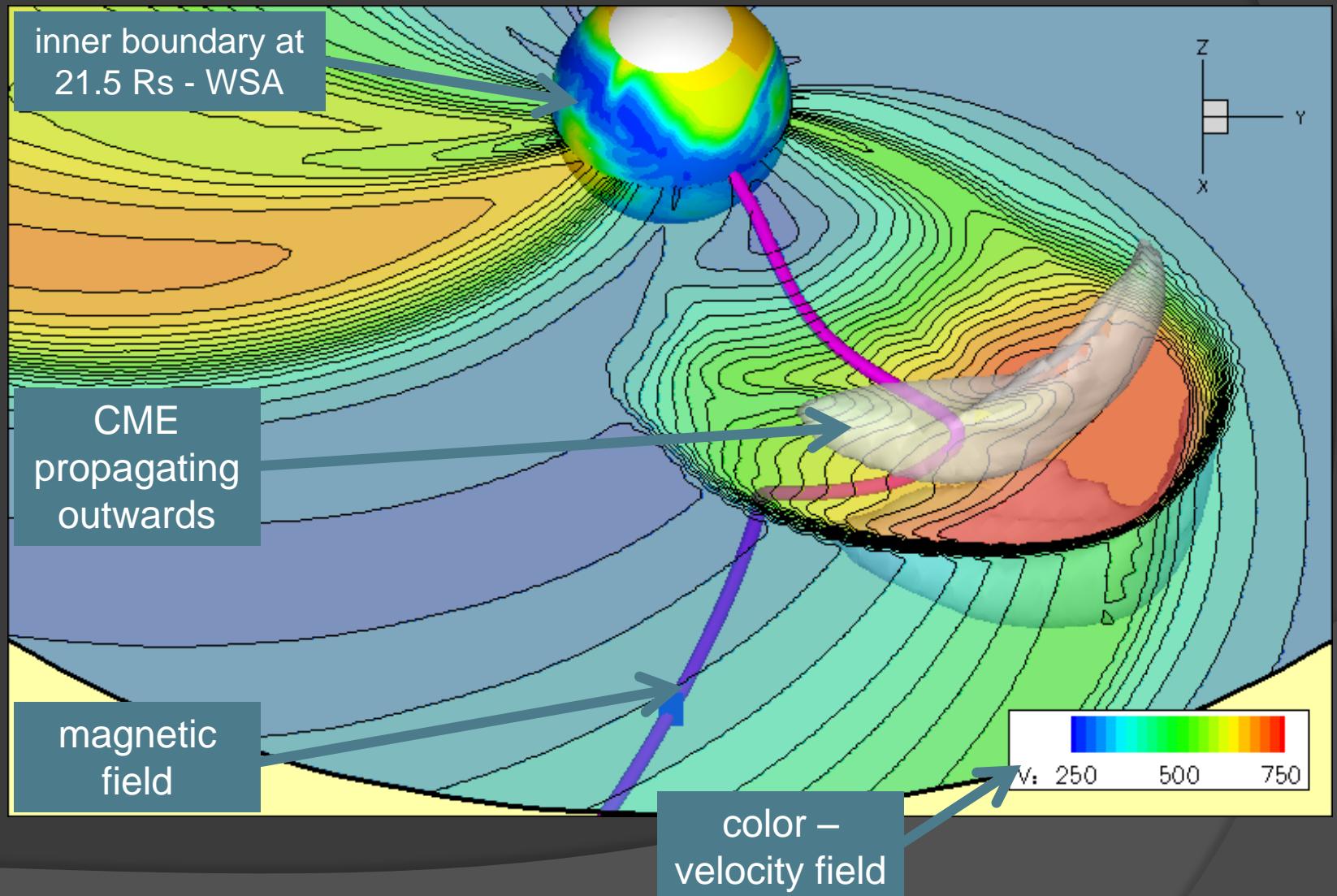
Post-processing / output products

- October 2011 : WSA-Enlil in ‘parallel operations’ at NWS
- December 2011 : WSA-Enlil fully operational on NCEP supercomputers
- April 2012 (ie, Now) : Deployment of SPI and Analysis tools into SWPC Forecast Office
- March – September : Forecaster Training
- October 2012 : Fully Operational (SWFO in full control)
- 2013 : Version 2 development (SWPT)

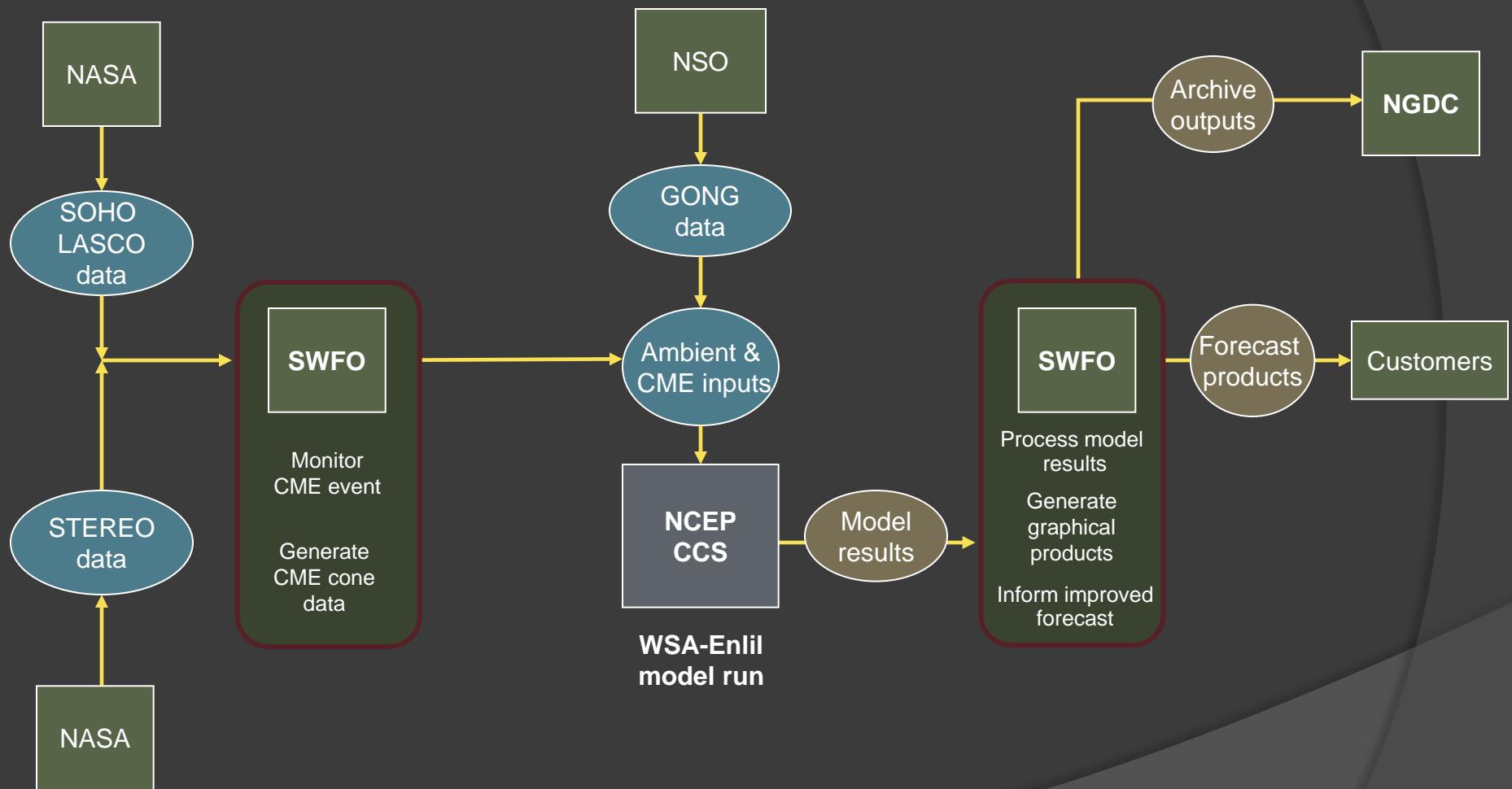
# WSA-Enlil

A comprehensive, 3D, MHD, time-dependent, forecast model of the Heliosphere (solar wind)



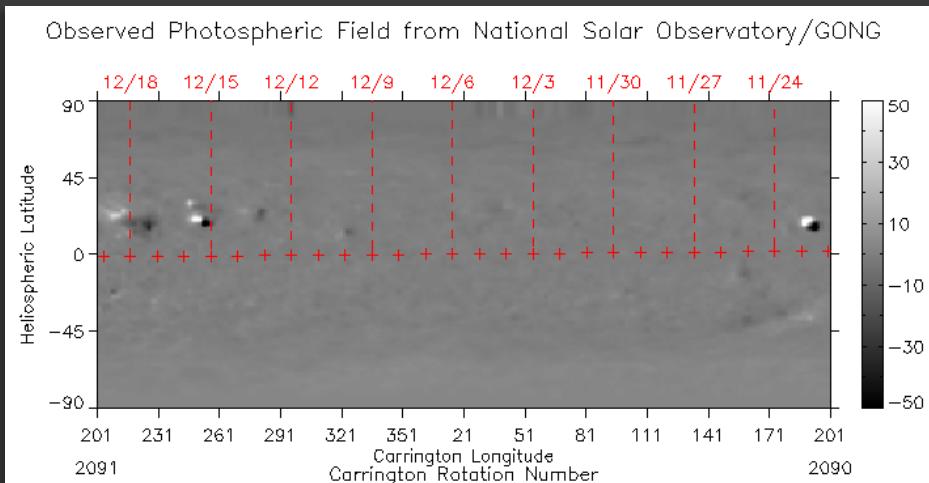


# WSA-Enlil CONOPS



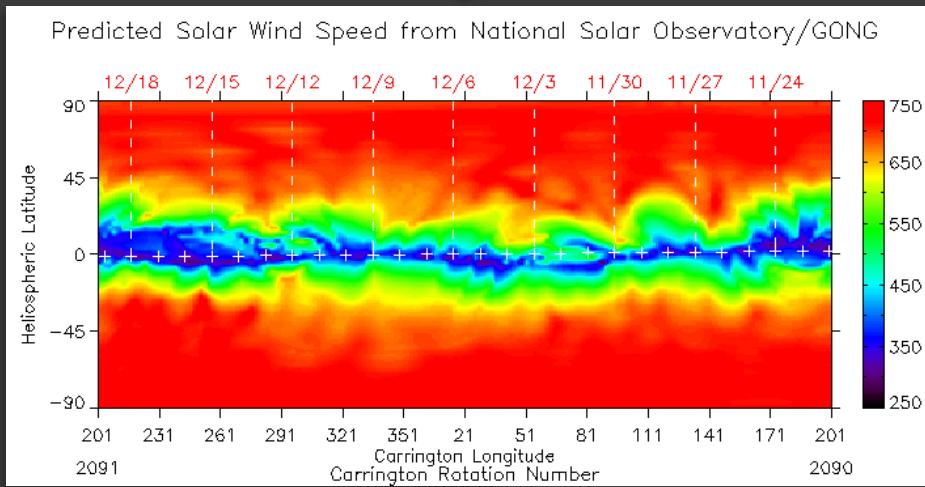
# Wang-Sheeley-Arge (WSA) model:

INPUT:  
Solar photospheric  
magnetic field  
(NSO, GONG)



WSA

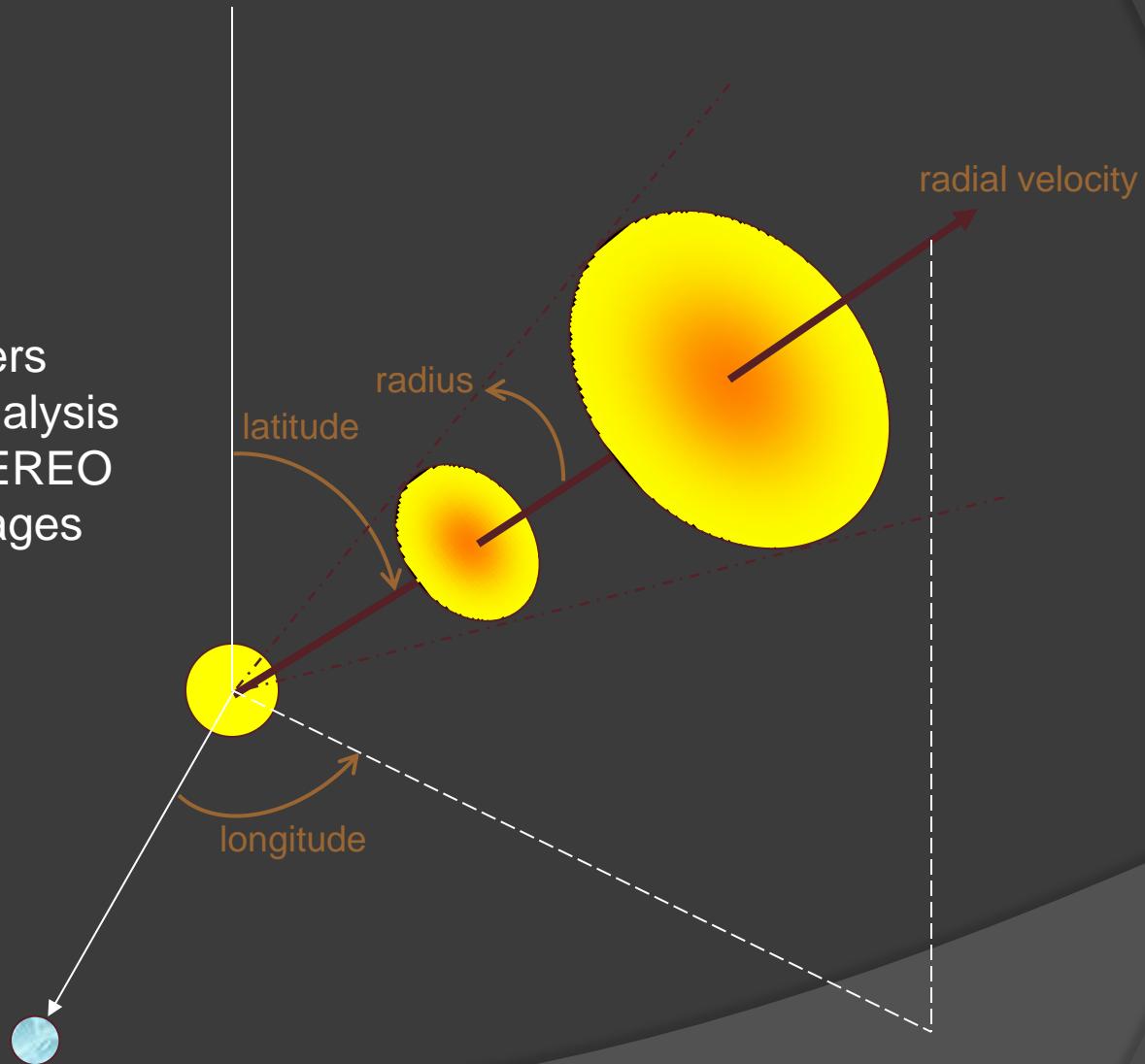
OUTPUT:  
Global velocity and  
magnetic polarity



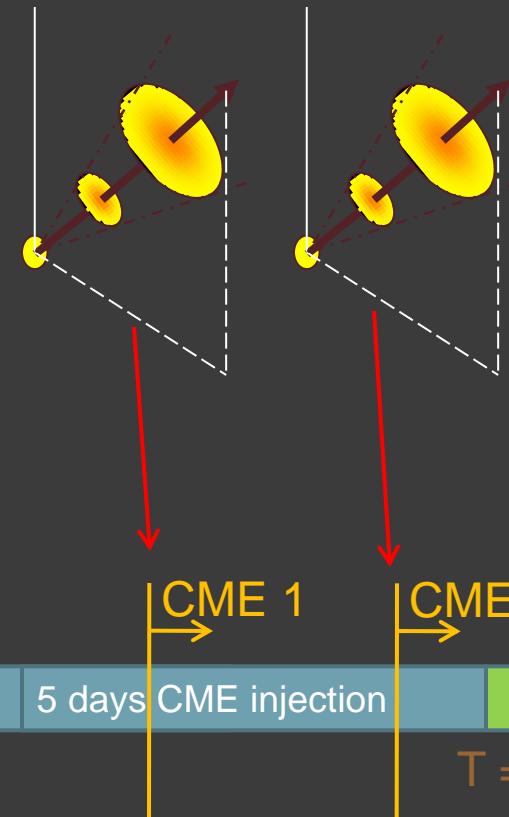
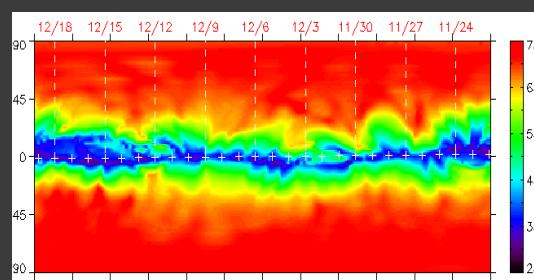
Steady, co-rotating  
“ambient”  
background flow at  
21.5Rs

## CME 'Cone' Geometry

CME parameters  
calculated from analysis  
of SOHO and STEREO  
coronagraph images



## WSA-Enlil Model Run Schematic



10 day model startup

5 days CME injection

*forecast*

$T = -15$

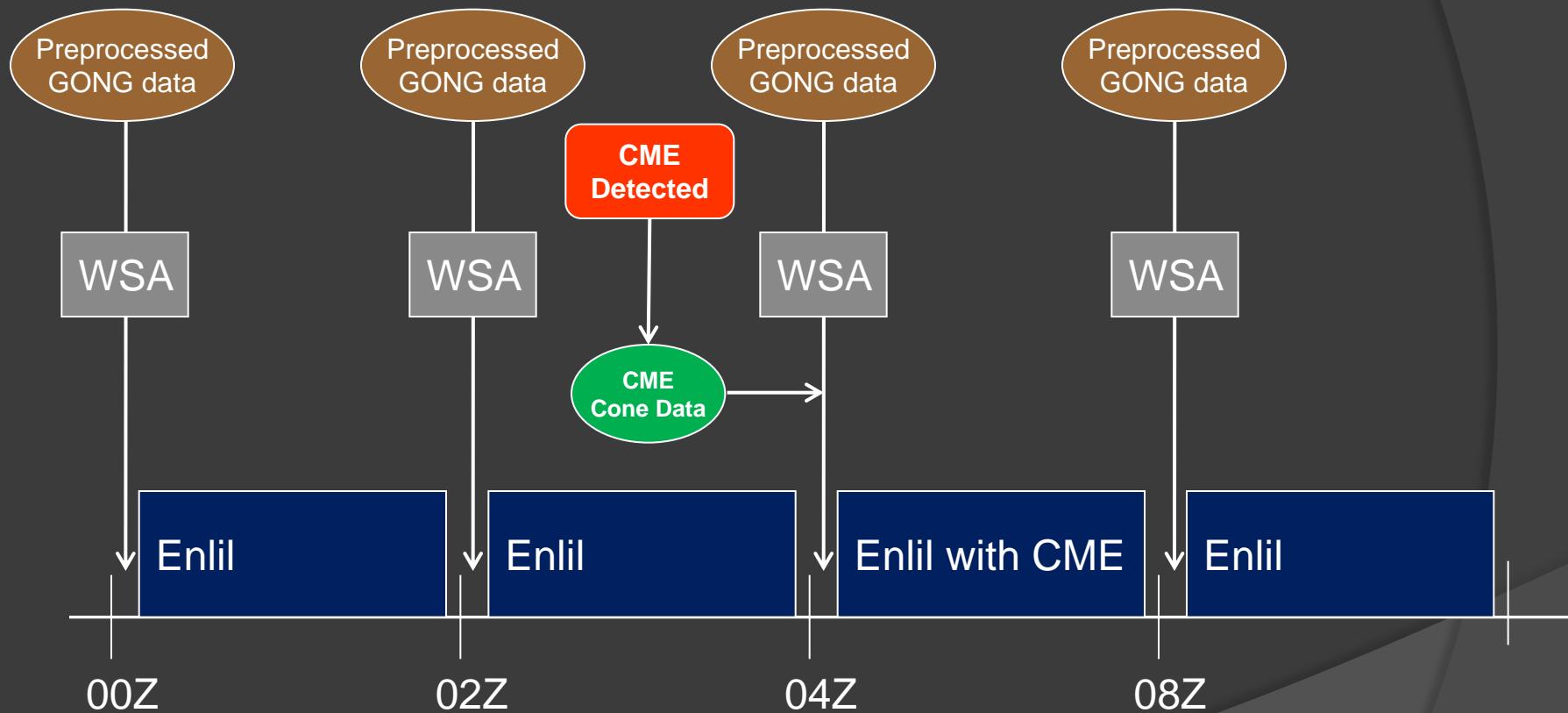
$T = 0$

$T = 5$  days

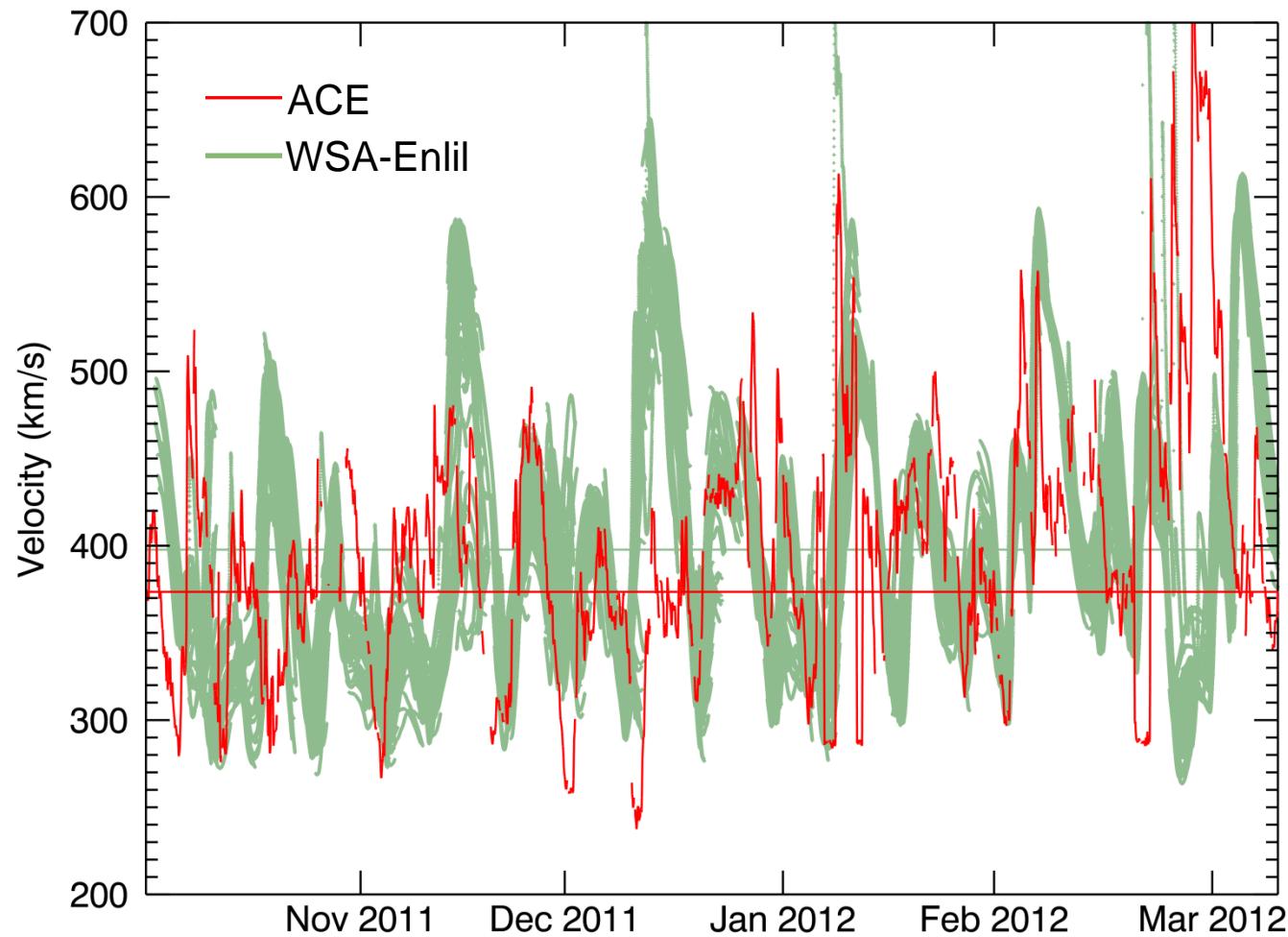
1.5 hours Wallclock time on NWS CCS

# WSA-Enlil production run cycle at NCO

model runs every 2 hours

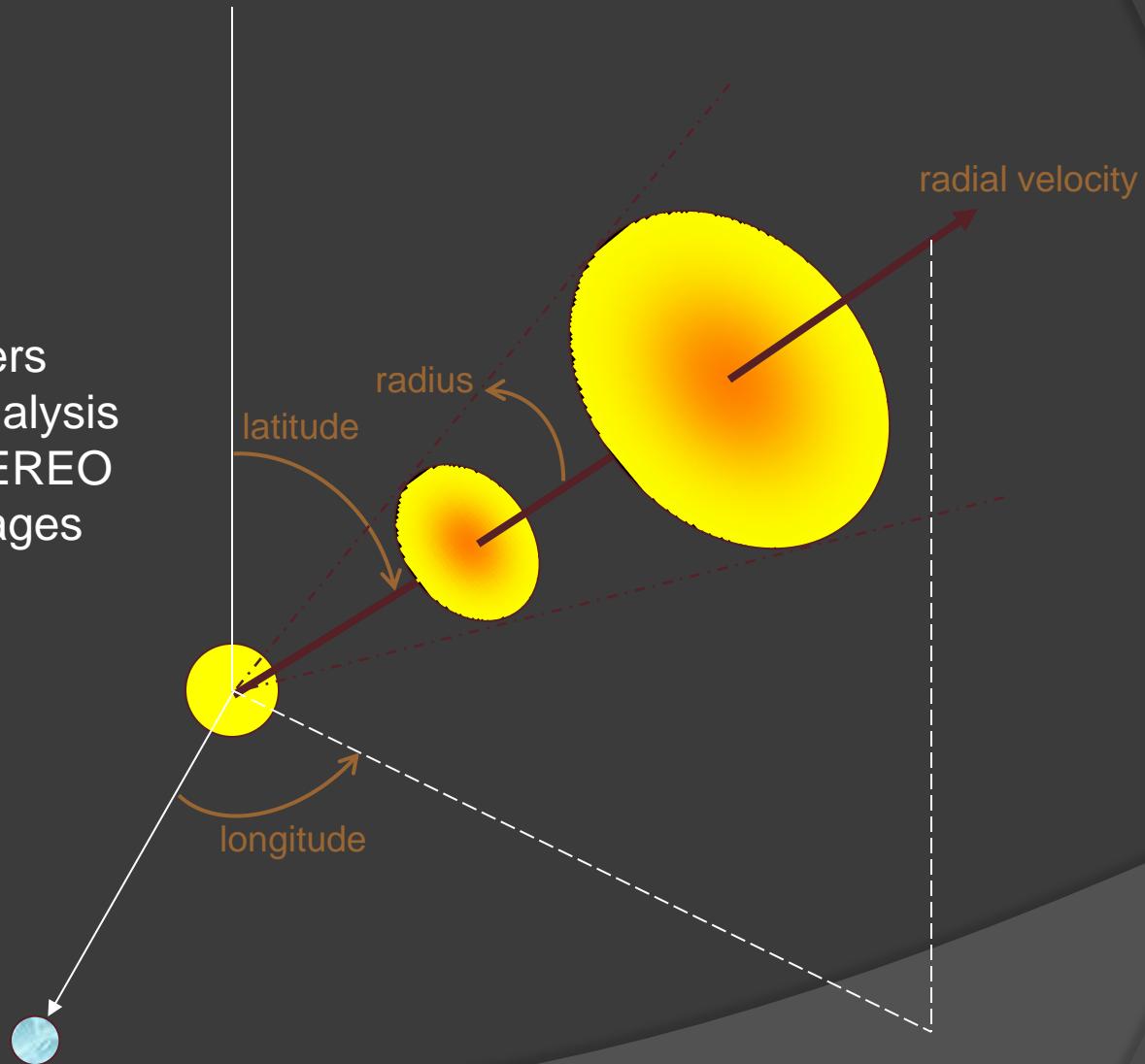


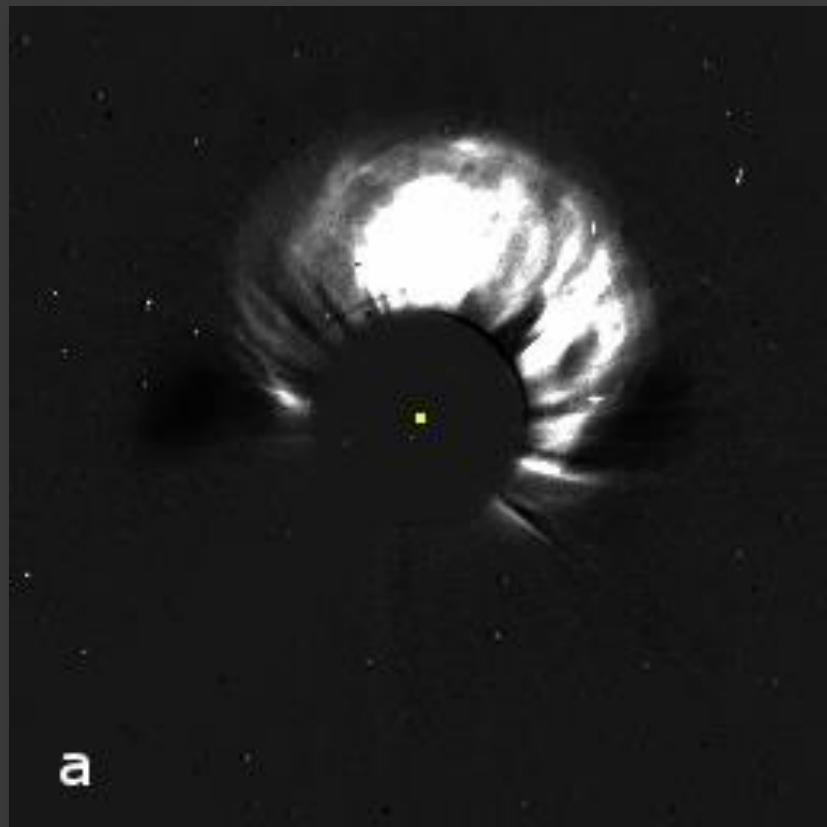
SWPC WSA-Enlil OPS: 4 to 5 day ahead forecast of SW velocity



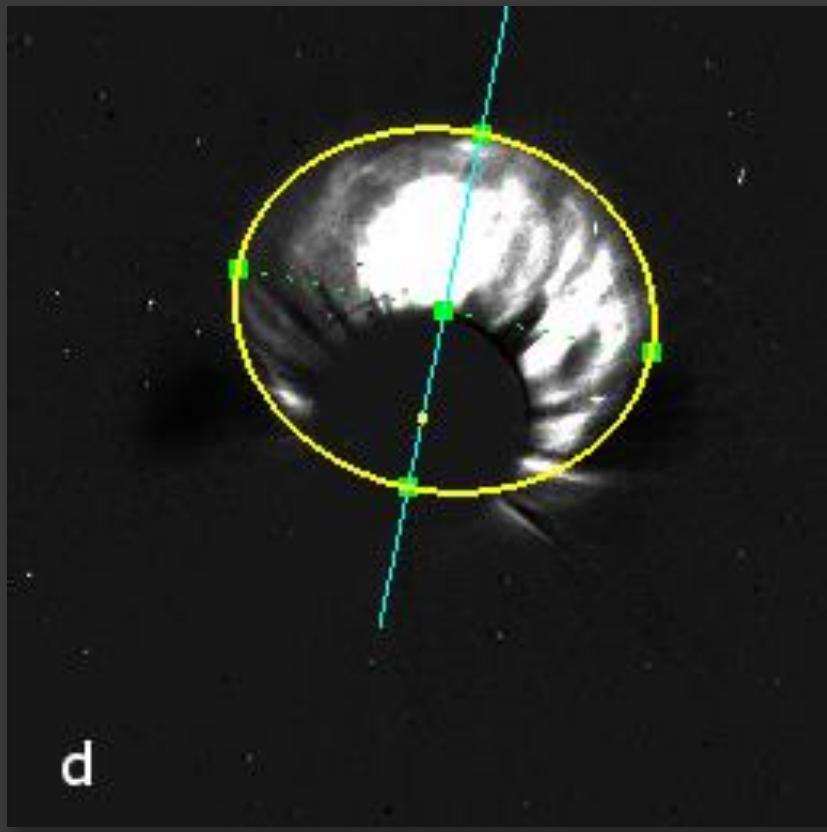
## CME 'Cone' Geometry

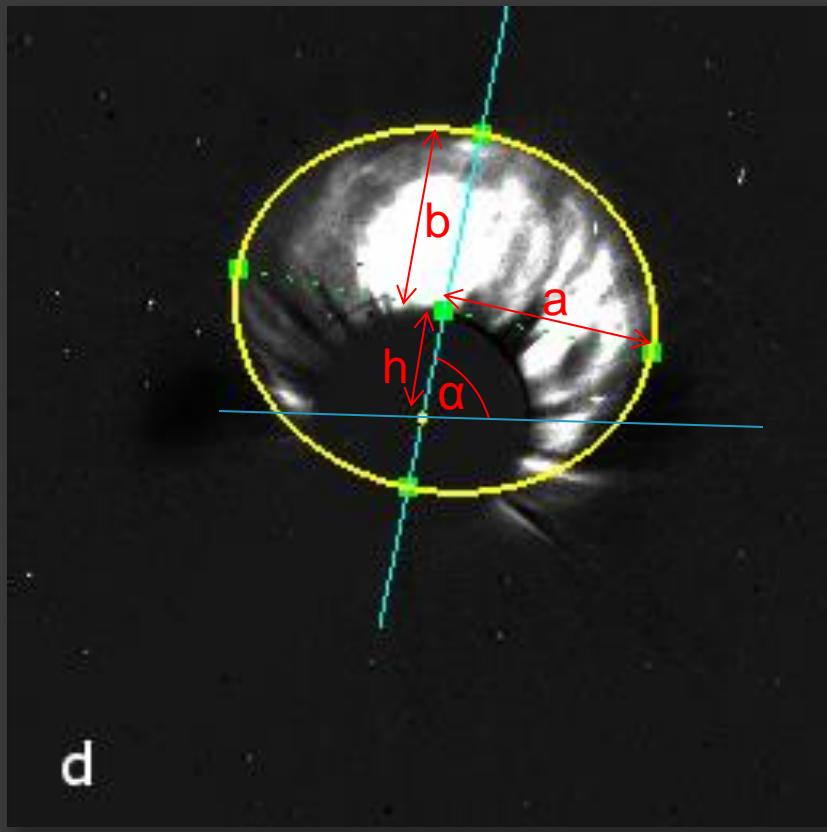
CME parameters  
calculated from analysis  
of SOHO and STEREO  
coronagraph images

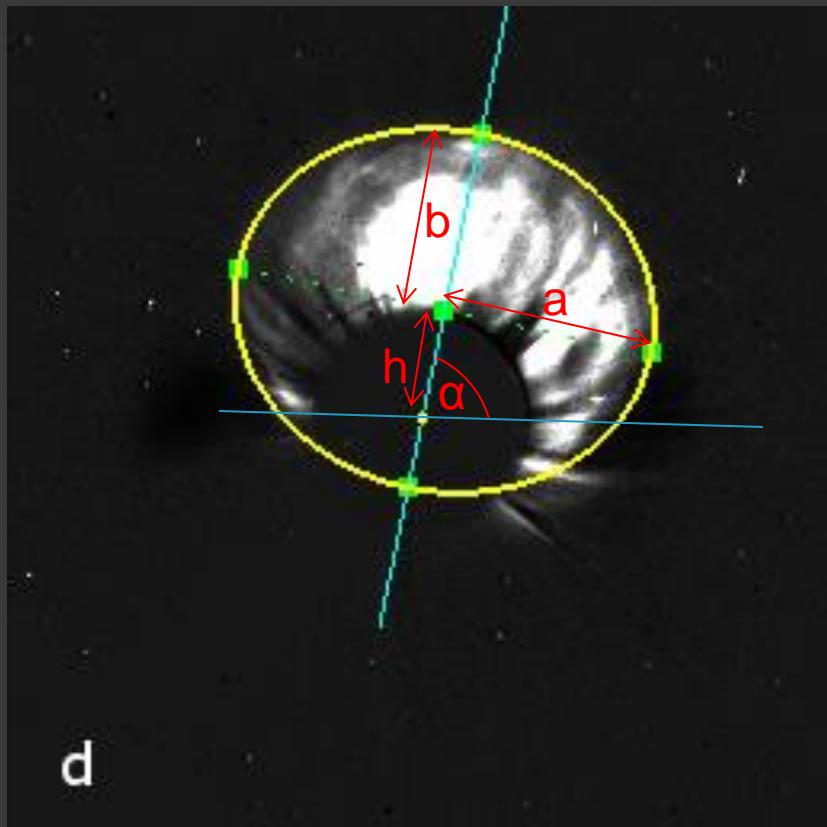




a

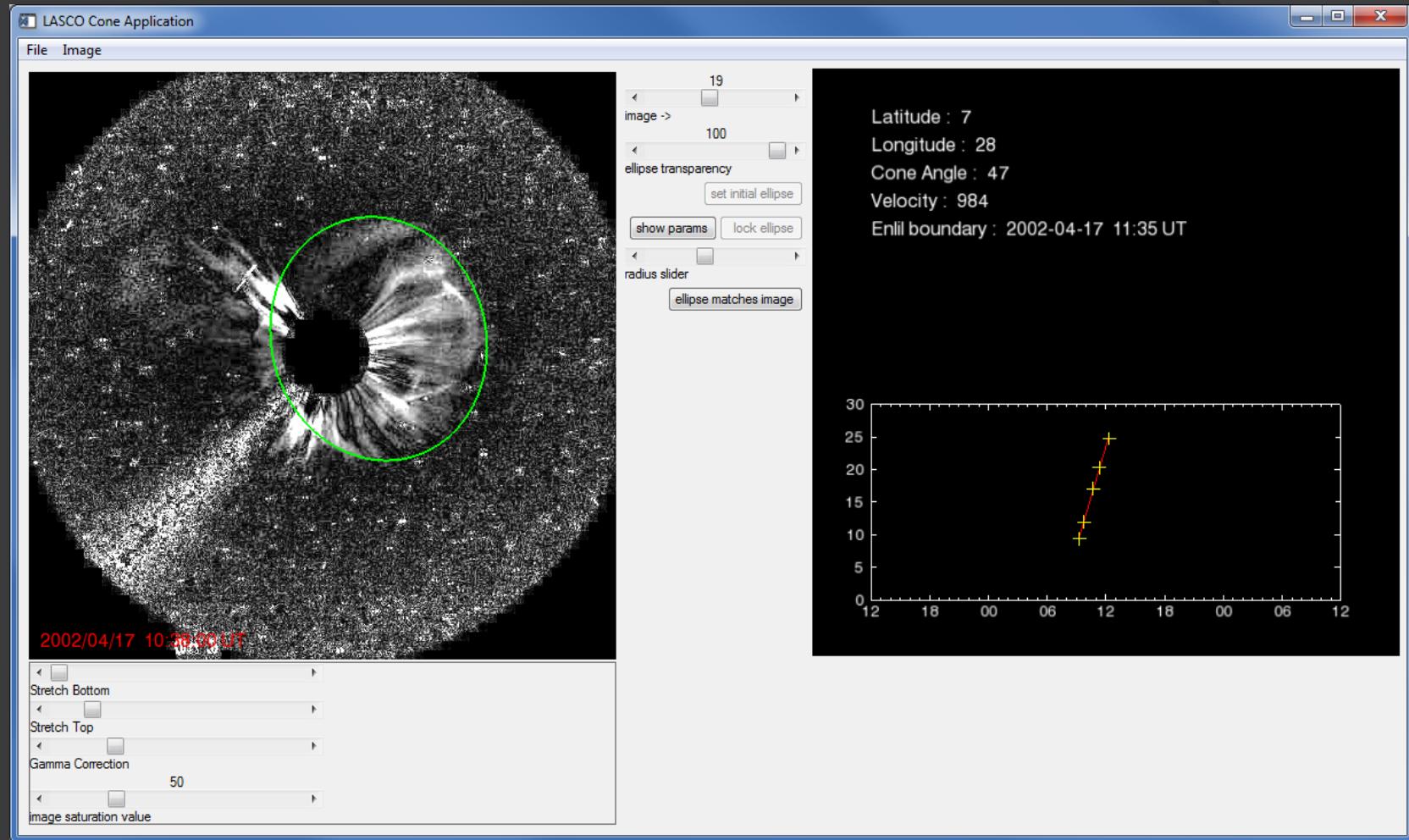






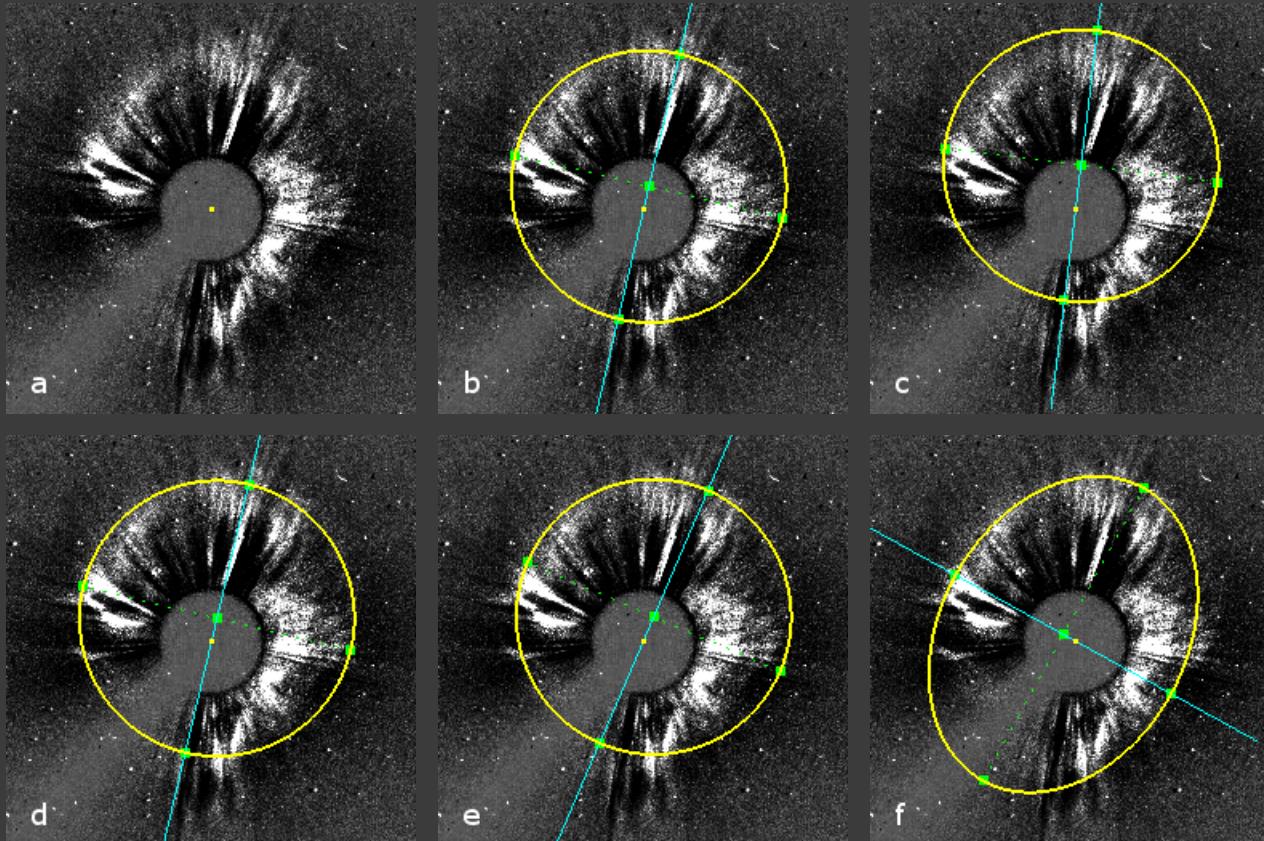
Ellipse parameters gives CME propagation direction and cone angle.

A second coronagraph image yields propagation velocity.



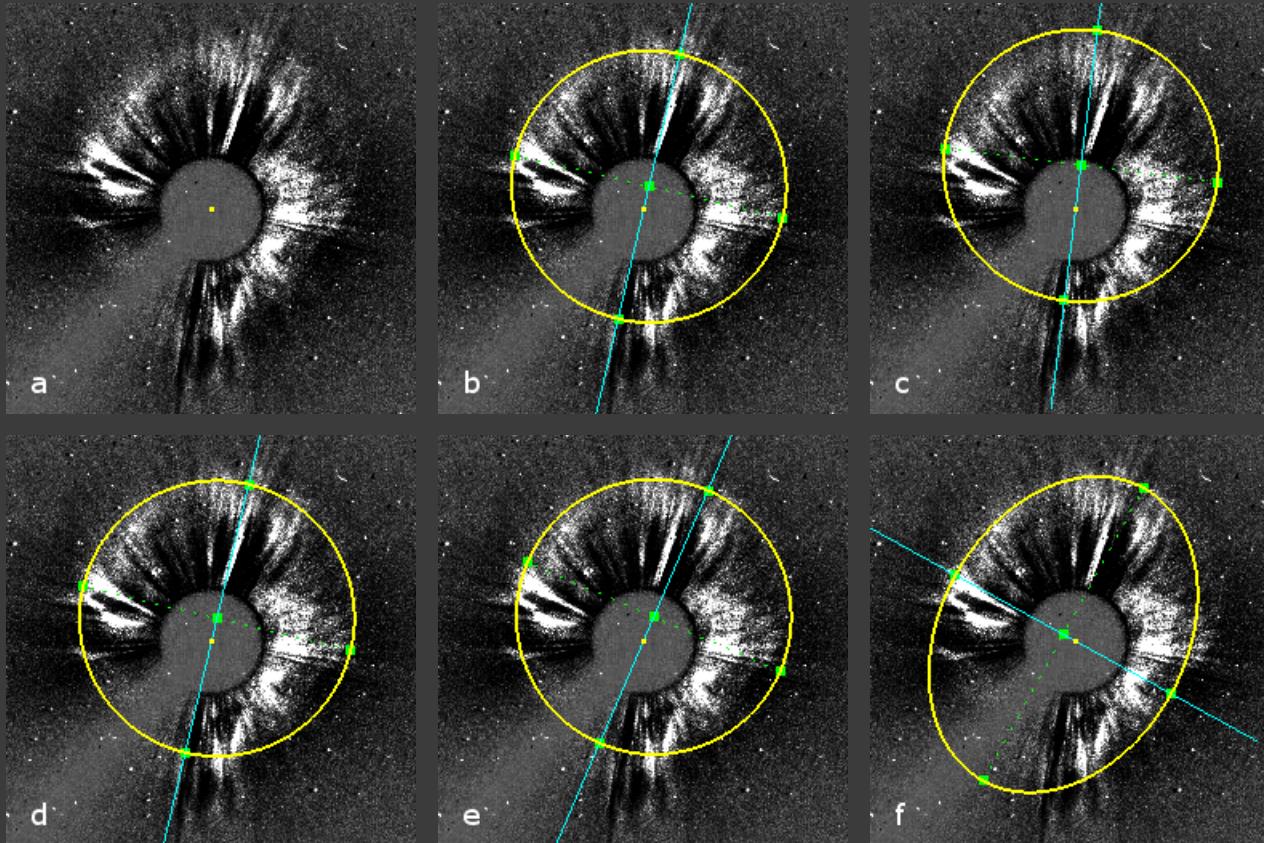
- Built the ellipse formulation into an operational tool.
- Subsequent V&V studies revealed the technique to be highly problematic in many real world situations.

## Problem: Which ellipse ?



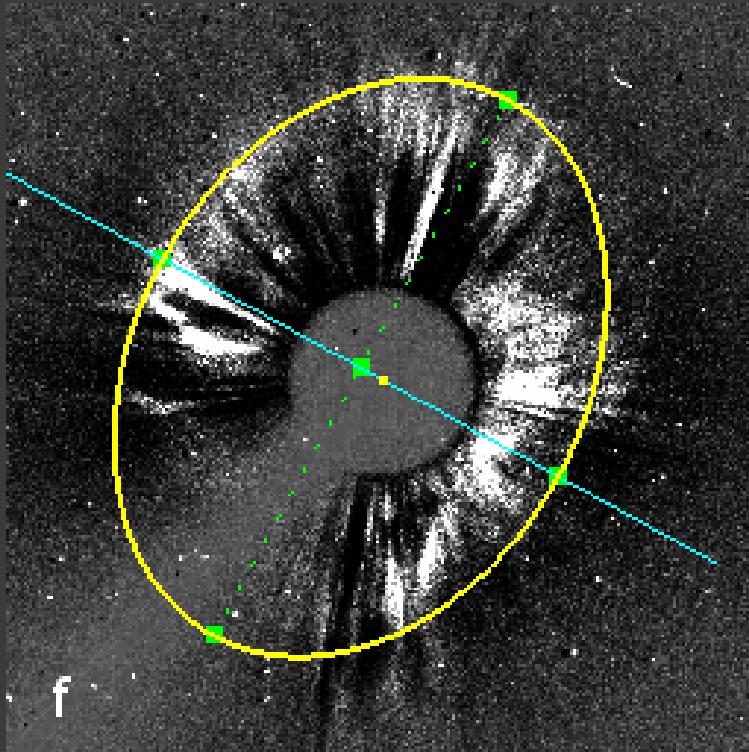
	Latitude (deg)	Longitude (deg)	Cone ½ Angle (deg)	Radial distance (Rs)
b	9.1	2.3	43.2	14.7
c	9.4	1.3	26.9	22.3
d	0.7	0.2	4.4	132.4
e	3.8	1.7	20.3	29.0
f	20.8	-37.8	83.0	12.3

## Problem: Which ellipse ?

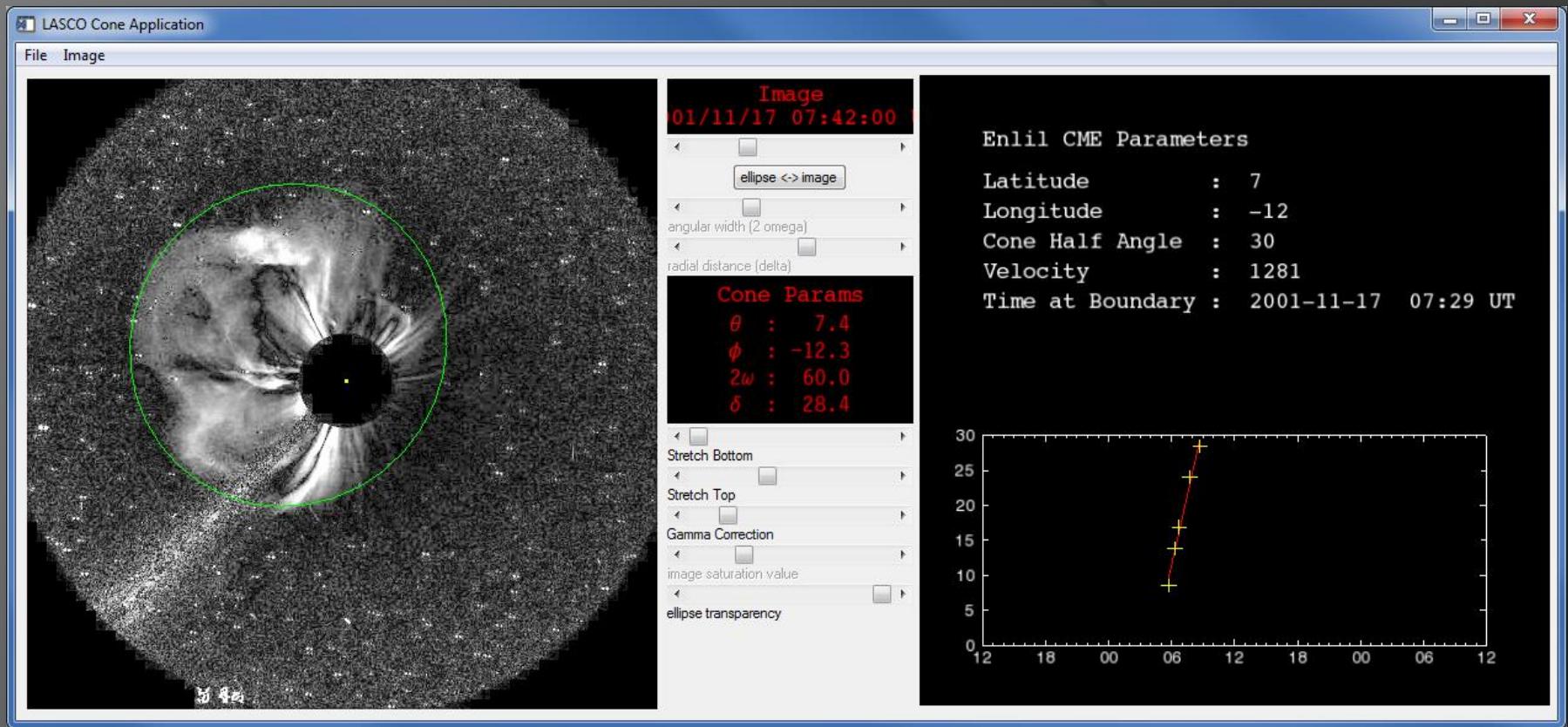


	Latitude (deg)	Longitude (deg)	Cone ½ Angle (deg)	Radial distance (Rs)
b	9.1	2.3	43.2	14.7
c	9.4	1.3	26.9	22.3
d	0.7	0.2	4.4	132.4
e	3.8	1.7	20.3	29.0
f	20.8	-37.8	83.0	12.3

Problem: Ellipses are “freeform” – no constraints on eccentricity vs offset



Cone  $\frac{1}{2}$  Angle = 83 degrees (full Angle 166 !!)

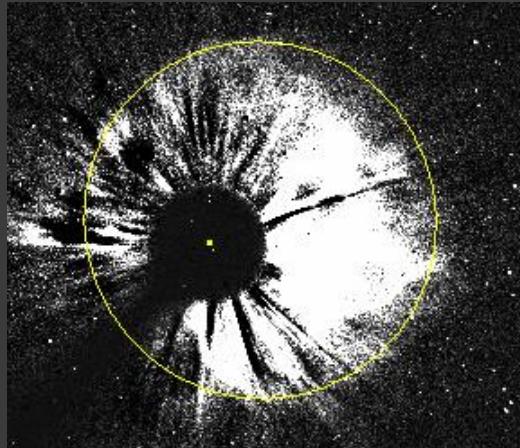


- Full 3D graphics solution – can only represent ‘correct’ cones originating at the Sun
- Need to know the cone angle
- Big problem since cone angle inversely proportional to *velocity (roughly)*

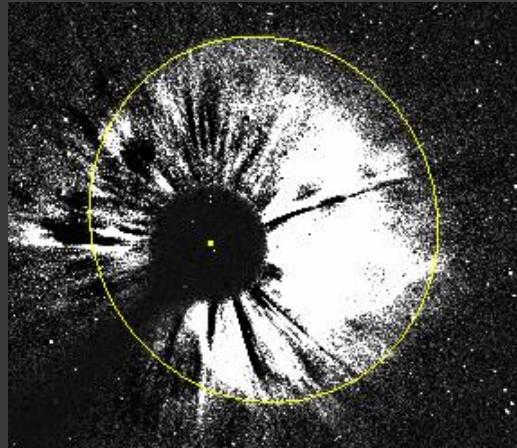
Again: Which ellipse ?

Cone ½ Angle

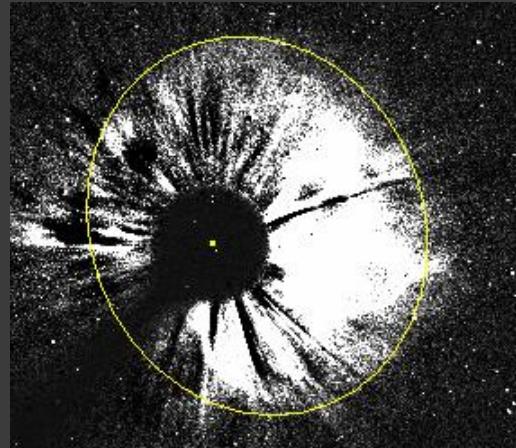
30 degrees



45 degrees

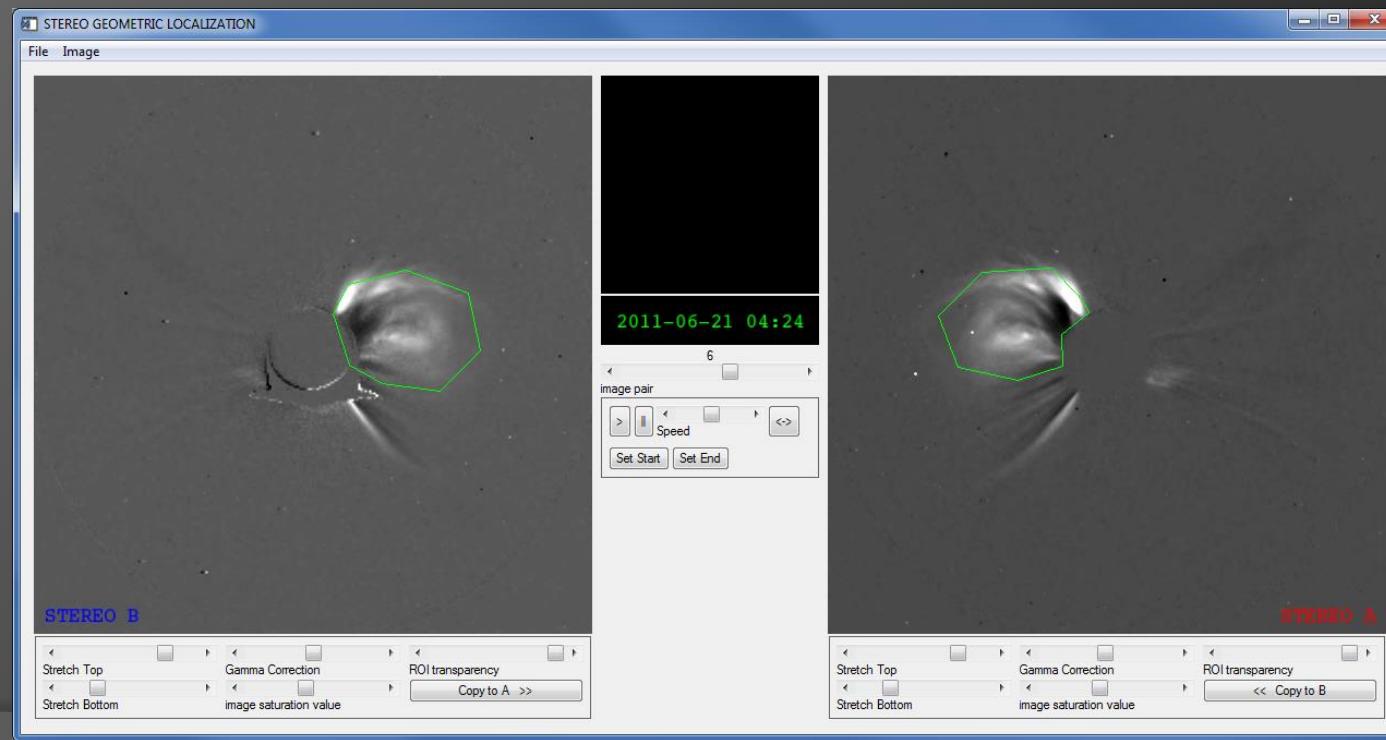
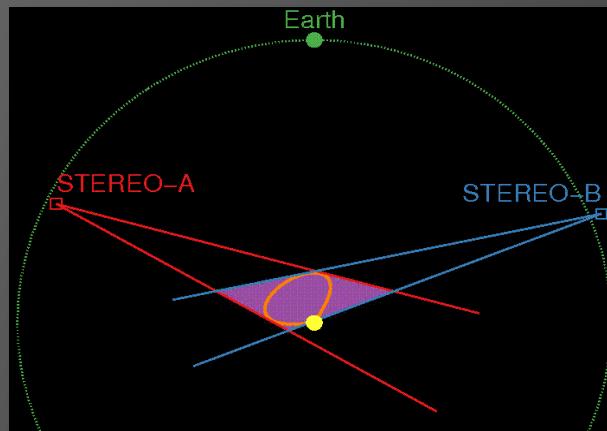


60 degrees

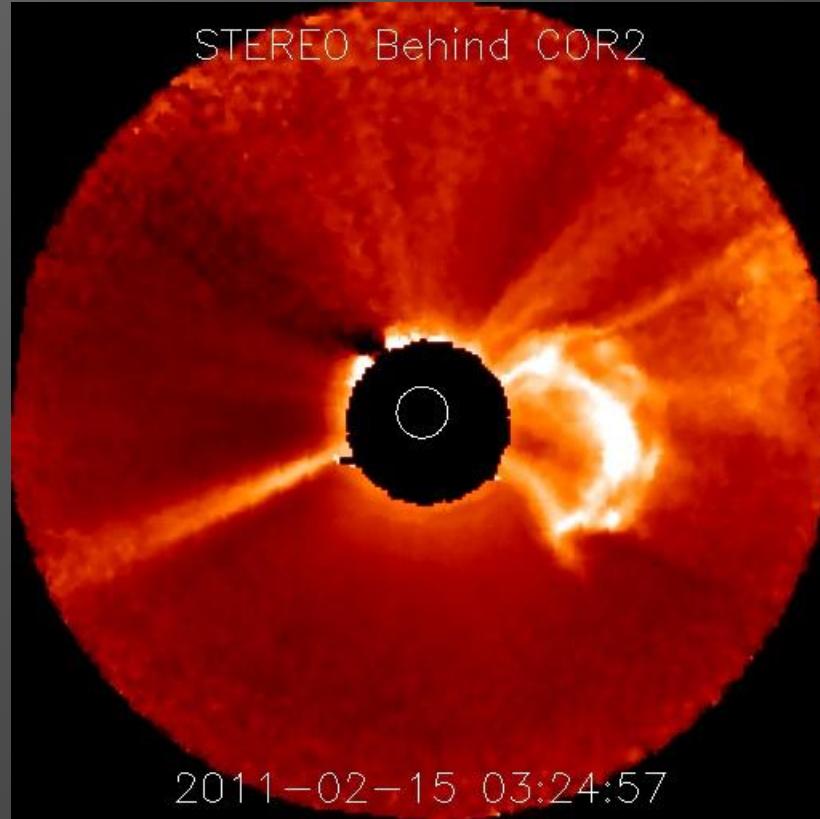


factor 2 difference  
in velocity

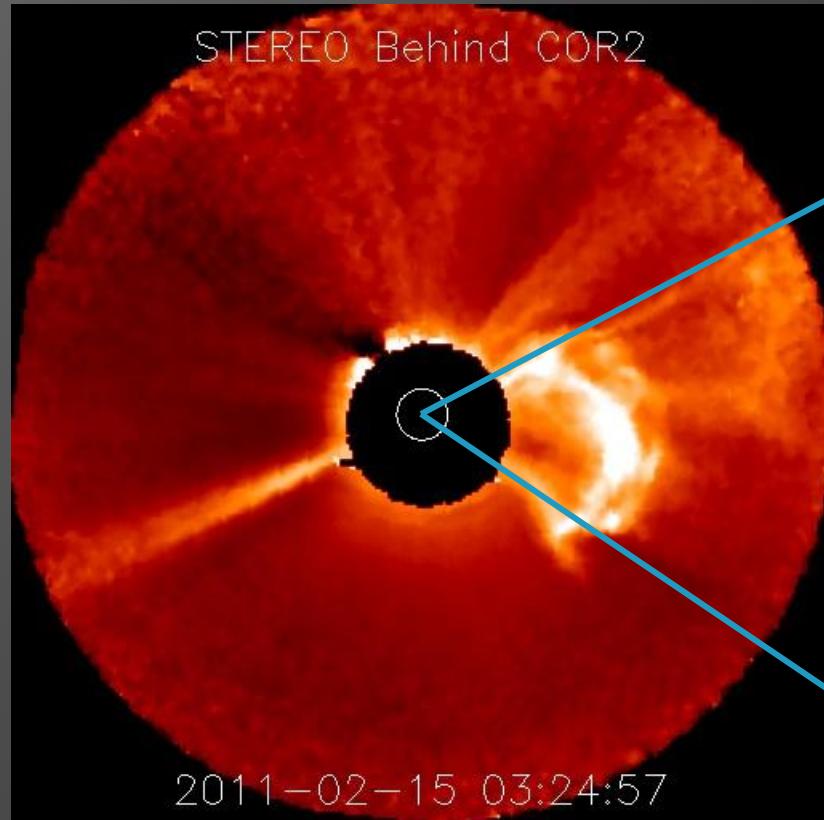
# STEREO geometric localization Tool



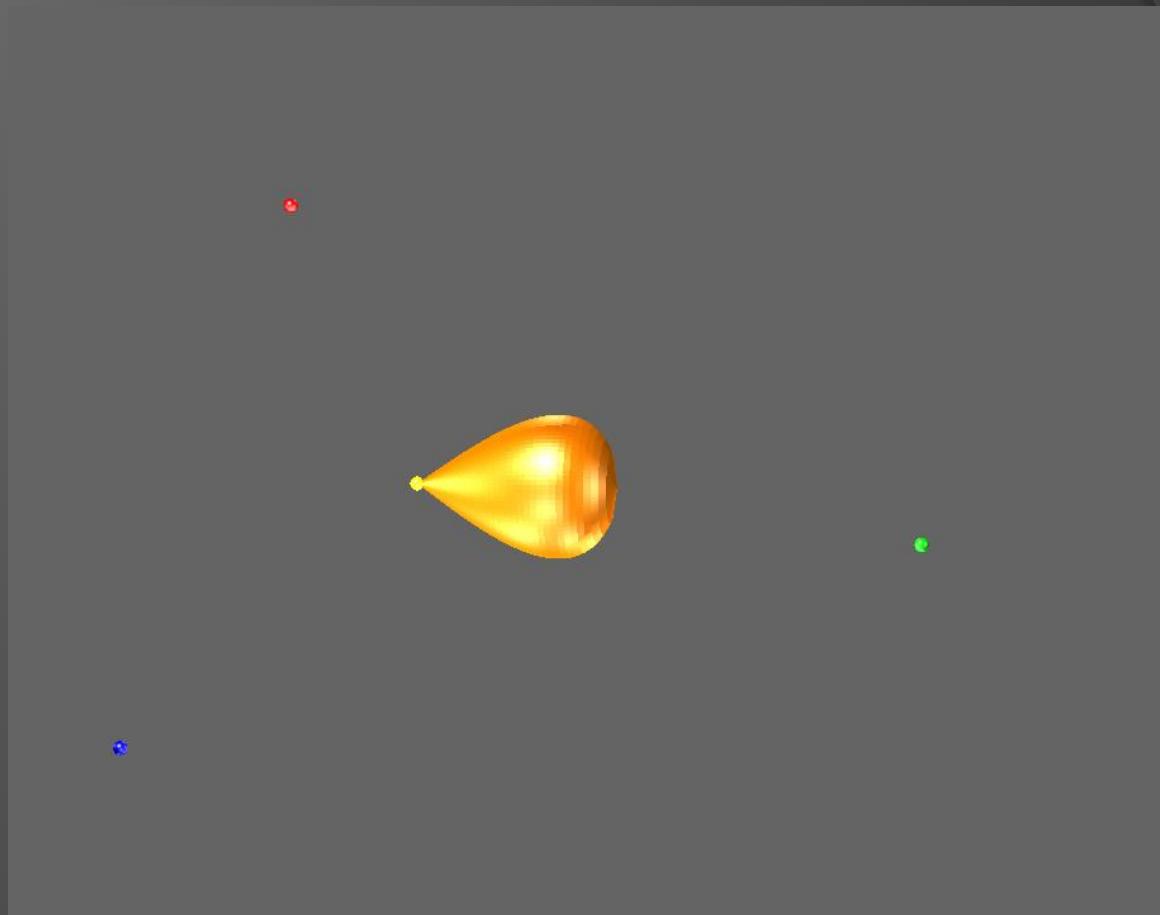
## Estimation of Cone Angle from a side view (STEREO B)



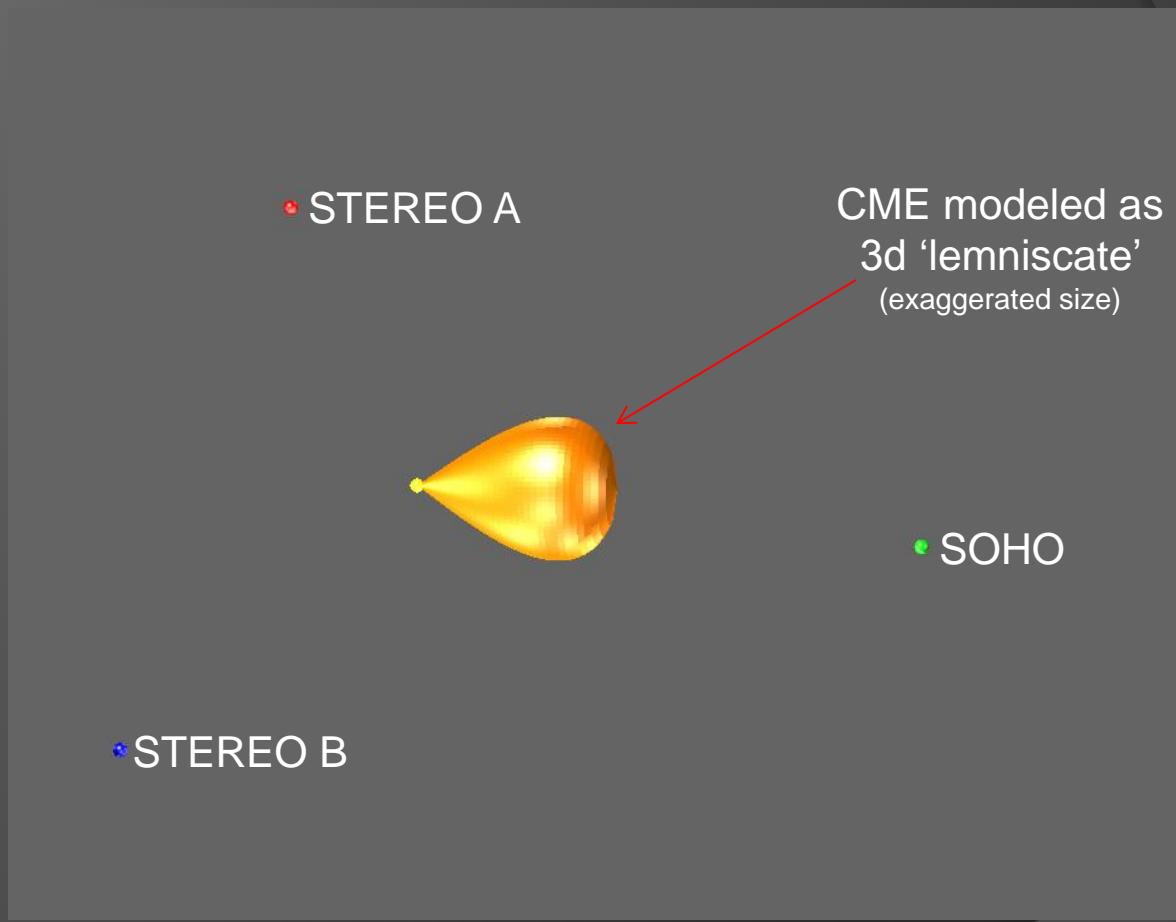
## Estimation of Cone Angle from a side view (STEREO B)



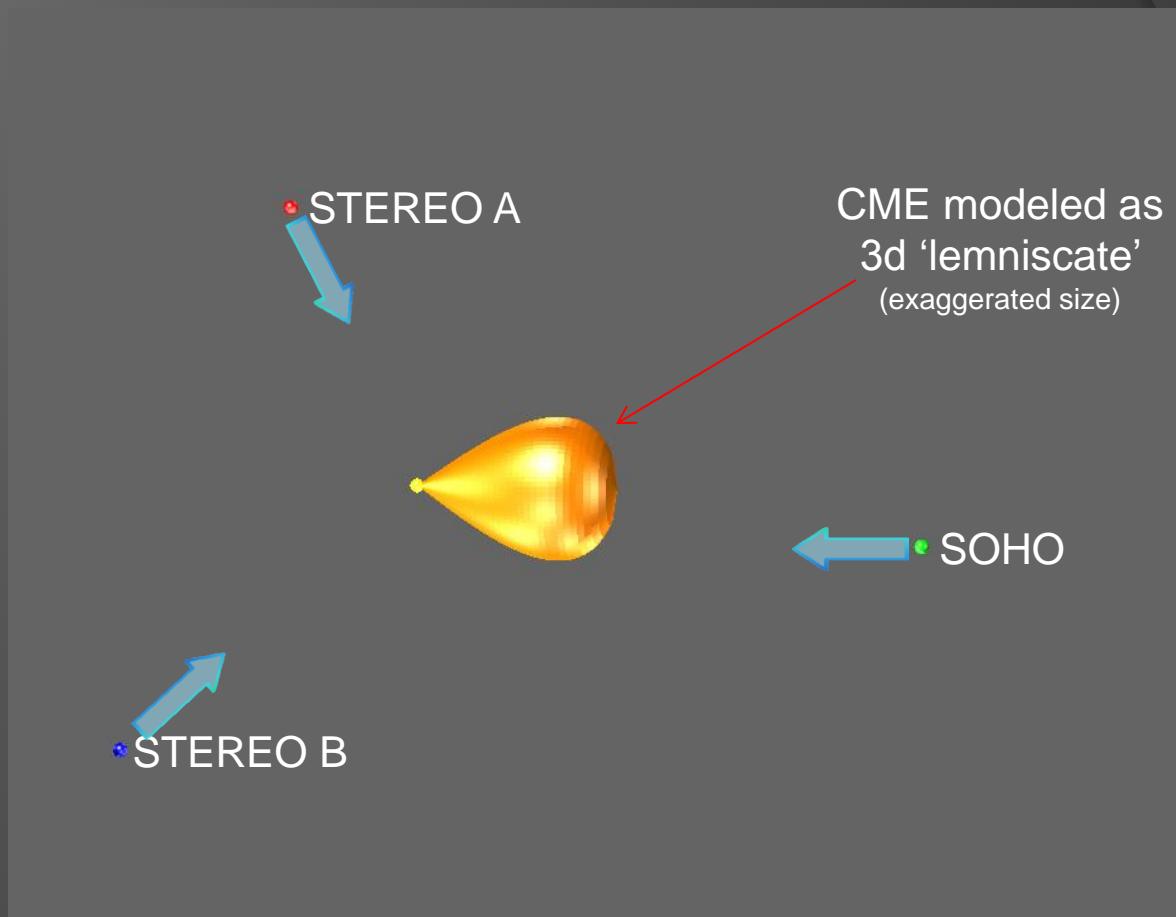
# 3D Graphics modeling



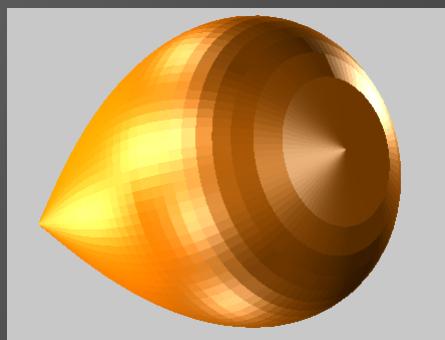
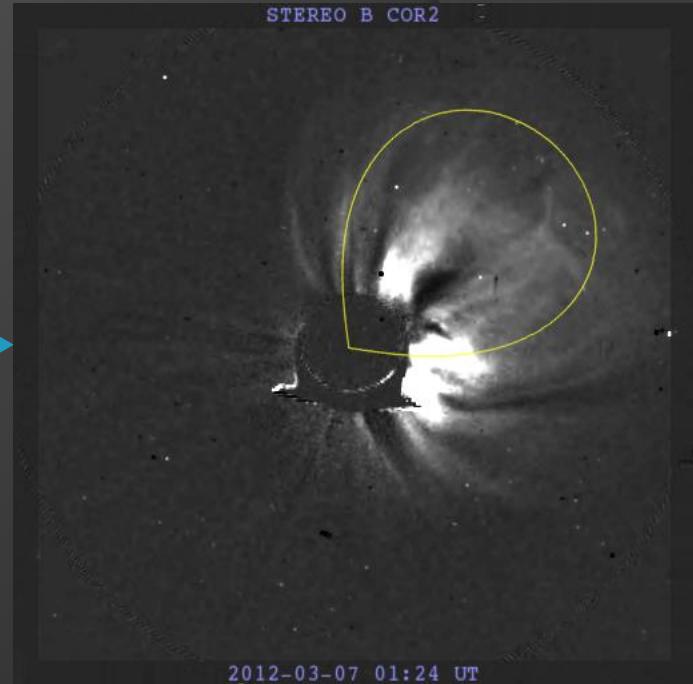
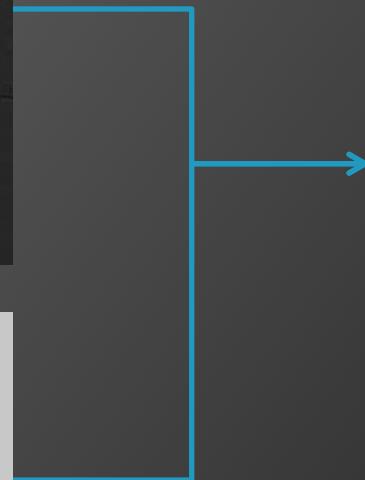
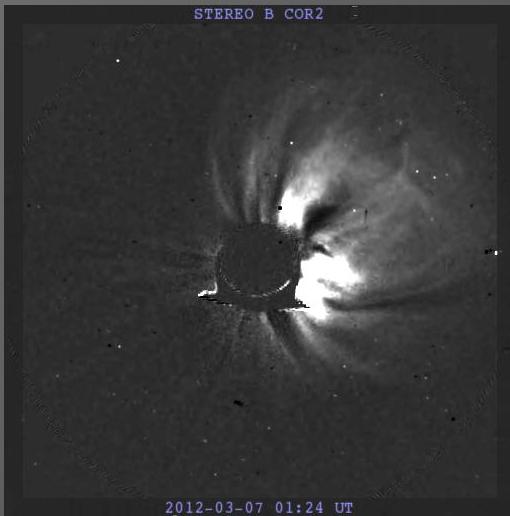
## 3D Graphics modeling



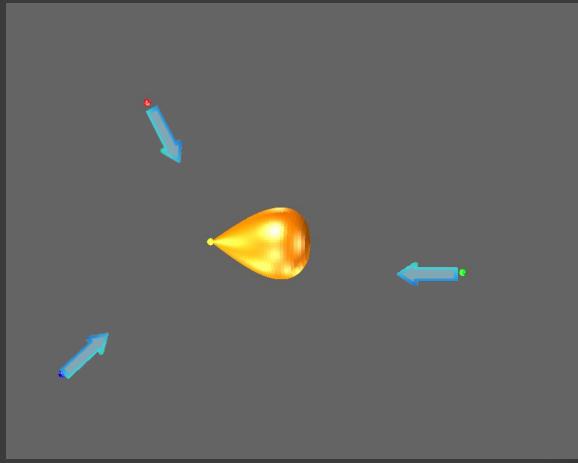
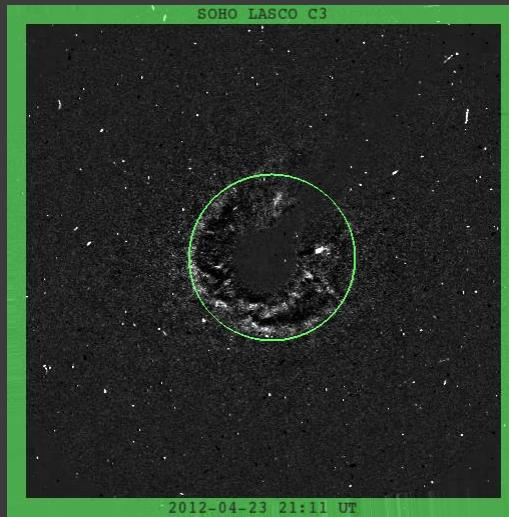
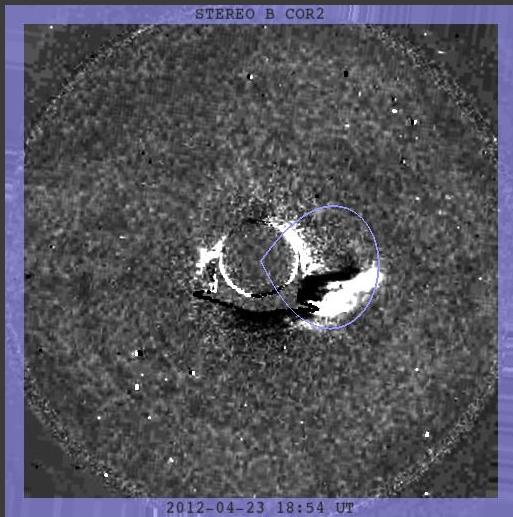
## 3D Graphics modeling



## Overlay 3D model on coronagraph image



### '3 view'



# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

STEREO A COR2

2011-08-02 06:39 UT

2011-08-02 06:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency Bernoulli

CME LEADING EDGE vs TIME PLOT

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis

The screenshot displays the CME Analysis Tool (CAT) interface. At the top, there are three panels showing solar images from STEREO B COR2 (blue), STEREO A COR2 (green), and STEREO A COR2 (red). The images show a CME event with white and red outlines. Below the panels is a timeline from 12 to 12. The interface is divided into several sections: 'START / END TIMES' (with fields for date and time, and +/- 12h/24h buttons); 'ANIMATION CONTROLS' (with radio buttons for L, C, R, a play button, and speed slider); 'IMAGE ADJUST' (with stretch, gamma correction, and saturation controls); 'CME CONTROLS' (with sliders for latitude, longitude, angular width, radial distance, transparency, and Bernoulli checkbox); 'CME LEADING EDGE vs TIME PLOT' (a graph showing the leading edge's position over time from 06 to 09, with data points in red and green); and 'ENCL PARAMETERS' (with text fields for T 2011-08-02 10:44, Lat 9, Lon 26, Cone 54, and Vel 827, and buttons for Calculate Velocity, Export Analysis, and Reset Analysis).

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

STEREO A COR2

2011-08-02 06:39 UT

2011-08-02 06:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play Speed Aitem8

IMAGE ADJUST

L C R Stretch Bottom Stretch Top Gamma Correction image saturation value Reset <- Copy to L Copy to R ->

CME CONTROLS

Latitude Longitude Angular Width (2 omega) Radial Distance (delta) Transparency Bernoulli

CME Parameters

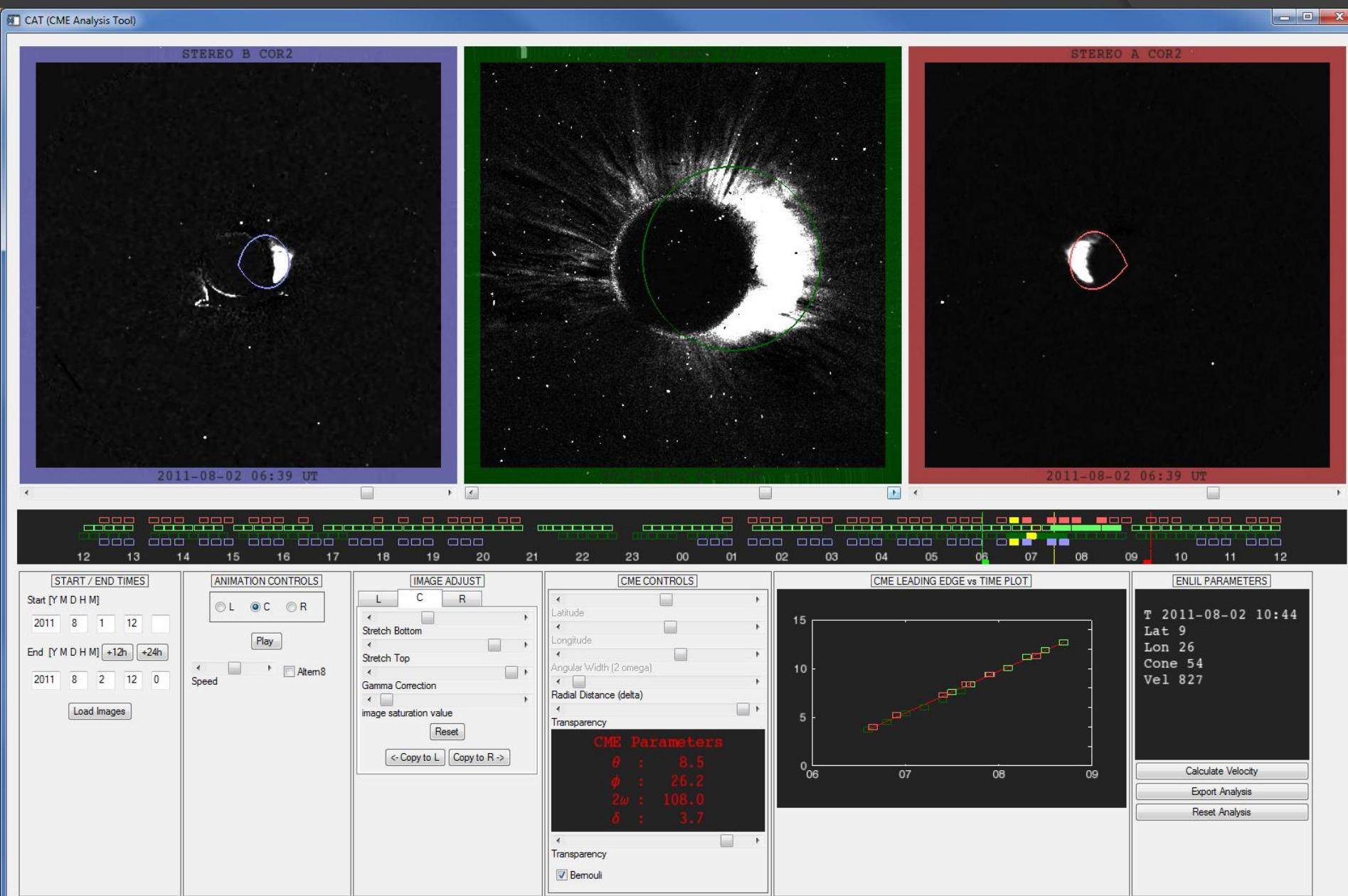
$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

CME LEADING EDGE vs TIME PLOT

T 2011-08-02 10:44 Lat 9 Lon 26 Cone 54 Vel 827

Calculate Velocity Export Analysis Reset Analysis

# CME Analysis Tool (CAT)



# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

STEREO A COR2

2011-08-02 06:39 UT

2011-08-02 06:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency Bernoulli

CME LEADING EDGE vs TIME PLOT

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis

The interface displays three panels showing CME images from STEREO B (blue), STEREO A (red), and a central green panel with a green ellipse highlighting the CME. Below the panels is a timeline from 12 to 12. The bottom section contains various controls for start/end times, animation speed, image adjustment, CME parameters, and a plot of the leading edge over time.

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

STEREO A COR2

2011-08-02 06:39 UT

2011-08-02 06:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

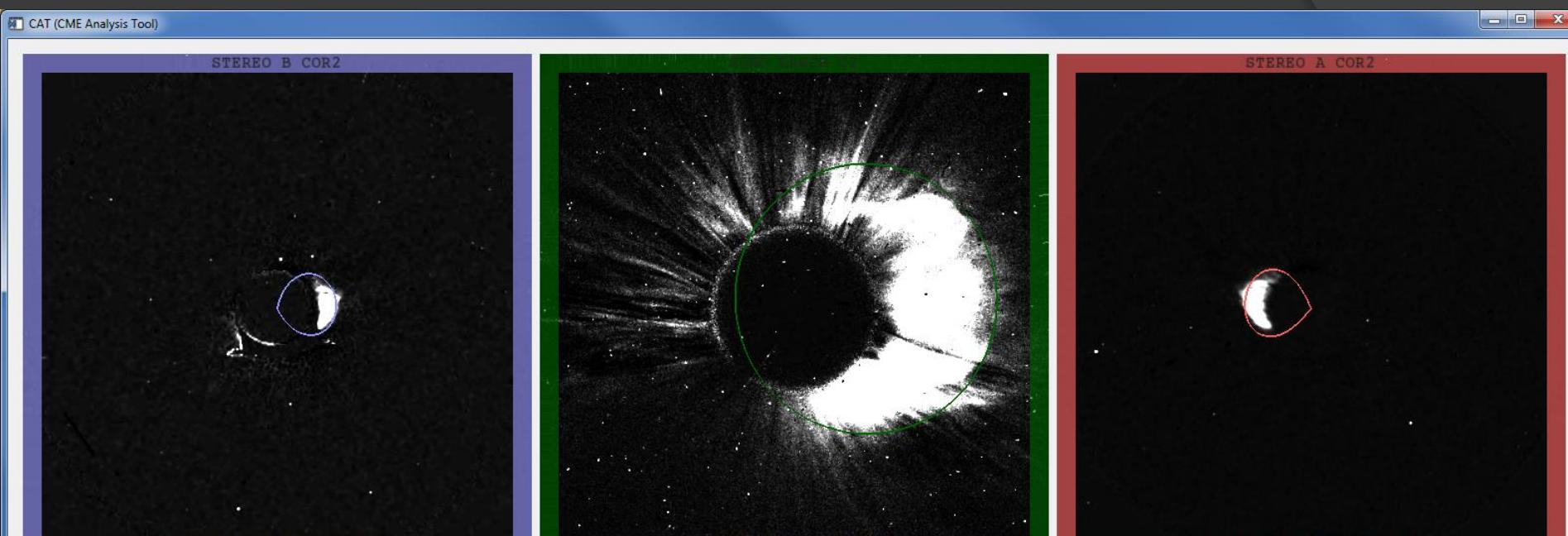
$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency Bernouli

CME LEADING EDGE vs TIME PLOT

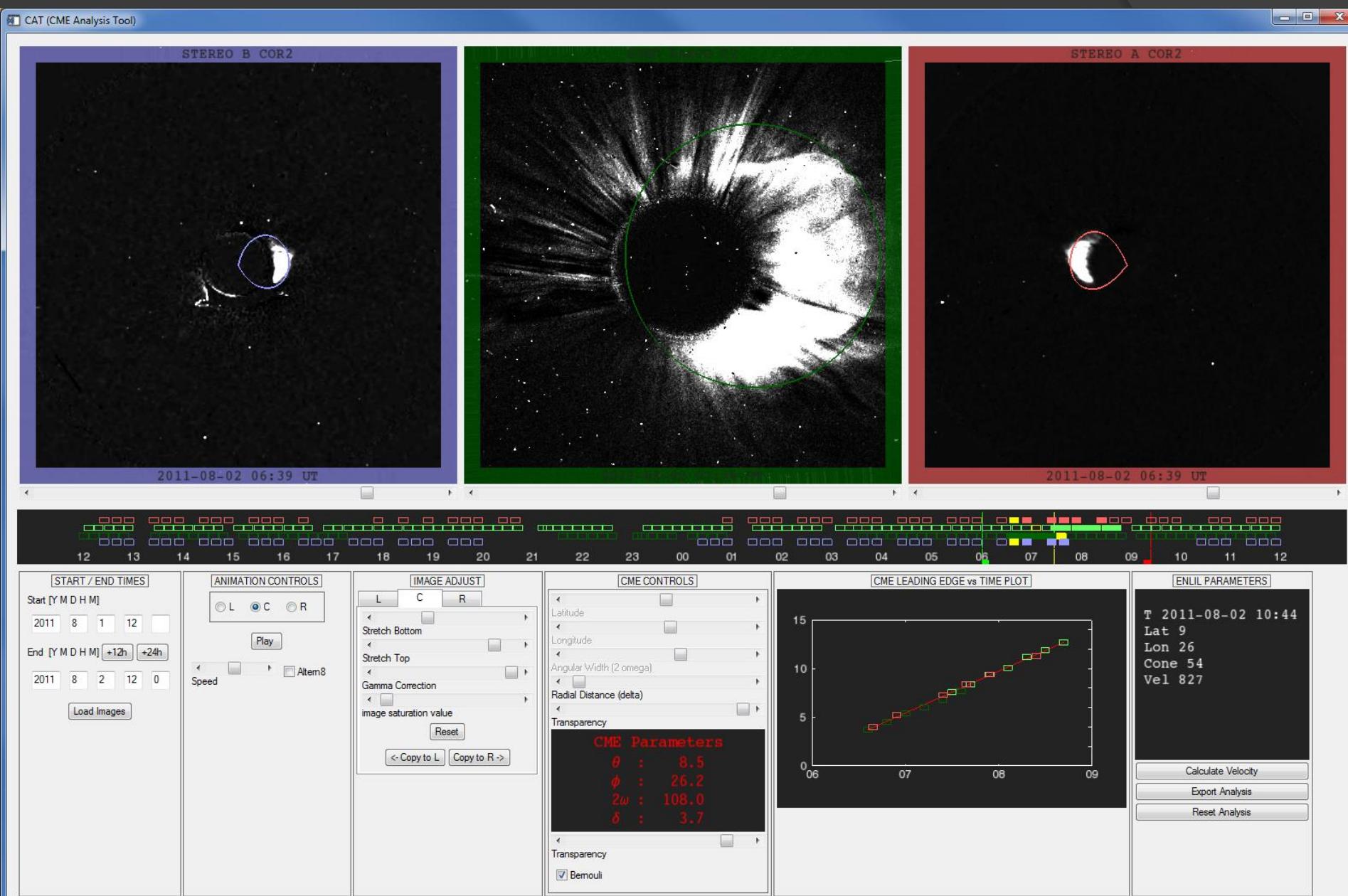
T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis



The interface consists of three main panels at the top showing CME images from STEREO B (left), STEREO A (right), and a central processed version with a green outline. Below these are two timelines from 12 to 12. The left panel contains controls for 'START / END TIMES' and 'ANIMATION CONTROLS'. The right panel contains 'IMAGE ADJUST' and 'CME CONTROLS' settings. The bottom right panel displays 'CME LEADING EDGE vs TIME PLOT' with data points and parameters: T 2011-08-02 10:44, Lat 9, Lon 26, Cone 54, Vel 827. Buttons for 'Calculate Velocity', 'Export Analysis', and 'Reset Analysis' are also present.

# CME Analysis Tool (CAT)



# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2      SOHO LASCO C2      STEREO A COR2

2011-08-02 06:39 UT      2011-08-02 06:24 UT      2011-08-02 06:39 UT

START / END TIMES      ANIMATION CONTROLS      IMAGE ADJUST      CME CONTROLS      CME LEADING EDGE vs TIME PLOT      ENIL PARAMETERS

Start [Y M D H M] 2011 8 1 12      End [Y M D H M] +12h +24h 2011 8 2 12 0      Load Images

L C R      Play      Speed Aitem8

Stretch Bottom      Stretch Top      Gamma Correction      image saturation value      Reset      <- Copy to L      Copy to R ->

Latitude      Longitude      Angular Width (2 omega)      Radial Distance (delta)      Transparency

**CME Parameters**

$\theta$ :	8.5
$\phi$ :	26.2
$2w$ :	108.0
$\delta$ :	3.7

Transparency      Bernoulli

0 6      0 7      0 8      0 9

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity      Export Analysis      Reset Analysis

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

SOHO LASCO C2

STEREO A COR2

2011-08-02 06:54 UT

2011-08-02 06:24 UT

2011-08-02 06:54 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R

Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom

Stretch Top

Gamma Correction

image saturation value

Reset

< Copy to L Copy to R >

CME CONTROLS

Latitude

Longitude

Angular Width (2 omega)

Radial Distance (delta)

Transparency

CME Parameters

$\theta$  : 8.5

$\phi$  : 26.2

$2w$  : 108.0

$\delta$  : 3.7

Transparency

Bernoulli

CME LEADING EDGE vs TIME PLOT

T 2011-08-02 10:44

Lat 9

Lon 26

Cone 54

Vel 827

Calculate Velocity

Export Analysis

Reset Analysis

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

SOHO LASCO C3

STEREO A COR2

2011-08-02 07:24 UT      2011-08-02 07:30 UT      2011-08-02 07:24 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

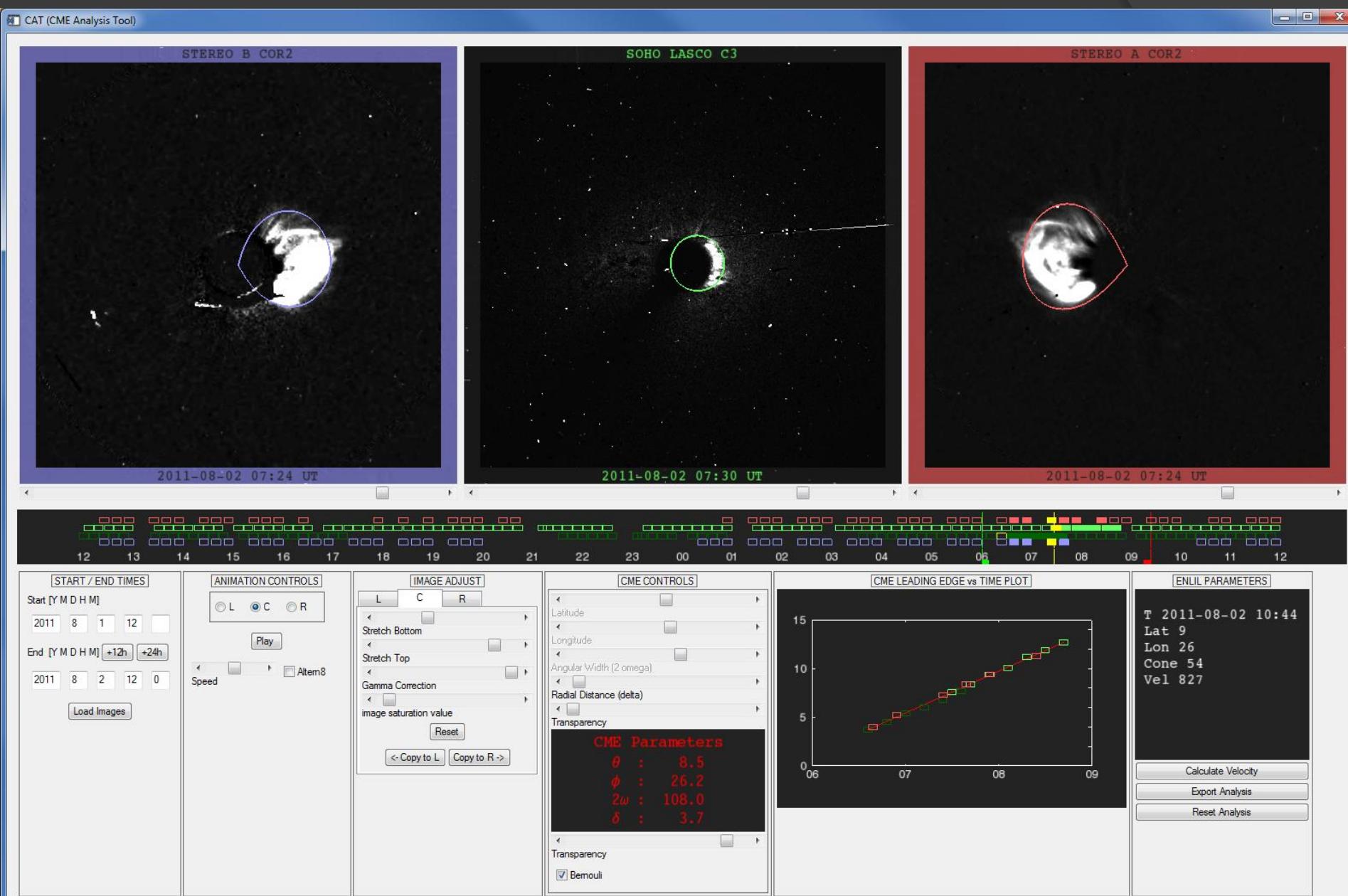
Transparency Bernoulli

CME LEADING EDGE vs TIME PLOT

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

ENL PARAMETERS

Calculate Velocity  
Export Analysis  
Reset Analysis



# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

SOHO LASCO C3

STEREO A COR2

2011-08-02 07:39 UT

2011-08-02 07:42 UT

2011-08-02 07:39 UT

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency

Bernoulli

CME LEADING EDGE vs TIME PLOT

ENLIL PARAMETERS

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

SOHO LASCO C3

STEREO A COR2

2011-08-02 10:24 UT      2011-08-02 07:54 UT      2011-08-02 07:54 UT

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
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 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency

Bernoulli

CME LEADING EDGE vs TIME PLOT

ENUL PARAMETERS

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2      SOHO LASCO C3      STEREO A COR2

2011-08-02 10:24 UT      2011-08-02 08:06 UT      2011-08-02 08:24 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

**START / END TIMES**  
Start [Y M D H M] 2011 8 1 12  
End [Y M D H M] +12h +24h 2011 8 2 12 0

**ANIMATION CONTROLS**  
 L    C    R

**IMAGE ADJUST**  
L   C   R  
 Stretch Bottom  
 Stretch Top  
 Gamma Correction  
 image saturation value

**CME CONTROLS**  
 Latitude  
 Longitude  
 Angular Width (2 omega)  
 Radial Distance (delta)  
 Transparency  
 Transparency  
 Bernoulli

**CME Parameters**

$\theta$ :	8.5
$\phi$ :	26.2
$2\omega$ :	108.0
$\delta$ :	3.7

**CME LEADING EDGE vs TIME PLOT**

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2      SOHO LASCO C3      STEREO A COR2

2011-08-02 10:24 UT      2011-08-02 08:18 UT      2011-08-02 08:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

**START / END TIMES**  
Start [Y M D H M] 2011 8 1 12  
End [Y M D H M] +12h +24h 2011 8 2 12 0

**ANIMATION CONTROLS**  
 L    C    R

**IMAGE ADJUST**  
L   C   R  
 Stretch Bottom  
 Stretch Top  
 Gamma Correction  
 image saturation value

**CME CONTROLS**  
 Latitude  
 Longitude  
 Angular Width (2 omega)  
 Radial Distance (delta)  
 Transparency  
 Transparency  
 Bernoulli

**CME Parameters**

$\theta$ :	8.5
$\phi$ :	26.2
$2\omega$ :	108.0
$\delta$ :	3.7

**CME LEADING EDGE vs TIME PLOT**

T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

# CME Analysis Tool (CAT)

CAT (CME Analysis Tool)

STEREO B COR2

SOHO LASCO C3

STEREO A COR2

2011-08-02 10:24 UT

2011-08-02 08:42 UT

2011-08-02 08:39 UT

12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 12

START / END TIMES

Start [Y M D H M] 2011 8 1 12

End [Y M D H M] +12h +24h 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R Play

Speed Aitem8

IMAGE ADJUST

L C R

Stretch Bottom  
Stretch Top  
Gamma Correction  
image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude  
Longitude  
Angular Width (2 omega)  
Radial Distance (delta)  
Transparency

CME Parameters

$\theta$  : 8.5  
 $\phi$  : 26.2  
 $2\omega$  : 108.0  
 $\delta$  : 3.7

Transparency

Bernoulli

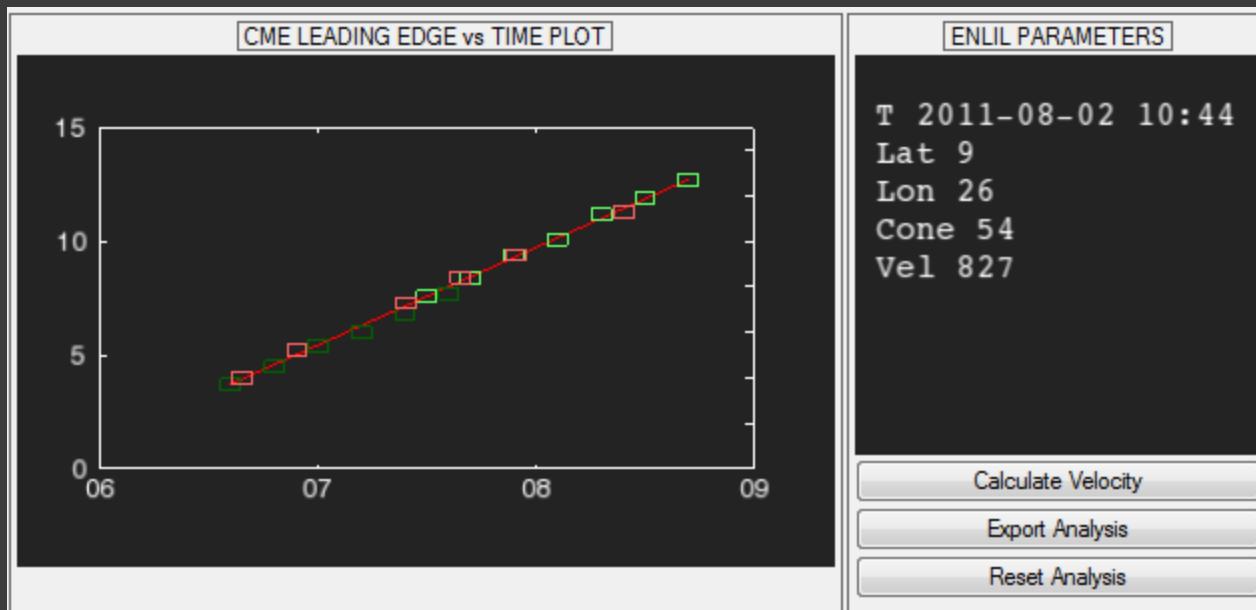
CME LEADING EDGE vs TIME PLOT

ENUL PARAMETERS

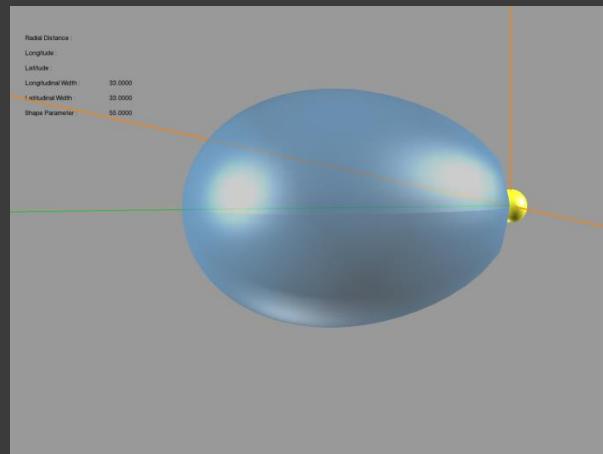
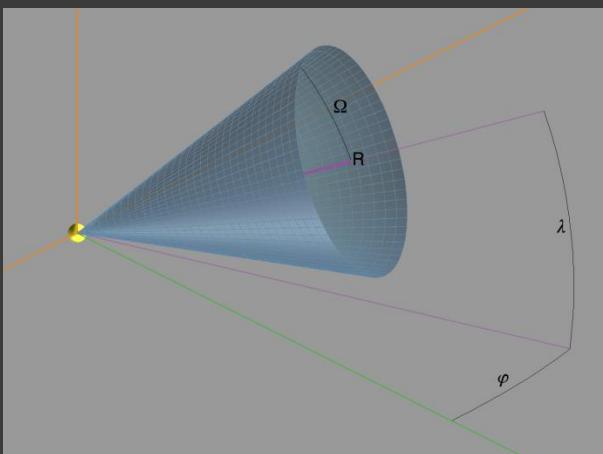
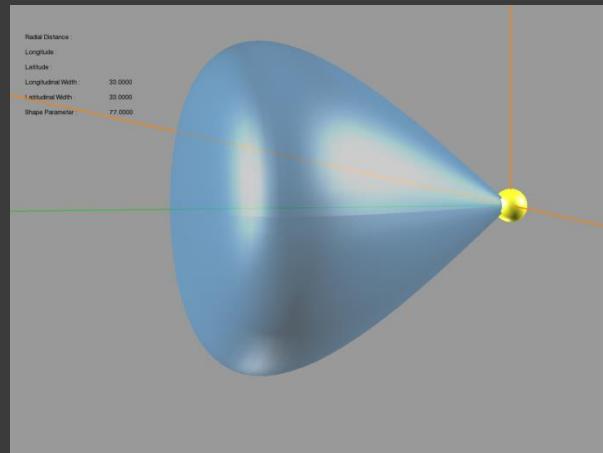
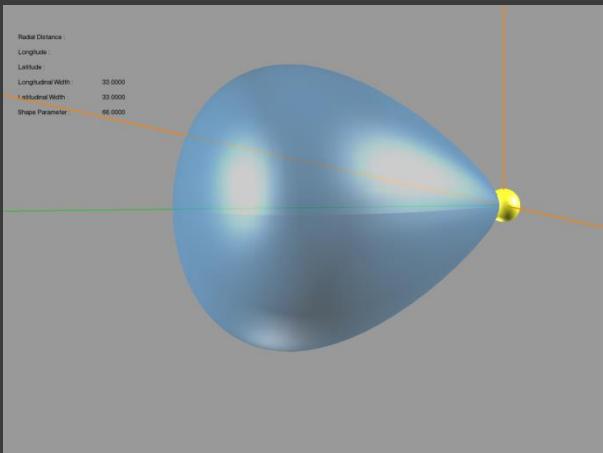
T 2011-08-02 10:44  
Lat 9  
Lon 26  
Cone 54  
Vel 827

Calculate Velocity  
Export Analysis  
Reset Analysis

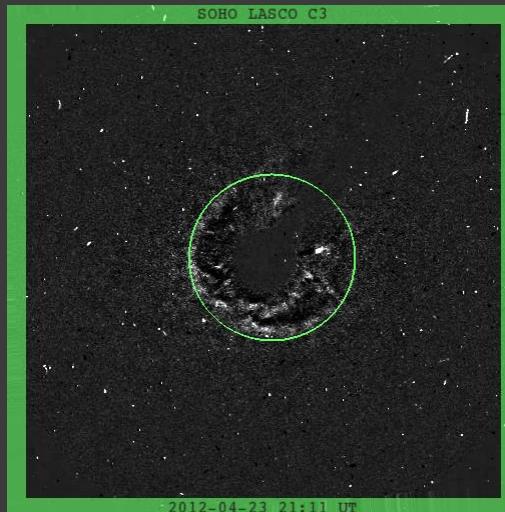
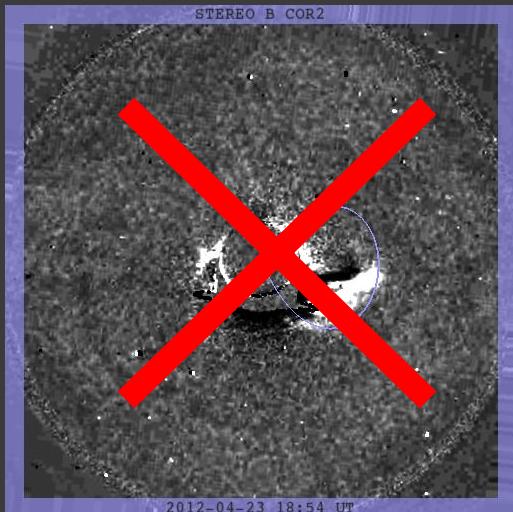
## The result: CME parameters for Enlil



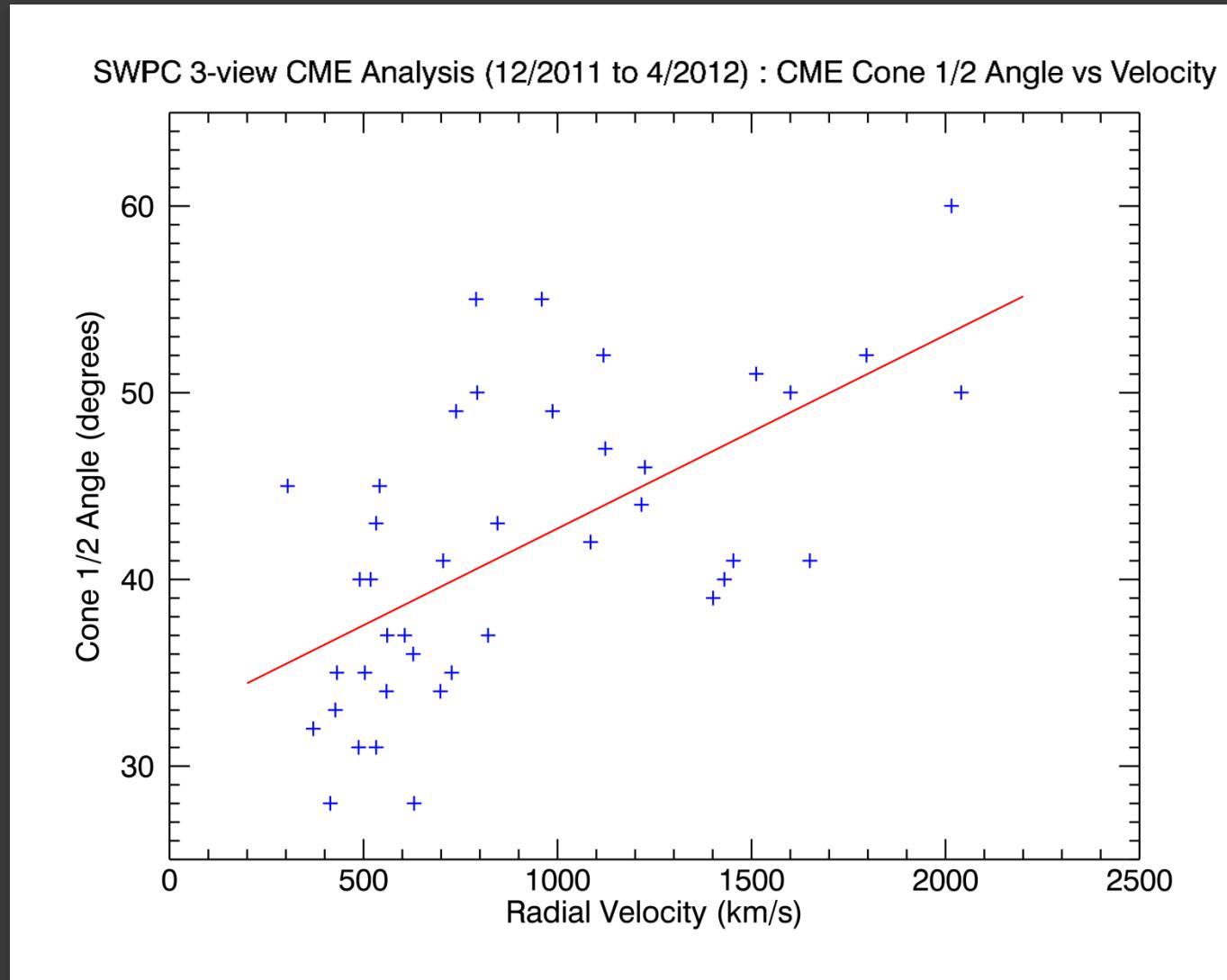
## Researching different CME objects (Curt de Koning)



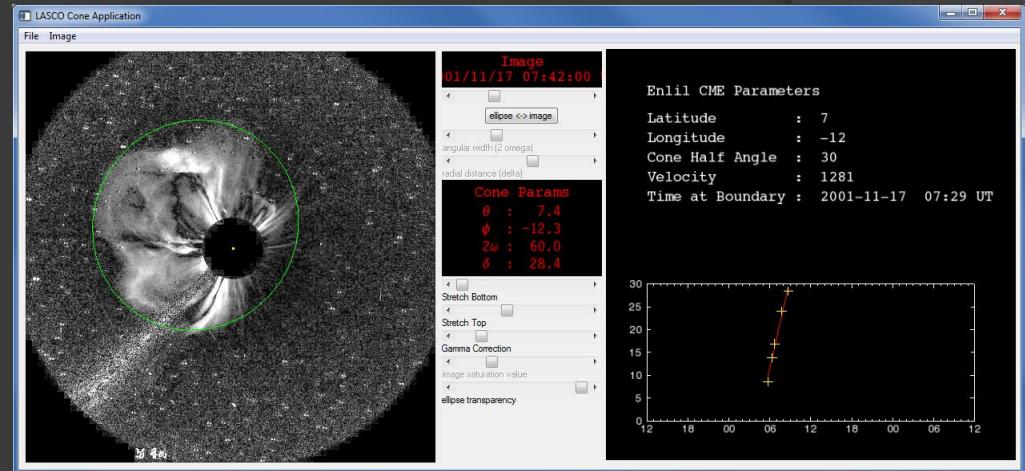
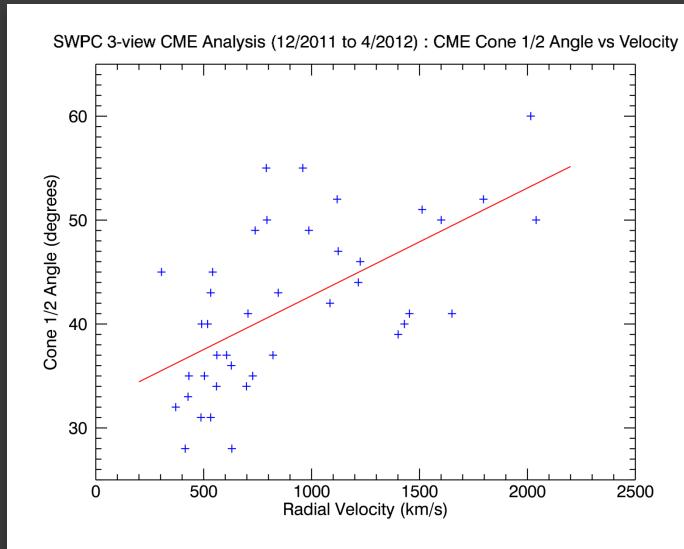
# What if we only have one Coronagraph ?



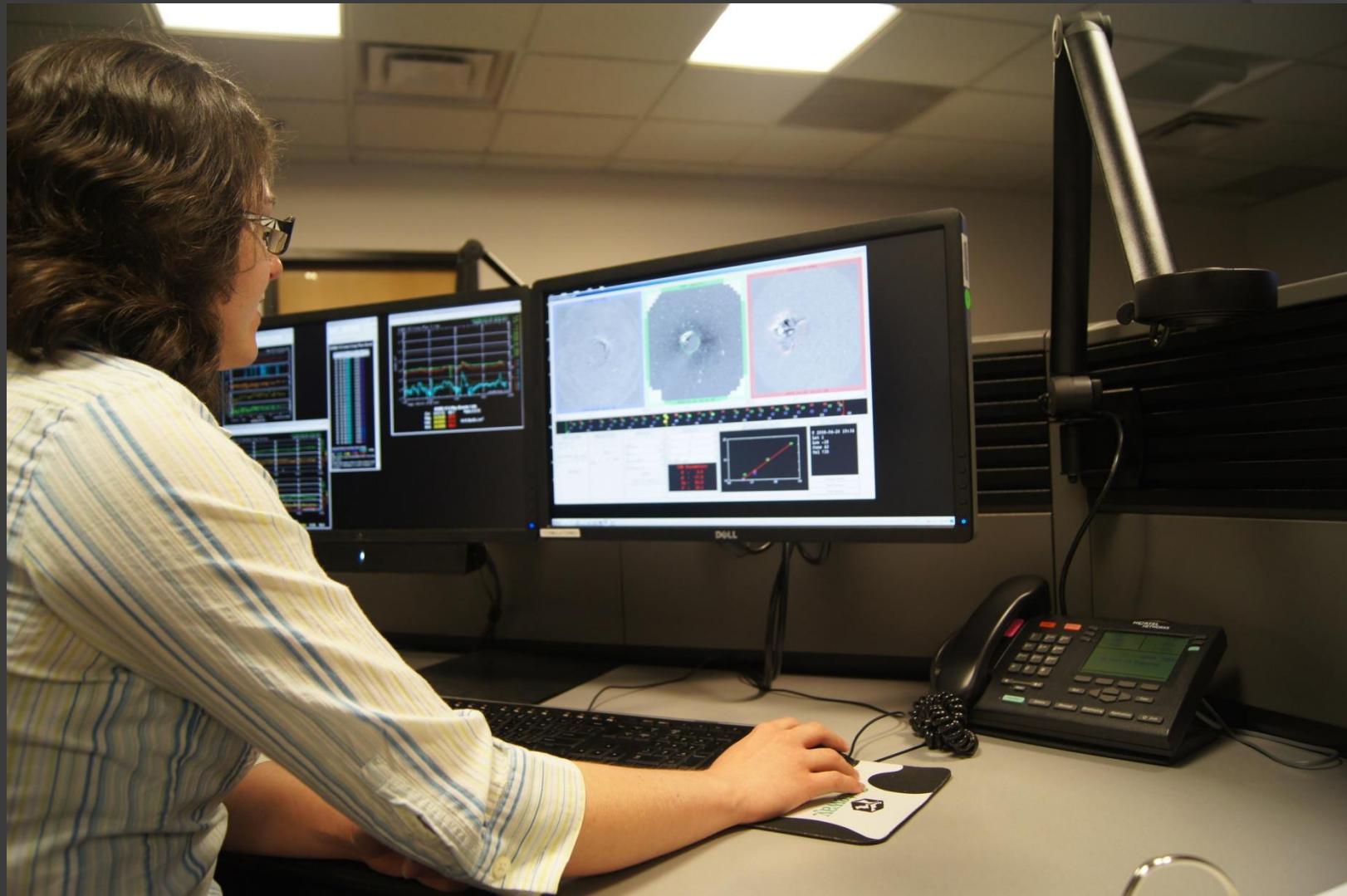
## What if we only have one Coronagraph ?



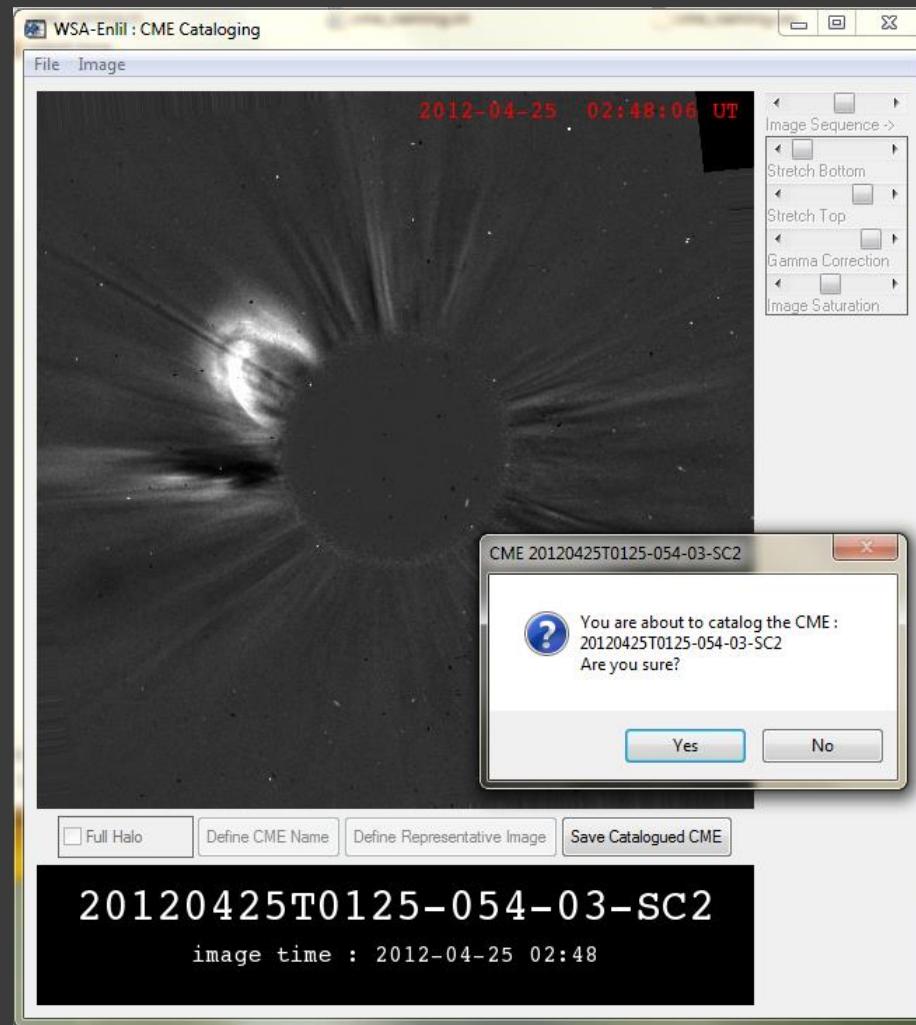
# What if we only have one Coronagraph ?



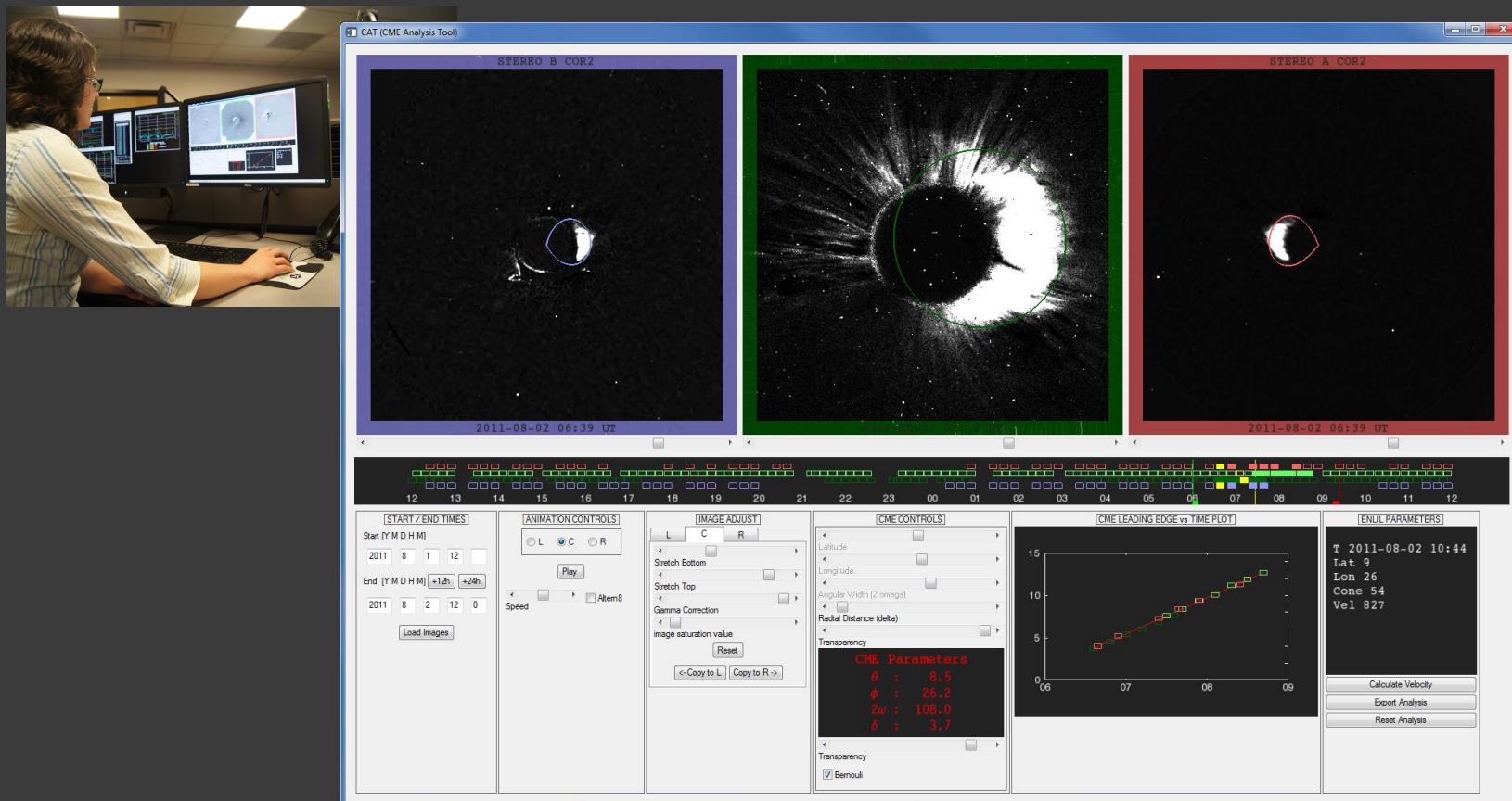
?



# CME Naming / Cataloging



# CME Analysis



# Solar Predictions Interface (SPI)



The screenshot shows the Solar Predictions Interface (SPI) web application running in a Microsoft Internet Explorer browser window. The title bar reads "Solar Predictions Interface" and the address bar shows the URL "solarwinds.ncs.swpc.noaa.gov/spi/".

The main content area features a large yellow sun icon with the letters "SPI" on it. Below the icon, the text "Solar Predictions Interface" is displayed. In the top right corner of the main content area, the current date and time are shown as "Current Date/Time: 2012-04-25 17:51:15 UTC". On the far right of the main content area, there are links for "Home" and "Help".

The interface is divided into several sections:

- WSA-Enlil Model Status**: This section contains two main subsections:
  - Next Model Run**: Shows a pie chart with a small red slice and the text "9 minutes remain until the next scheduled model run." Below this, detailed information is provided:
    - Run Cycle: 1800 UTC
    - Run Name: 20120425T1800
    - Type: Ambient

[Edit Model Run Setup](#)
  - Previous Model Run**: Shows similar information:
    - Run Cycle: 1600 UTC
    - Run Name: 20120425T1600
    - Type: Ambient
    - Total Run Time: in progress...
- Functions Menu**: A sidebar menu containing three items:
  - View and Add Active CMEs
  - Model Run Setup
  - Browse Past Model Runs

At the bottom of the page, a dark blue footer bar contains the following text:

Disclaimer: This product is currently in beta and should not be relied upon operationally.  
NOAA's National Weather Service  
This product is produced by the Space Weather Prediction Center located in Boulder, CO.  
For assistance, contact [SWPC.Webmaster@noaa.gov](mailto:SWPC.Webmaster@noaa.gov).

# Solar Predictions Interface (SPI)

A screenshot of a web browser window titled "SPI - View CME". The URL is "solarwinds.ncs.swpc.noaa.gov/spi/view\_cme.shtml". The page features a large orange sun icon with the letters "SPI" on it. At the top right, there are links for "Home" and "Help". Below the title, it says "Current Date/Time: 2012-04-25 18:04:24 UTC".

The main content area is divided into two sections:

- Active CMEs**: This section shows a thumbnail image of a solar flare and a list of catalogued CMEs:
  - A0323-20120423T1848-360-04-SC2
- Functions Menu**: This section contains links for managing CMEs:
  - View and Add Active CMEs
  - Model Run Setup
  - Browse Past Model Runs

At the bottom of the page, there is a dark blue footer bar with white text containing a disclaimer and contact information:

Disclaimer: This product is currently in beta and should not be relied upon operationally.  
NOAA's National Weather Service  
This product is produced by the Space Weather Prediction Center located in Boulder, CO.  
For assistance, contact [SWPC.Webmaster@noaa.gov](mailto:SWPC.Webmaster@noaa.gov).

View catalogued CMEs: (available for CME analysis)

# Solar Predictions Interface (SPI)

A screenshot of a Windows application window titled "Solar Predictions Interface". The window shows the "WSA-Enlil Model Status" and "Functions Menu".

The "WSA-Enlil Model Status" section displays the following information:

- Current Date/Time: 2012-04-25 18:05:44 UTC
- Next Model Run: A pie chart indicating 114 minutes remain until the next scheduled model run.
- Run Cycle: 2000 UTC
- Run Name: 20120425T2000
- Type: CME-based

The "Available CME Analysis" section shows:

- An analysis icon with the text "Analysis ID: 69" and a checked checkbox labeled "Included".
- A grey "Add" button.

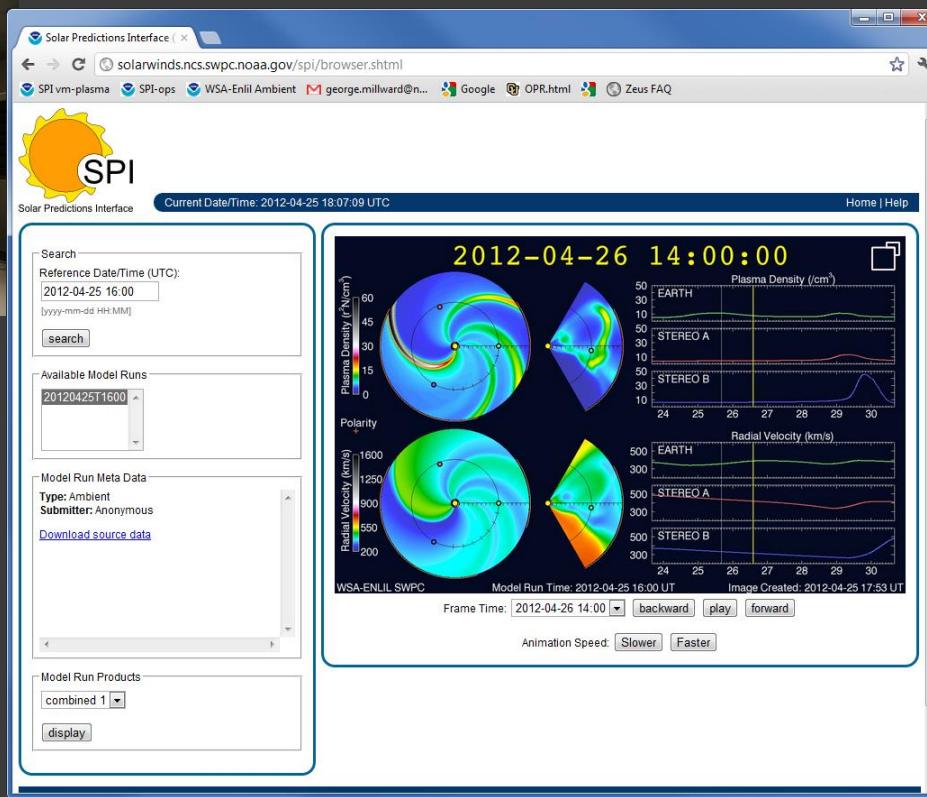
The "Functions Menu" on the right includes:

- View and Add Active CMEs
- Model Run Setup
- Browse Past Model Runs

At the bottom of the dialog are "OK" and "Cancel" buttons.

Add analyzed CME data to next model run

# Solar Predictions Interface (SPI)

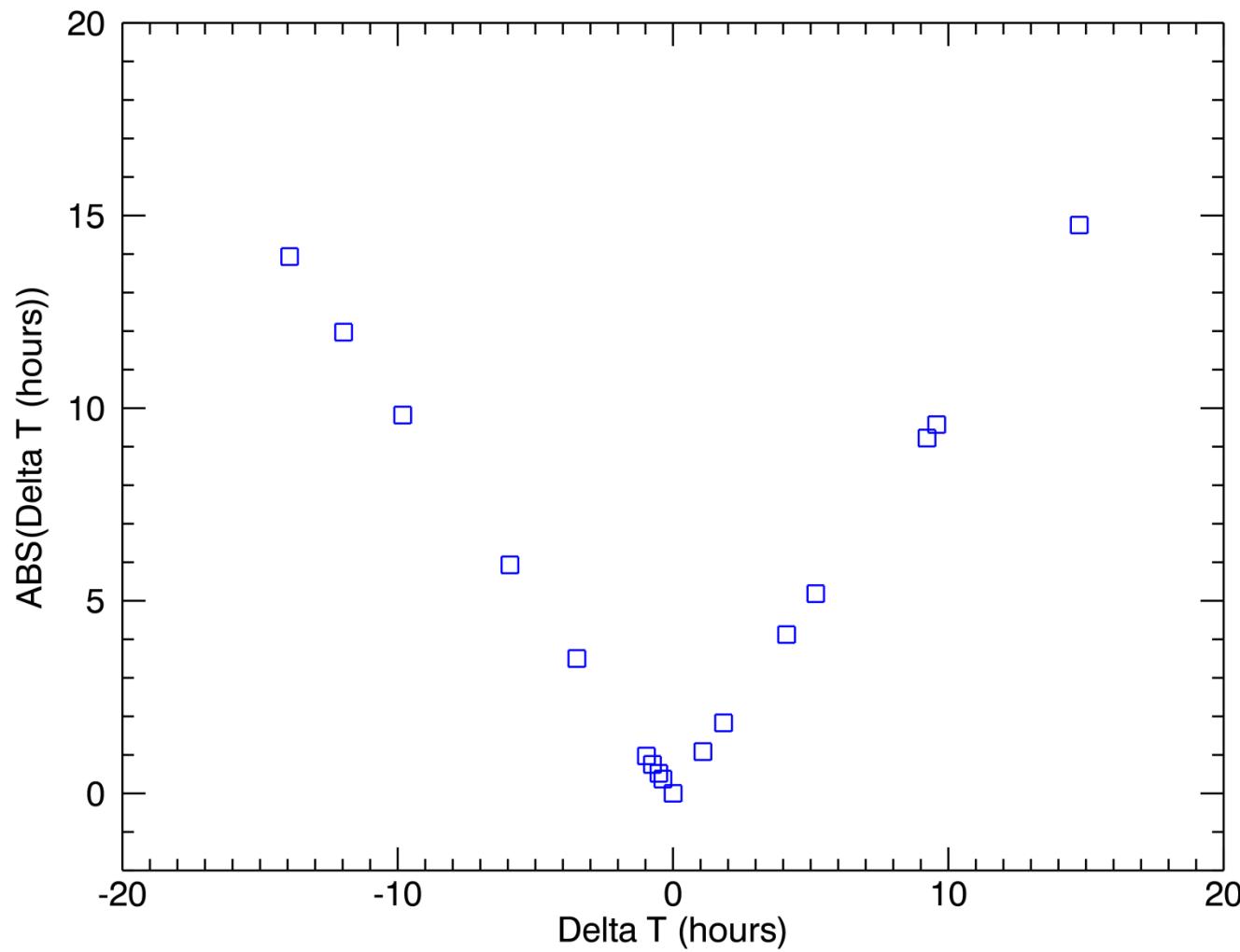


Browse model runs  
Select a model run for dissemination on the public webpage  
Inform SWFO forecast

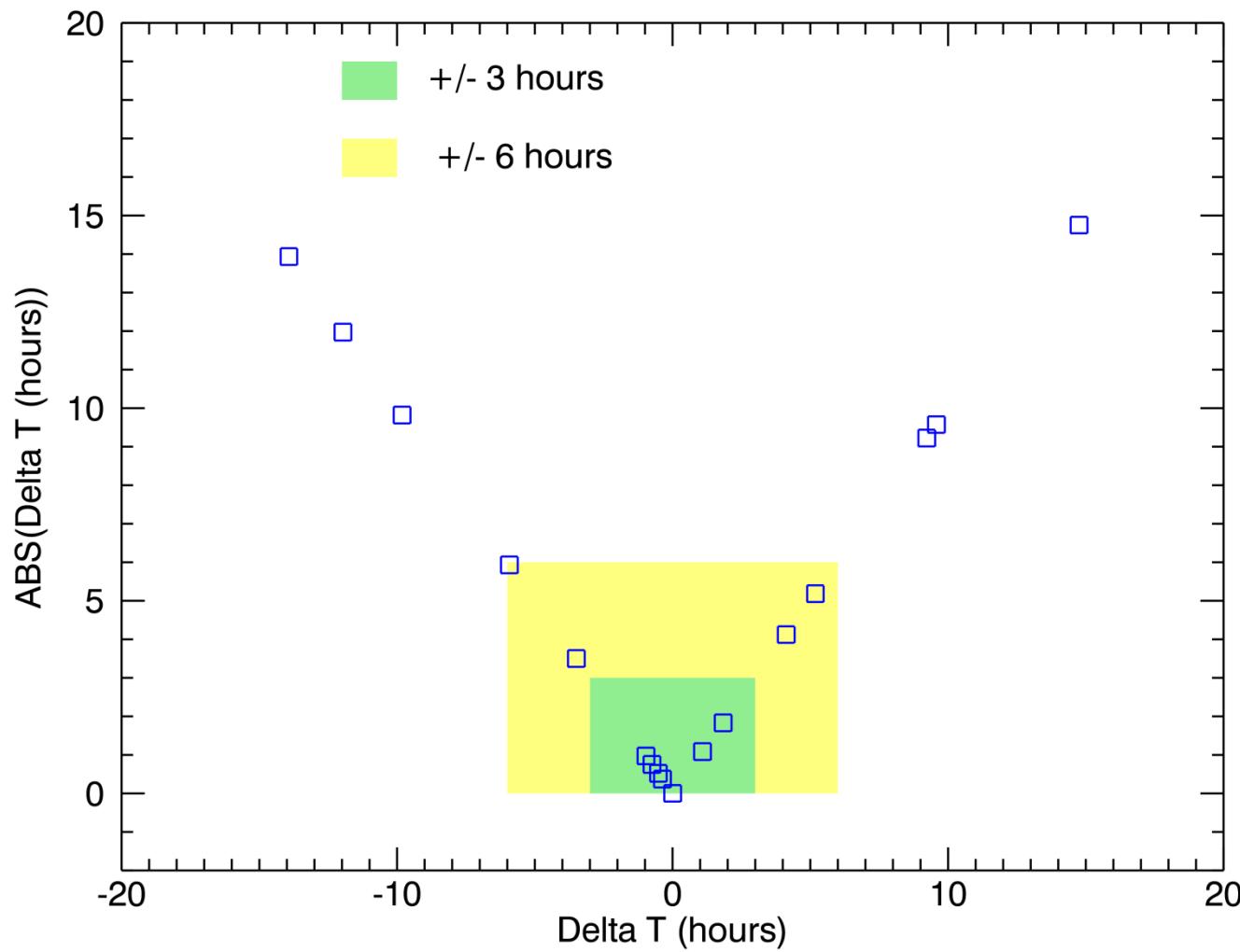




### SWPC WSA-Enlil ops: CME arrival time error (wrt ACE)

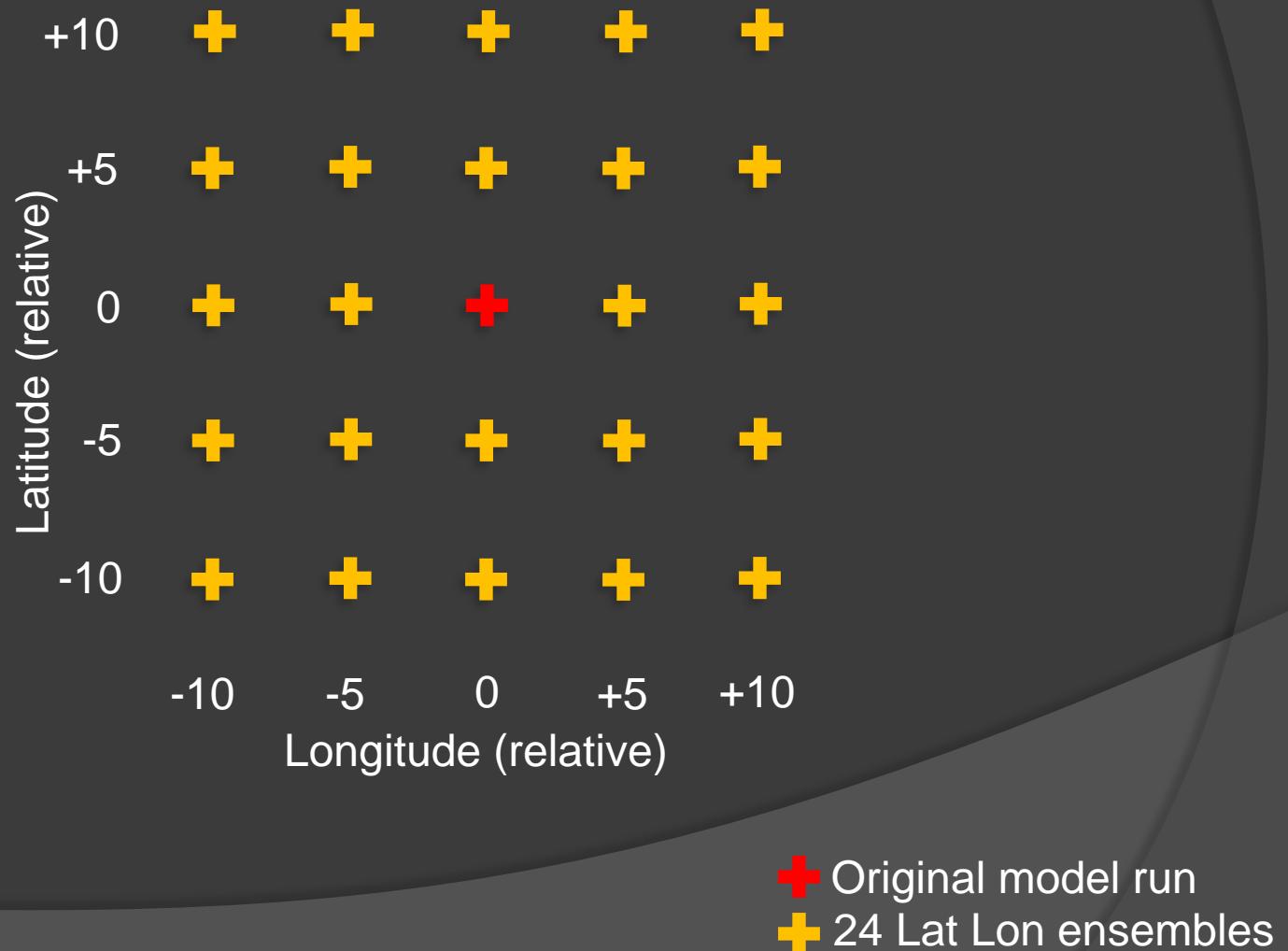


### SWPC WSA-Enlil ops: CME arrival time error (wrt ACE)



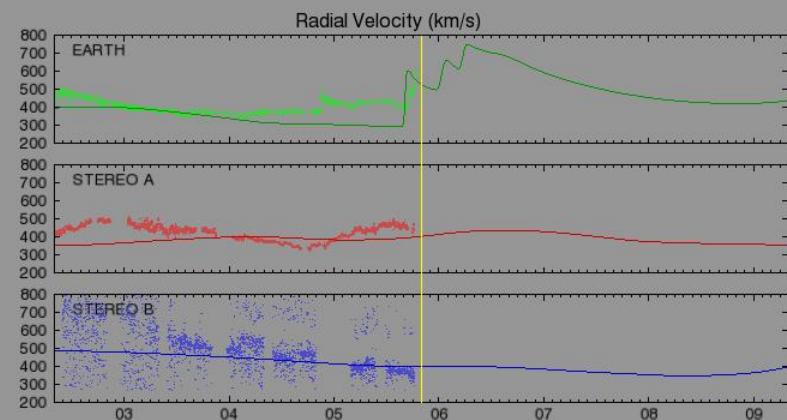
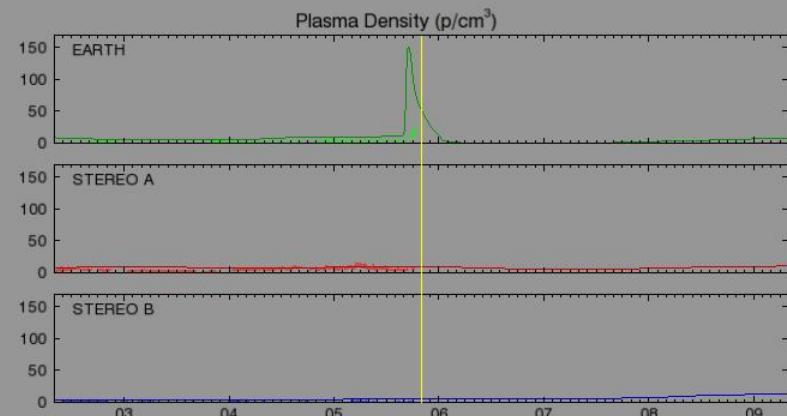
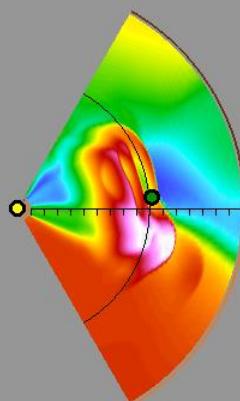
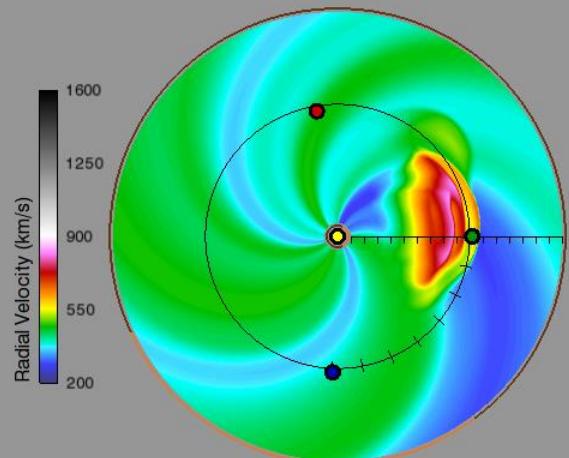
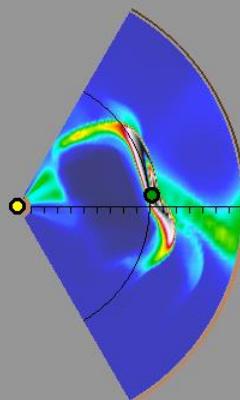
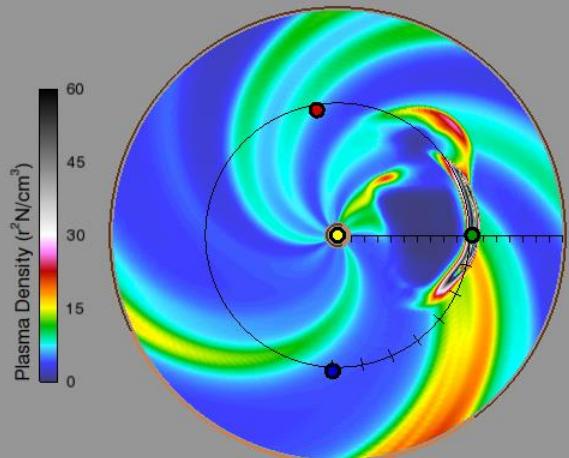
Ensemble of 25 WSA-Enlil model runs – varying the  
latitude / longitude of CME propagation direction.

(CME velocity and cone angle kept constant)



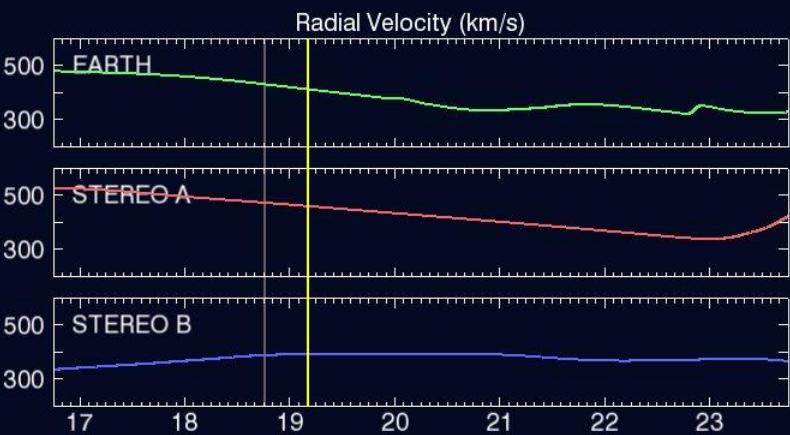
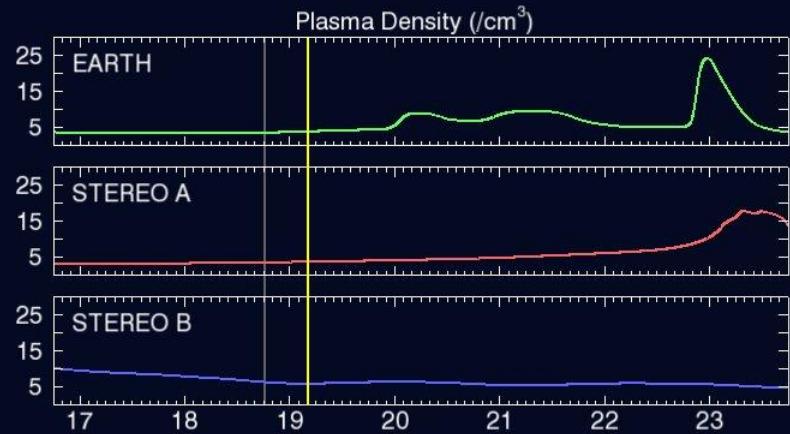
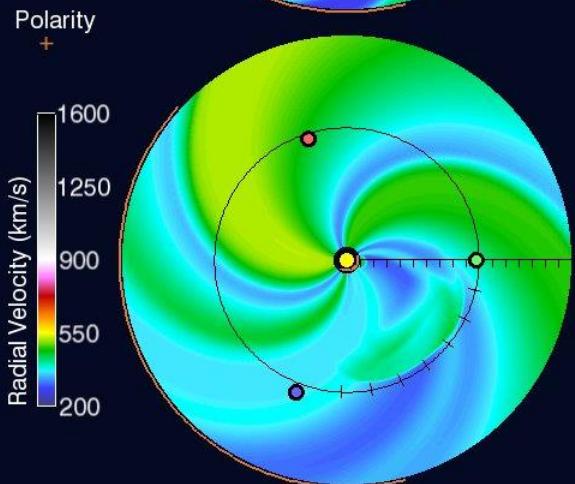
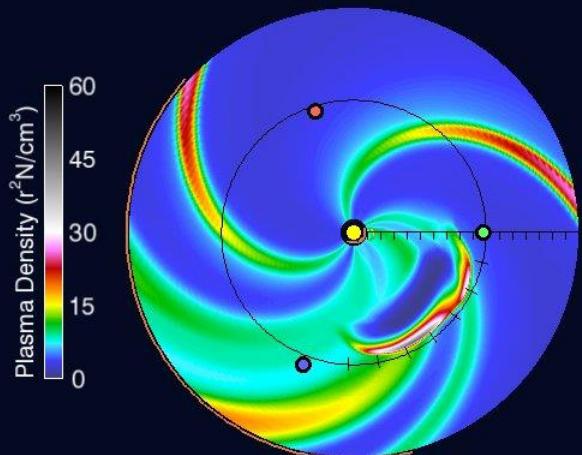
2011-08-05 19:00:00

“Direct Hit”



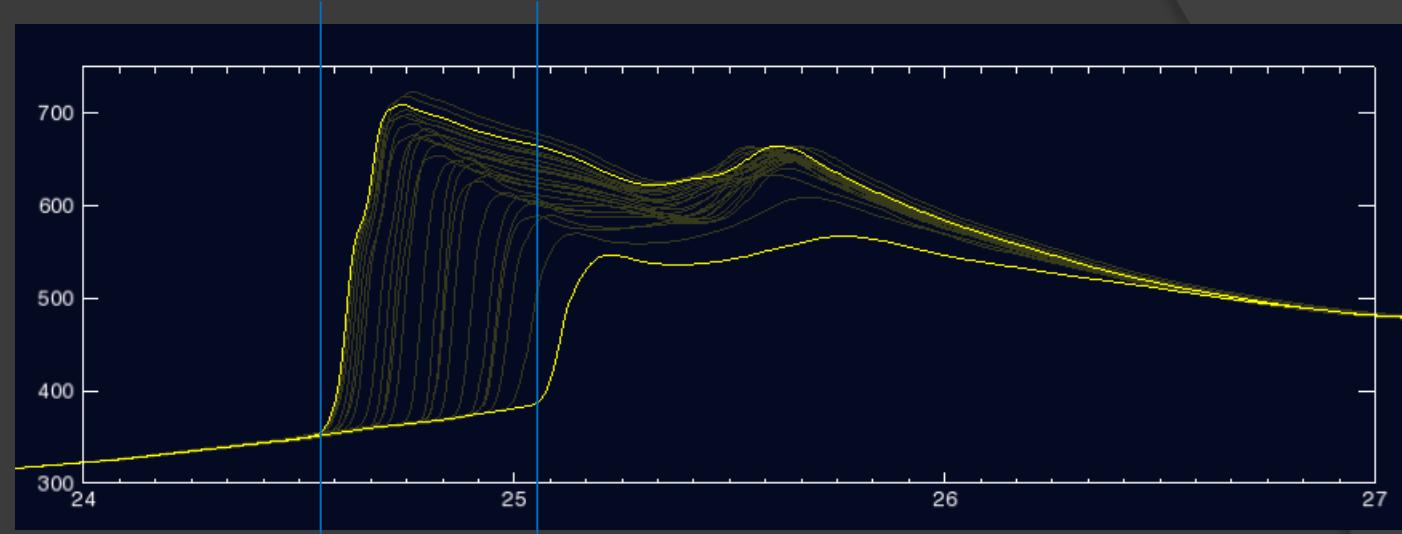
2012-01-19 04:00:00

“Glancing Blow”



“Direct Hit” ensemble

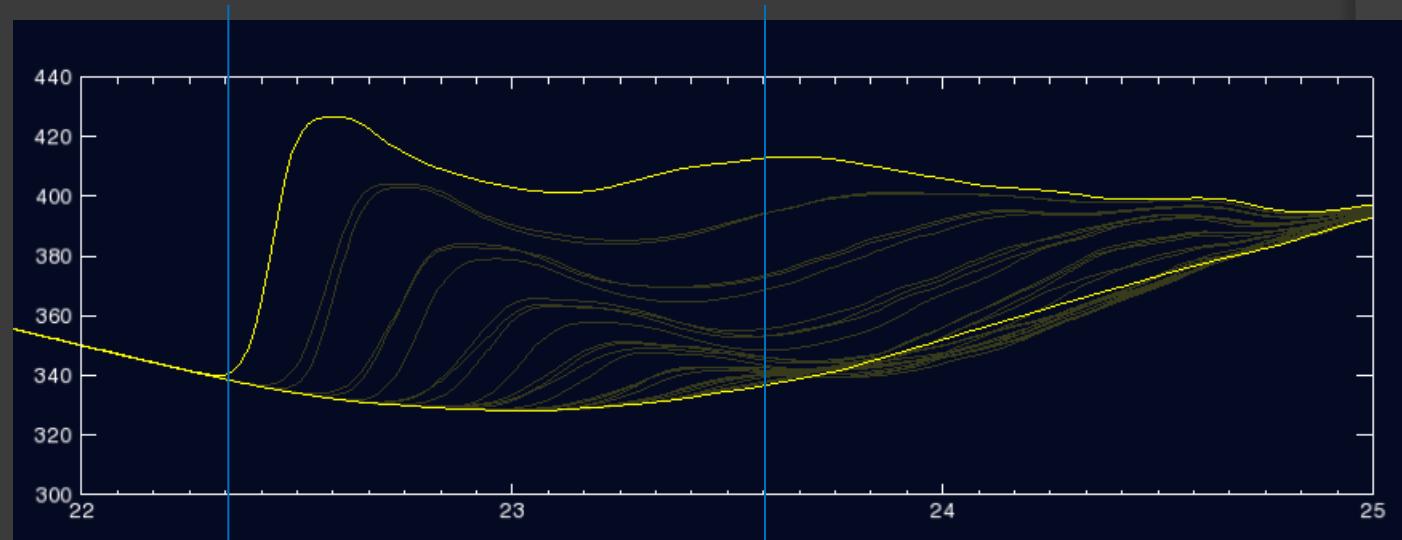
+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +



12 hours (+/- 6)

“Glancing Blow” ensemble

+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +  
+ + + + +



30 hours (+/- 15)

## The Future (2013)

- Continued validation/verification/performance tracking
- System developments
- Transition ADAPT (AFRL) : SWPT activity
- Enlil developments – real time updating : SWPT activity

