# Estimating the CMEs propagation direction by using SECCHI-COR1 data

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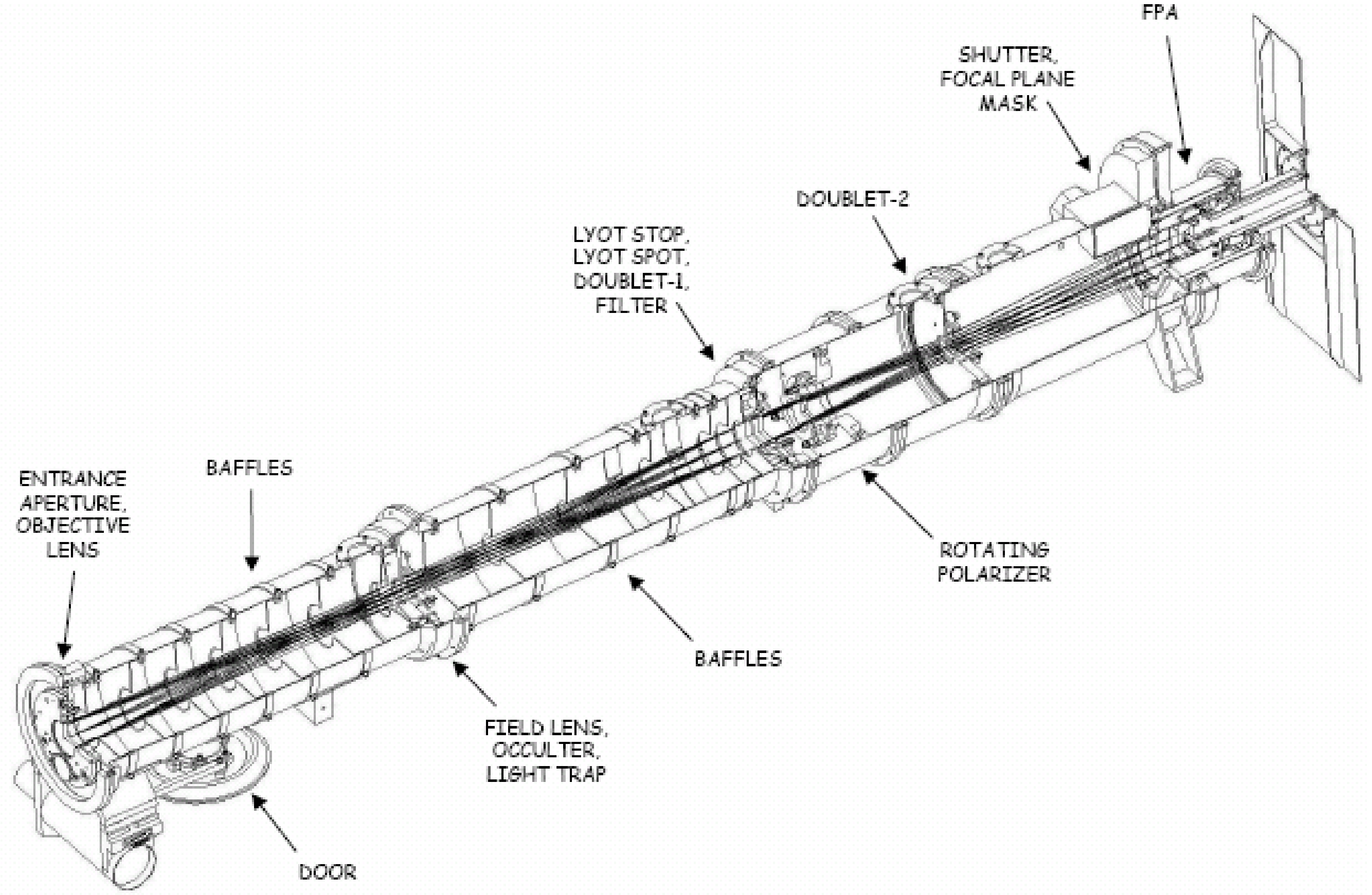
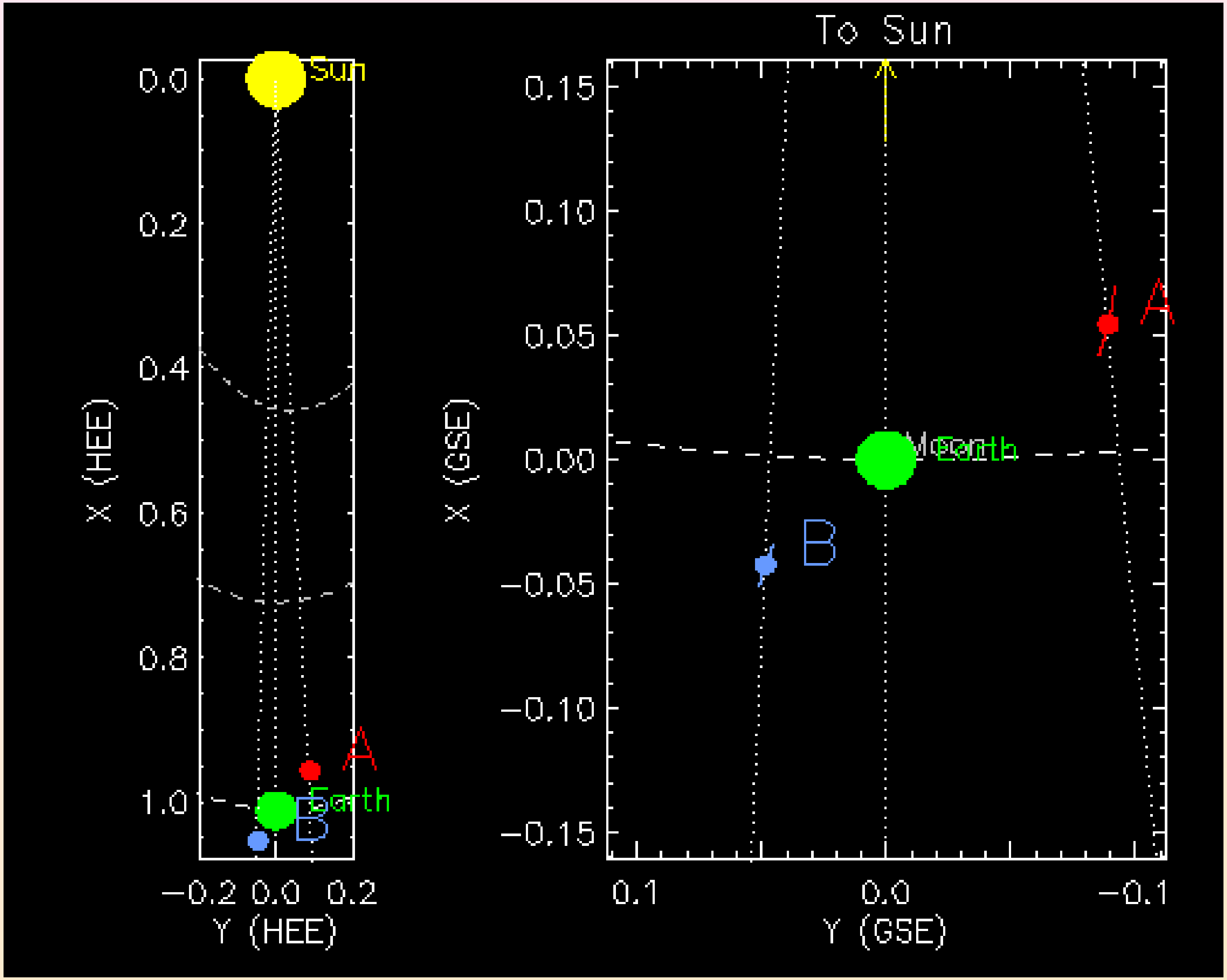
5. NRL, USA

# Contents

# STEREO-COR1


FPA
SHUTTER, FOCAL PLANE MASK
DOUBLET-2
LYOT STOP, LYOT SPOT, DOUBLET-1, FILTER
ENTRANCE APERTURE, OBJECTIVE LENS
BAFFLES
ROTATING POLARIZER
BAFFLES
FIELD LENS, OCCULTER, LIGHT TRAP
DOOR

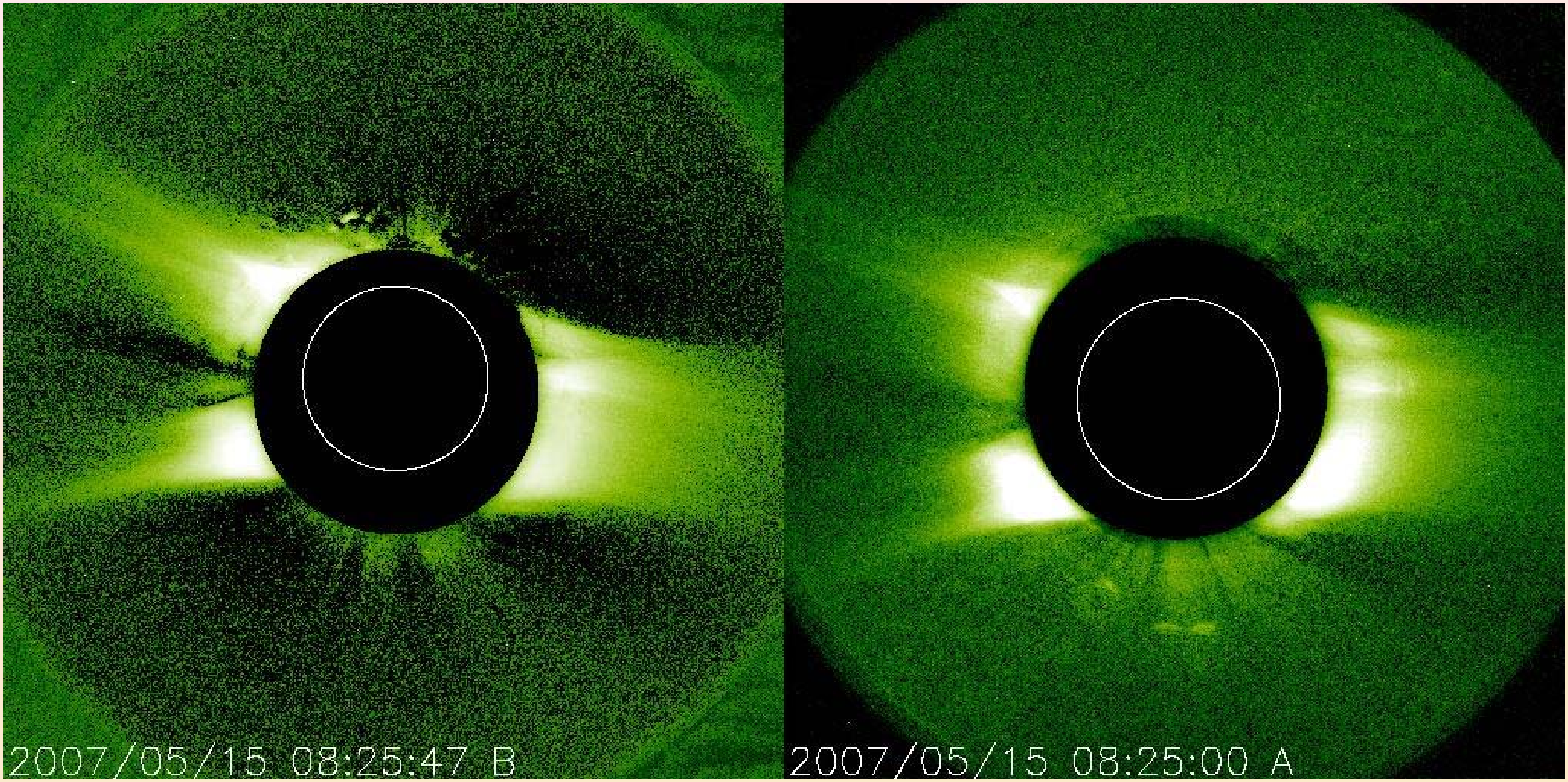
# STEREO Mission




**Positions of STEREO A and B for 2007-05-15 00:00 UT**

# Data Used

STEREO-COR1 data



**Data processing:**

Total brightness images

Monthly background subtracted

Minimum model image subtracted

Co-align the images in STEREO mission plane

**Method:**

-Height-Time (HT) plots of the same identified feature in COR1-A and –B images

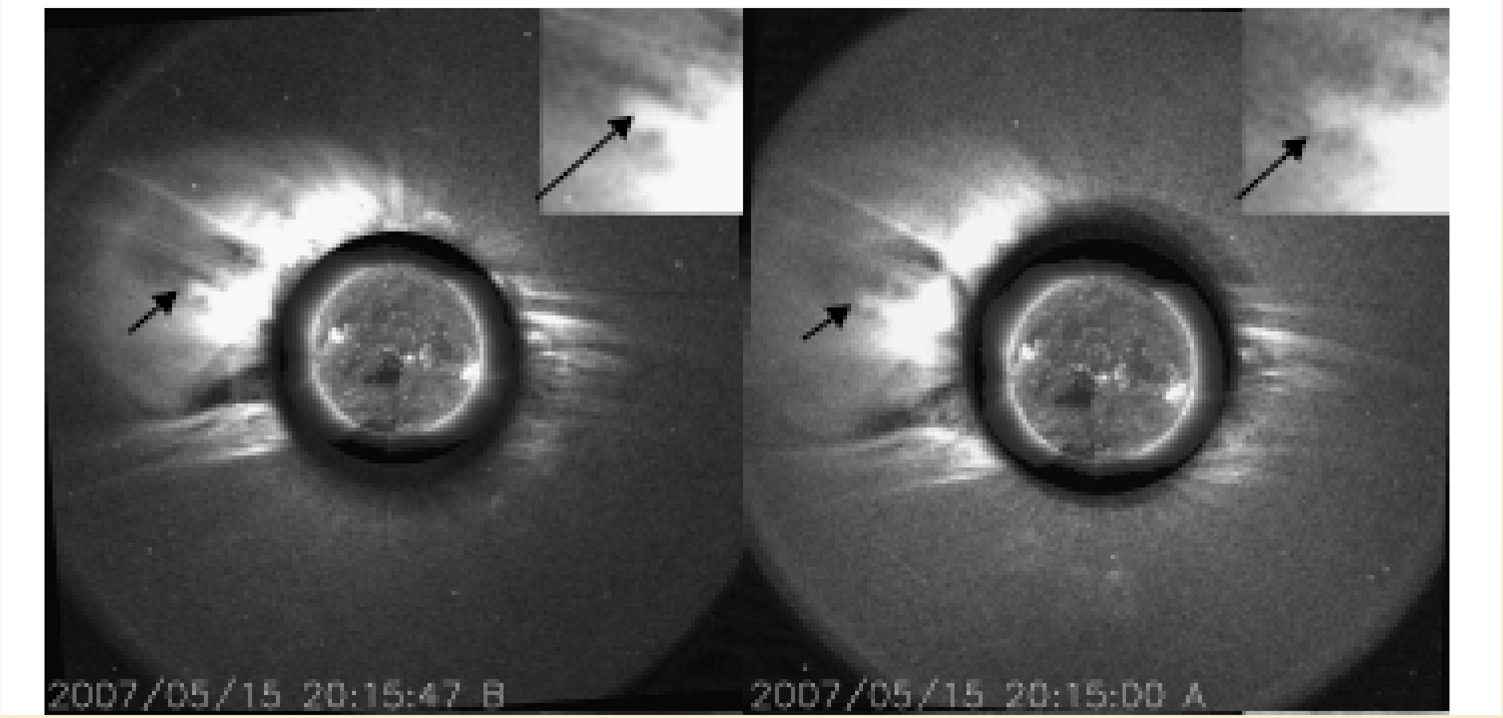
-- from a simple geometry: 3D coordinates of the coronal feature

Assumptions:

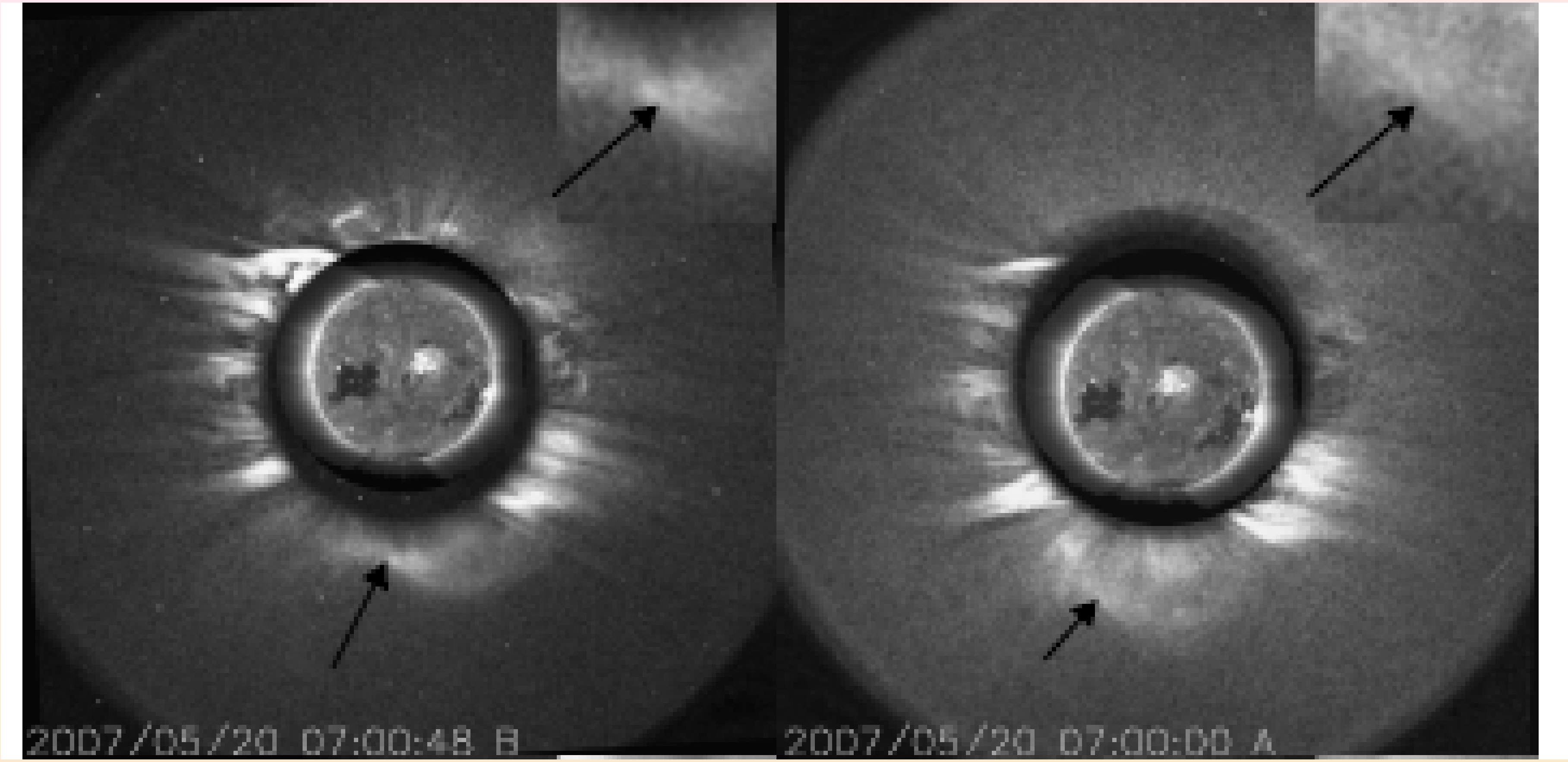
- the 2 spacecraft are in the ecliptic plane (errors < 3º)
- Affine geometry (for d=4Rs, error ~ 2%)

A Quick Method for Estimating the Propagation Direction of Coronal Mass Ejections using STEREO-COR1 Images

*M. Mierla et al., submitted*



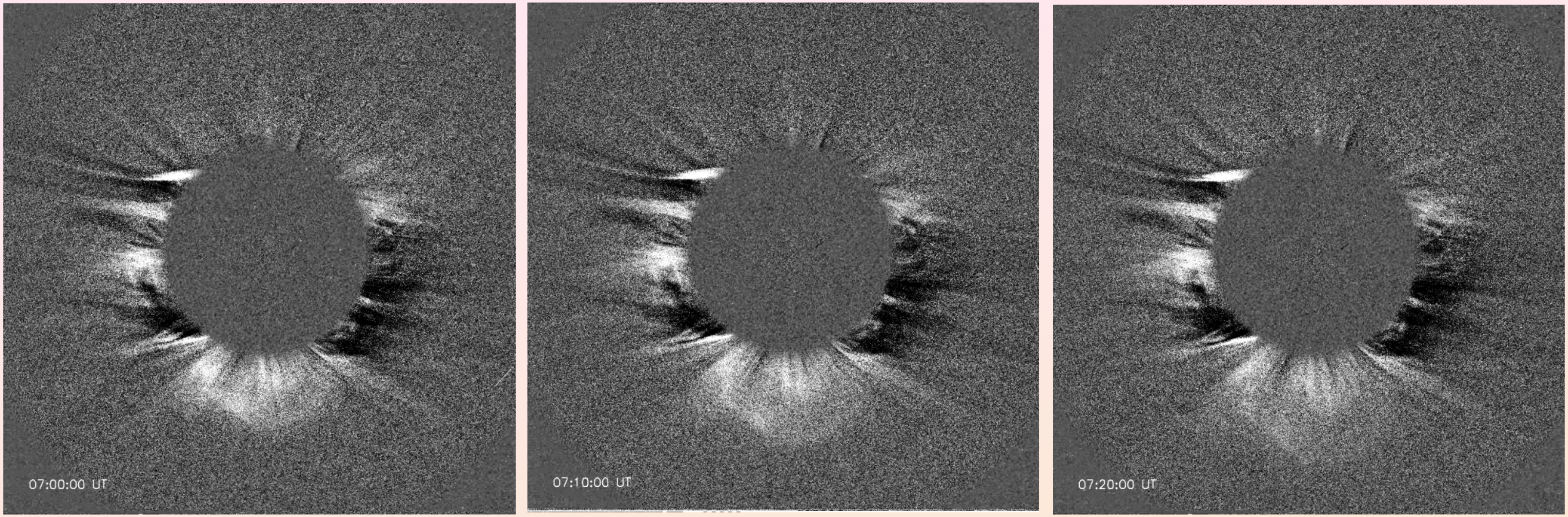

15 May 2007, 20:15 UT



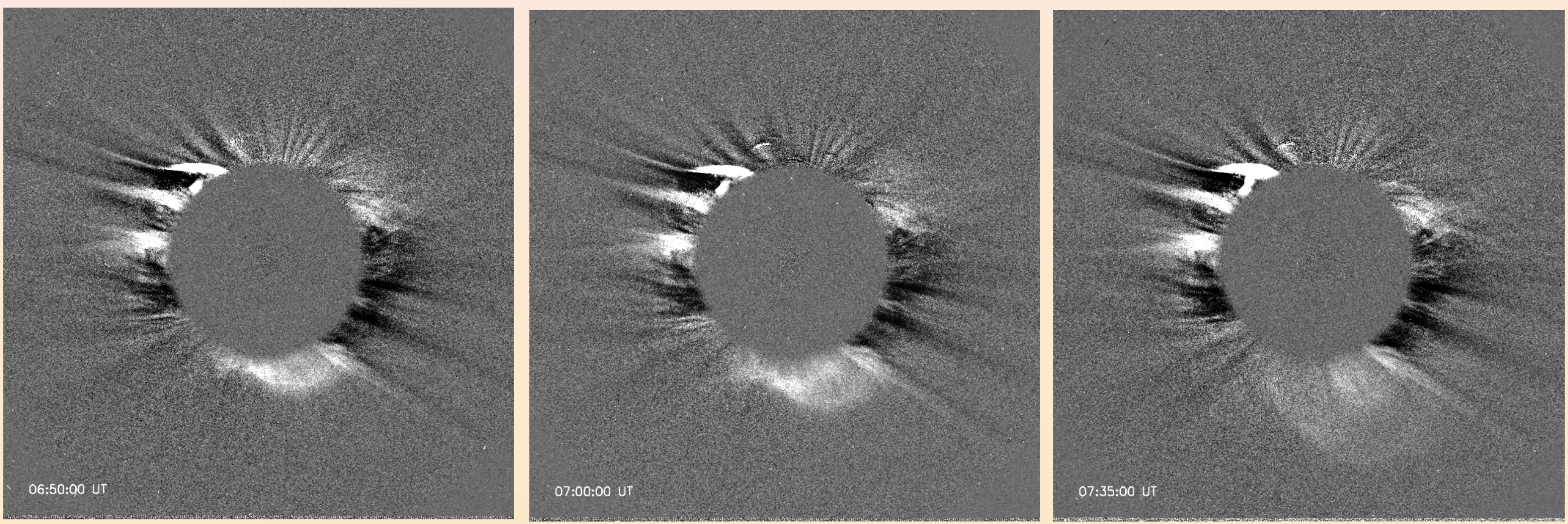

20 May 2007, 07:00 UT

# 20 May 2007

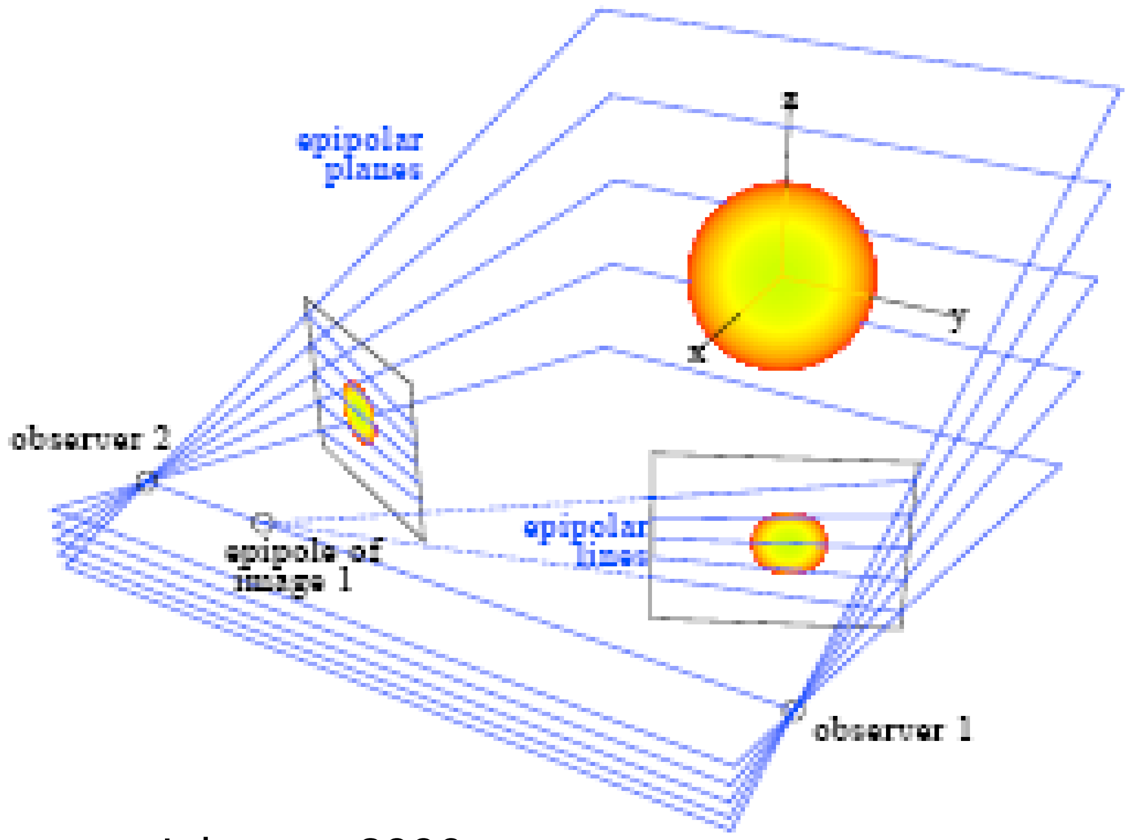
A




B

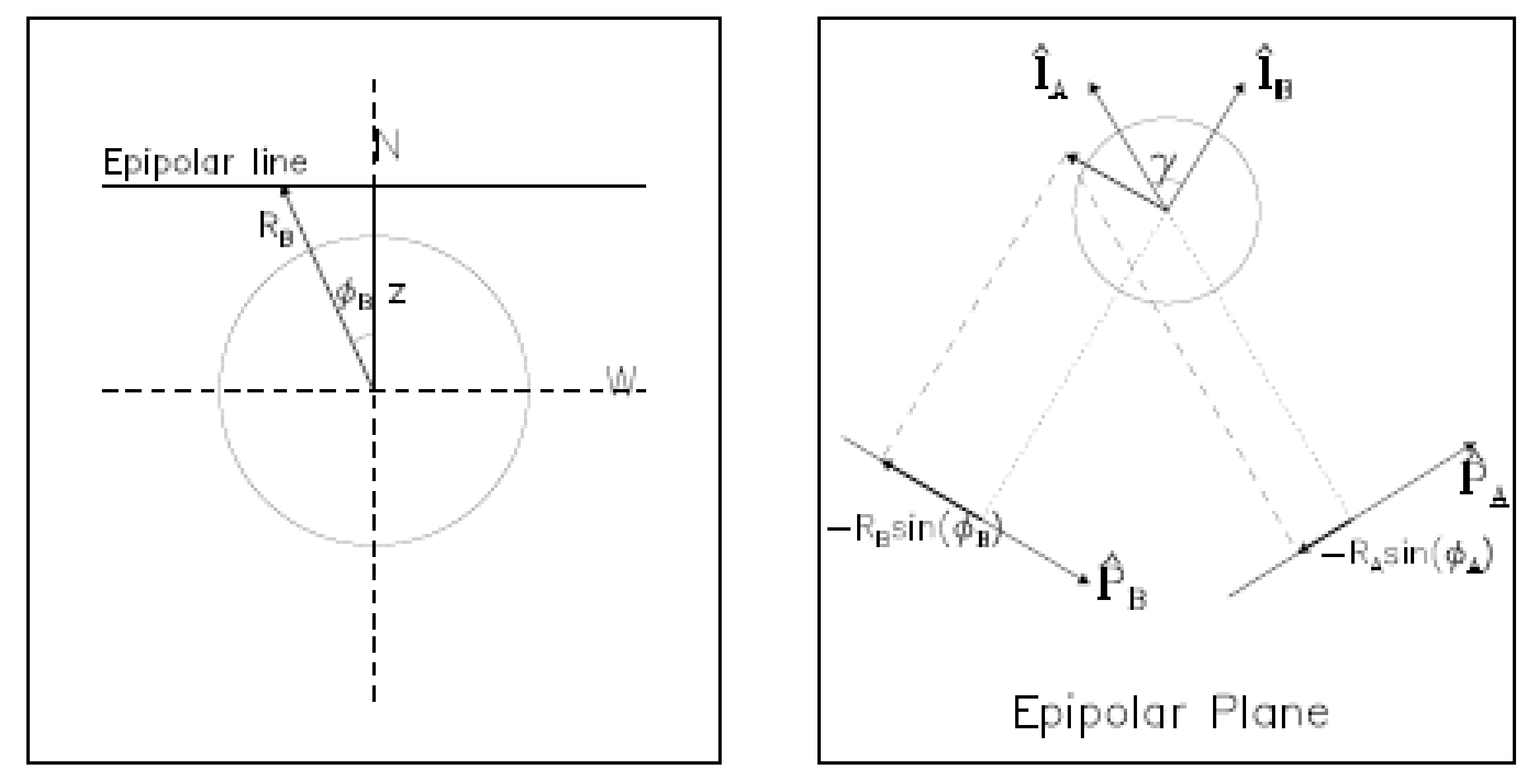


# Epipolar Geometry




Inhester, 2006

# Geometry



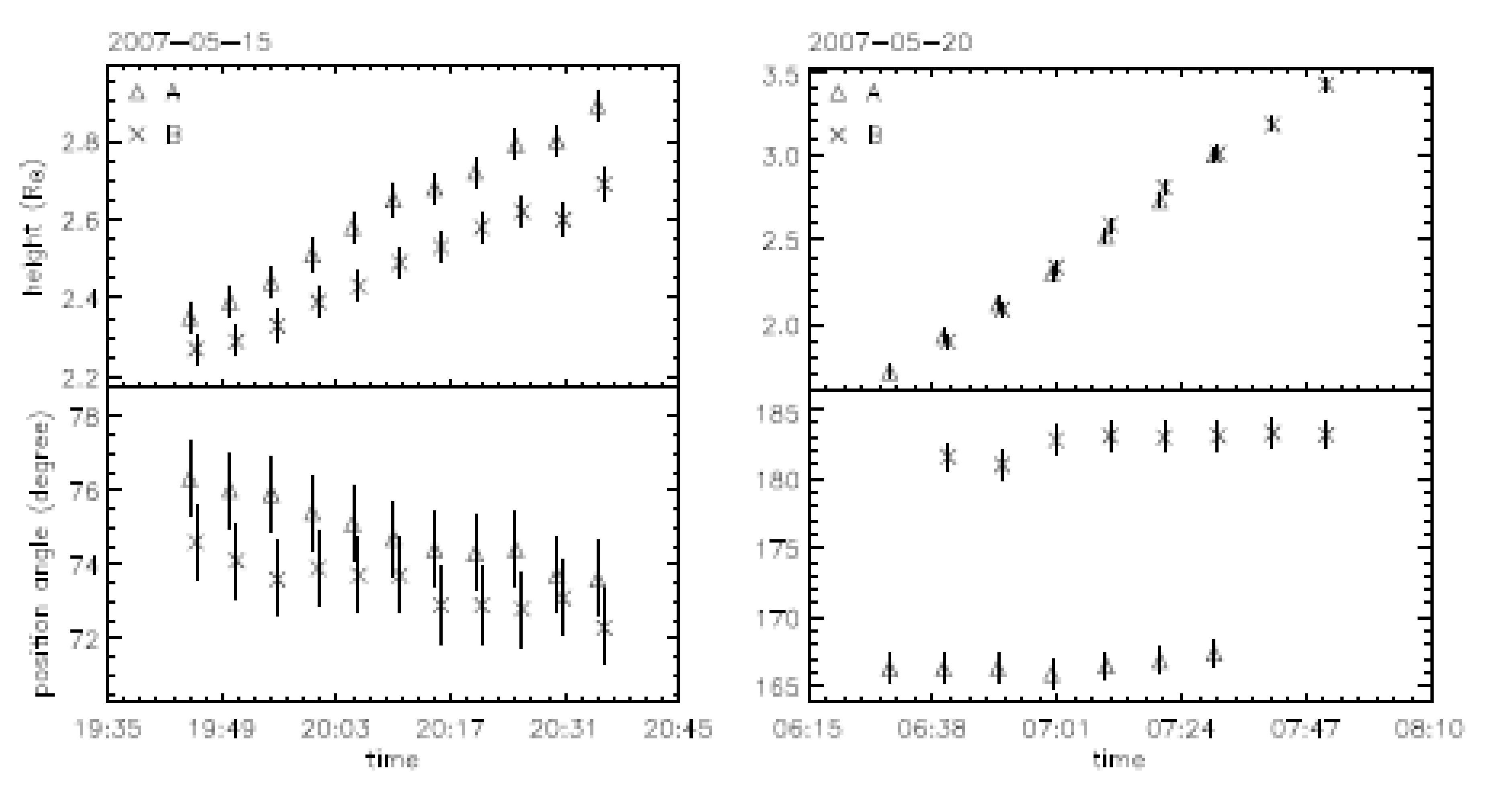
Epipolar line
N
$R_B$
$\phi_B$
z
W
$\hat{I}_A$
$\hat{I}_B$
$\gamma$
$\hat{P}_A$
$-R_B\sin(\phi_B)$
$\hat{P}_B$
$-R_A\sin(\phi_A)$
Epipolar Plane

$$
\begin{aligned}
R_{3d} &= \sqrt{(R_{2d})^2 + z^2} \\
\lambda &= \arctan\left(\tan\left(\frac{\gamma}{2}\right)\frac{a-b}{a+b}\right) \\
\theta &= \arctan\frac{R_{2d}}{z}
\end{aligned}
$$

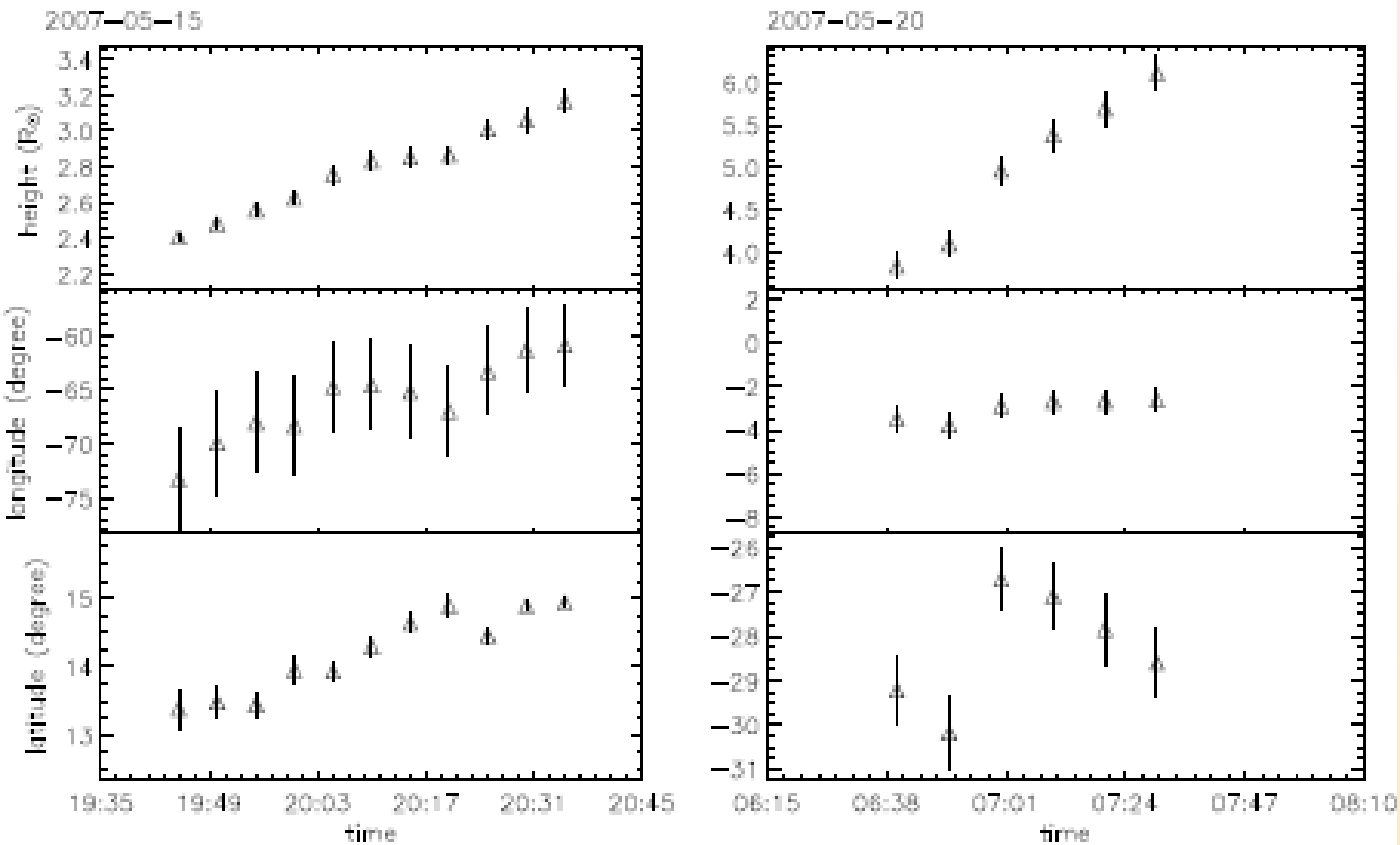
$$
\begin{aligned}
R_{2d} &= \sqrt{\alpha^2 + \beta^2 + 2\alpha\beta\cos\gamma}, \\
\alpha &= R_B \sin\phi_B / \sin\gamma, \\
\beta &= -R_A \sin\phi_A / \sin\gamma, \\
z &= R_B \cos\phi_B = R_A \cos\phi_A, \\
a &= -R_A \sin\phi_A, \\
b &= R_B \sin\phi_B
\end{aligned}
$$

# Input

HT: 15-05-2007    HT: 20-05-2007



# Output




Va = 125 km/s
Vb = 99 km/s
V = 169 km/s

Va = 242 km/s
Vb = 253 km/s
V = 548 km/s

# Summary

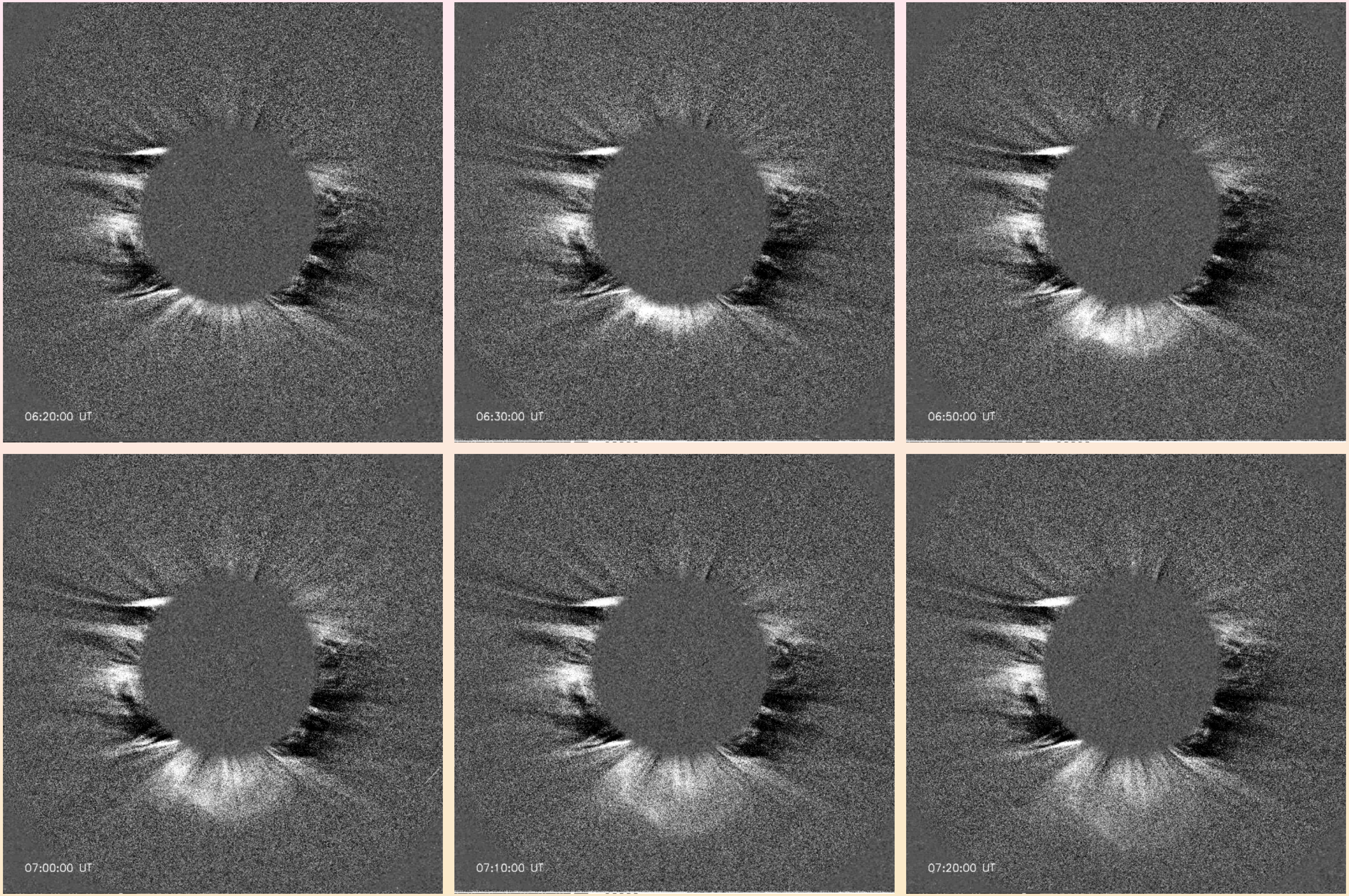
**Using HT diagrams on SECCHI-COR1 data:**

- the propagation direction of CMEs was derived
- their real speeds were inferred

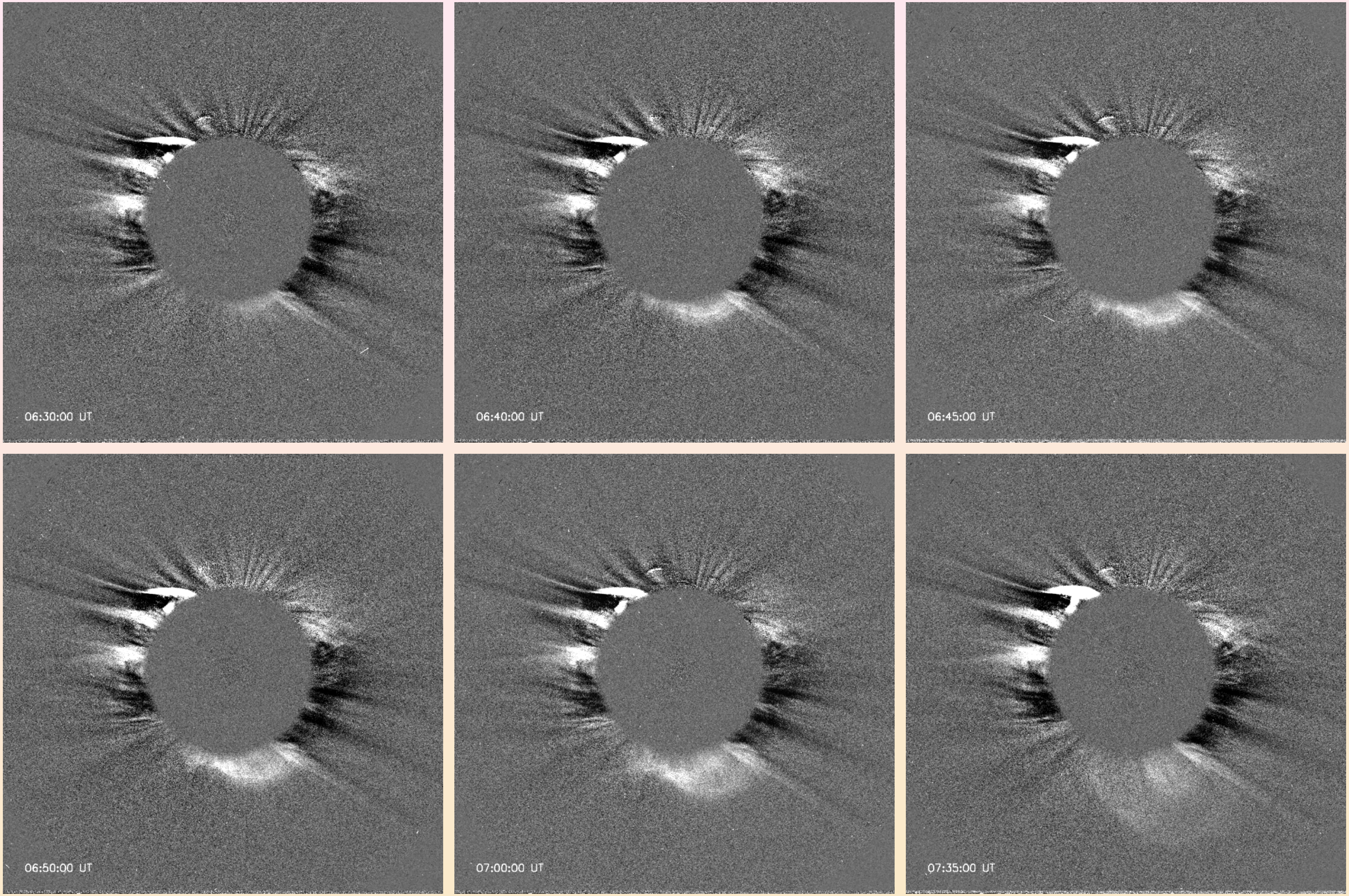
# Reconstruction of the 20th May 2007 CME Leading Edge

Nandita Srivastava

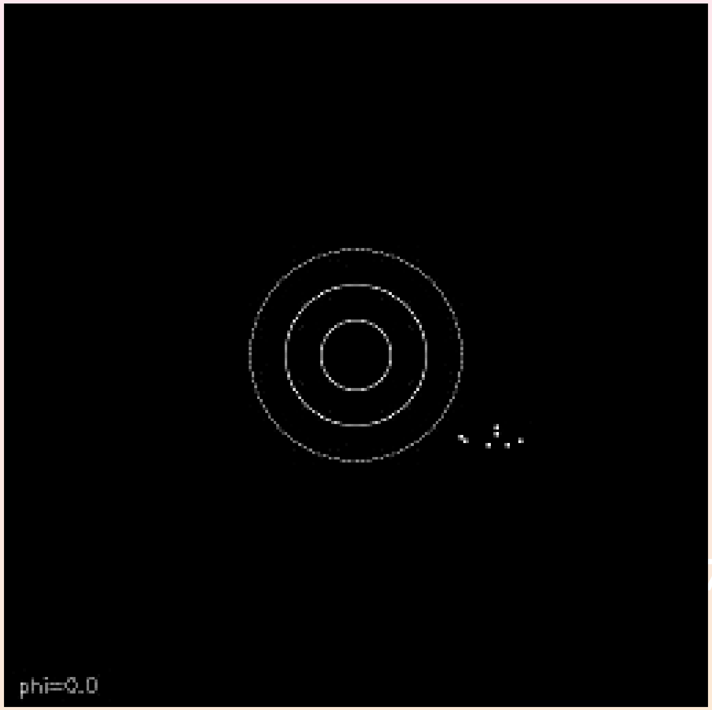
# COR1A images- 20 May 2007

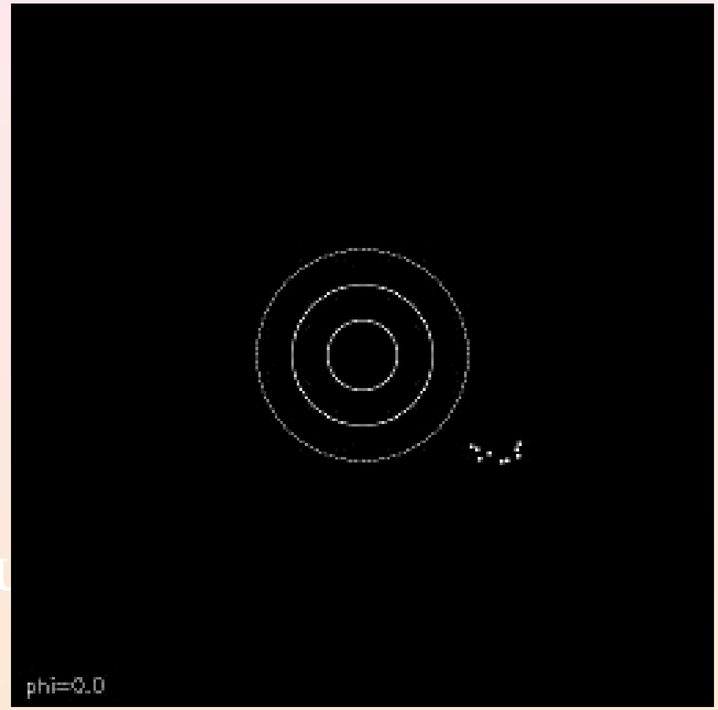


# COR1B images-20 May 2007



# Reconstruction of the leading edge using tie-pointing

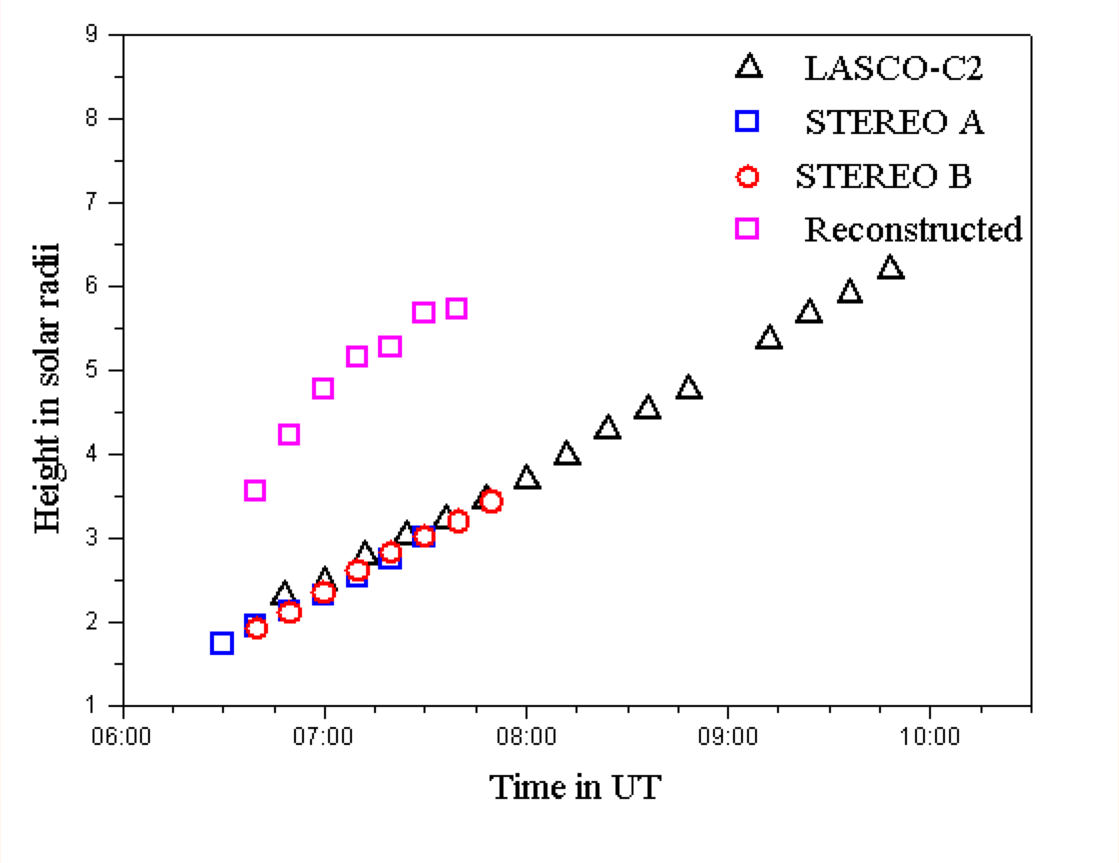



**07:00** **07:20**

**Identification of points along the leading edge.**
**Seen along the sun-earth line**
**Latitude is approximately 30 degrees south.**
**Longitude (phi) is expressed in Carrington longitude.**

# Comparisons of Height Time plots




Longitude is 10 W

Latitude is 30 S in stonyhurst coord. system

**Plane-of-sky speeds**
**LASCO, STEREO A and B ~ 230 km/s**

**True measured speed**
**From 3-D reconstruction ~ 470 km/s**

**Close to measured speed *in-situ ~ 500 km/s (PLASTIC data)***

# SUMMARY

**Tie-pointing and Height-time Reconstruction techniques applied to May 20, 2007 CME**

**The results obtained from both techniques are consistent and also are close to that measured**

**These prove to be effective tools to get true speeds of a point on leading edge of CME.**