The Influence of Apr 10, 2001 CME on the Magnetosphere

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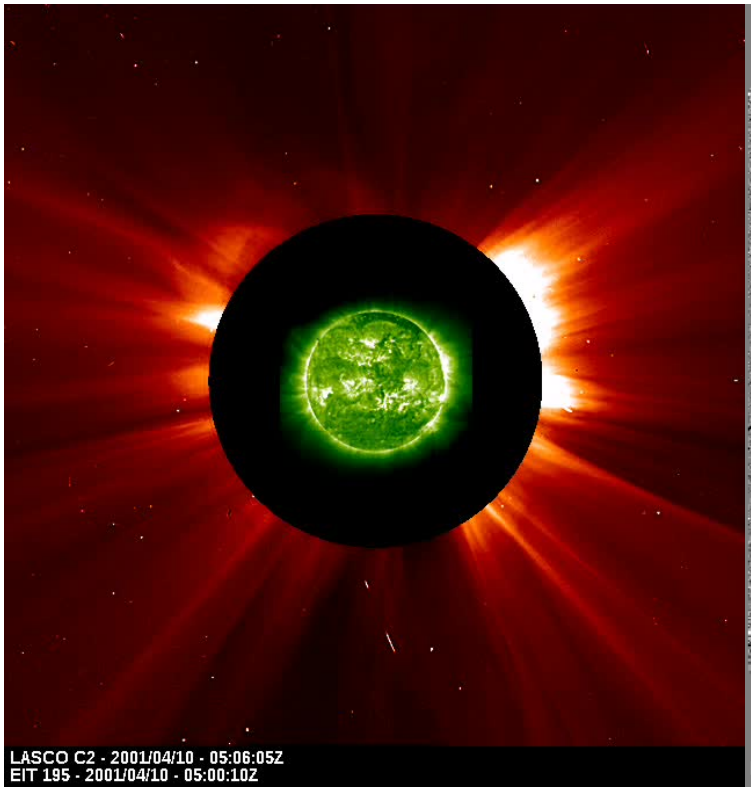
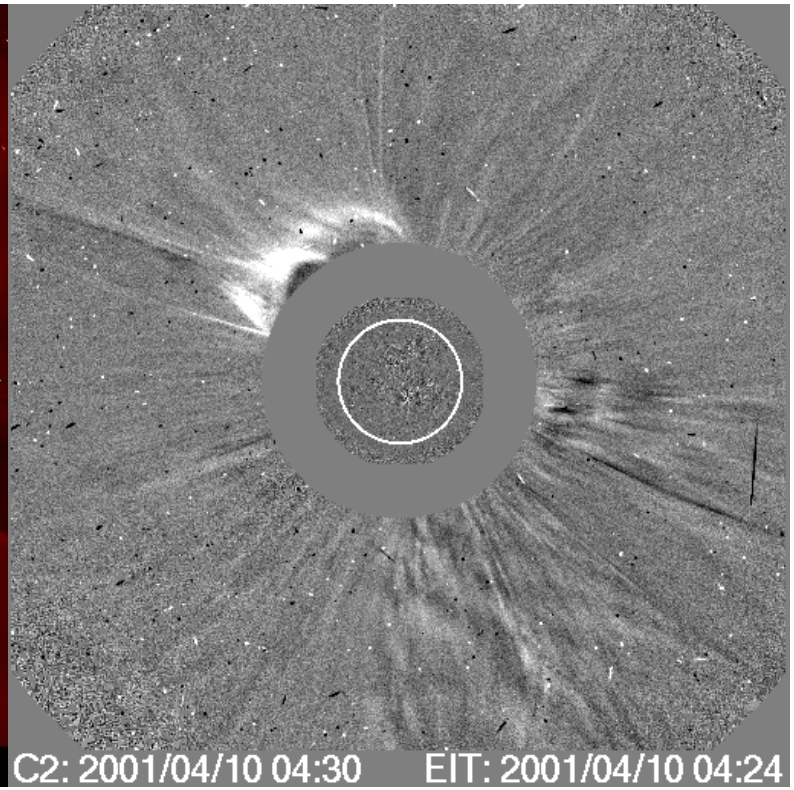
June 3, 2015

Apr 10, 2001 - 05:30 UT



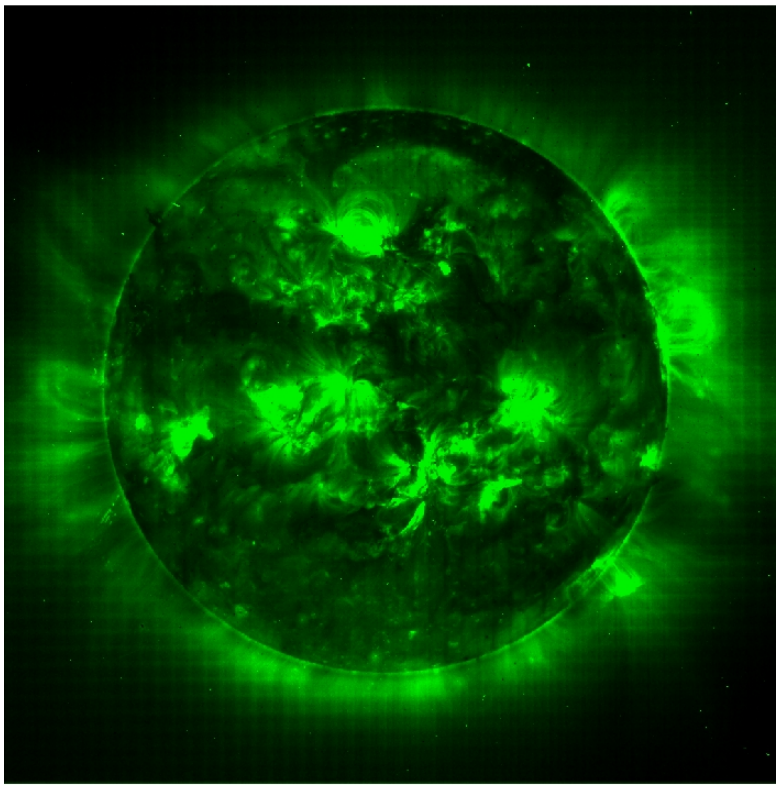


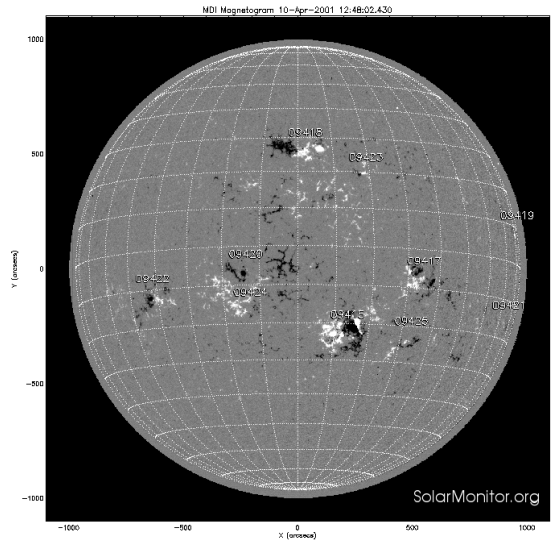
JHelioviewer

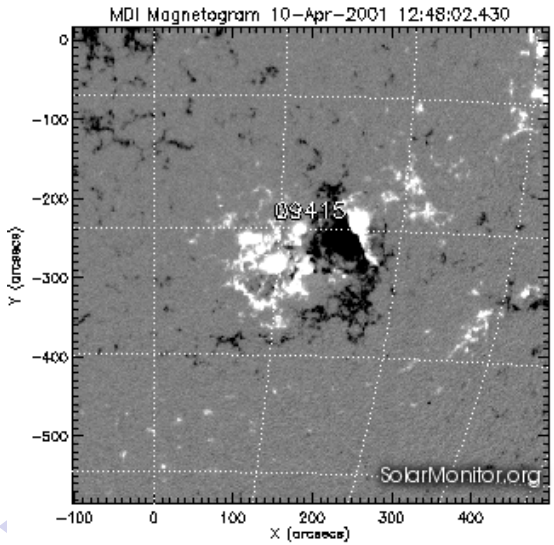
cdaw.gsfc.nasa.gov/CME_list/

$$V = 2411 \text{ km/s} \; ; \; a = 211 \text{ km/s}^2 \; ; \; V_{20R_\odot} = 2974 \text{ km/s}$$

Solar Source – Flare 05:06-05:26-05:42 UT

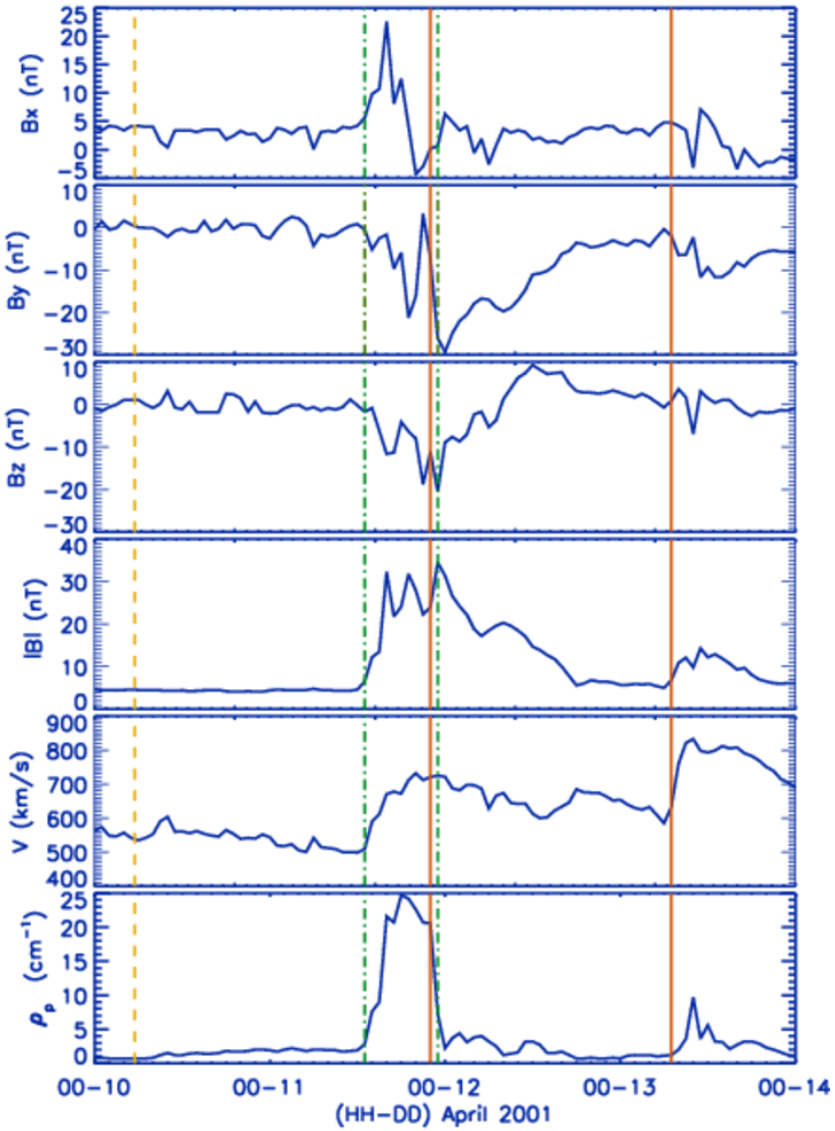






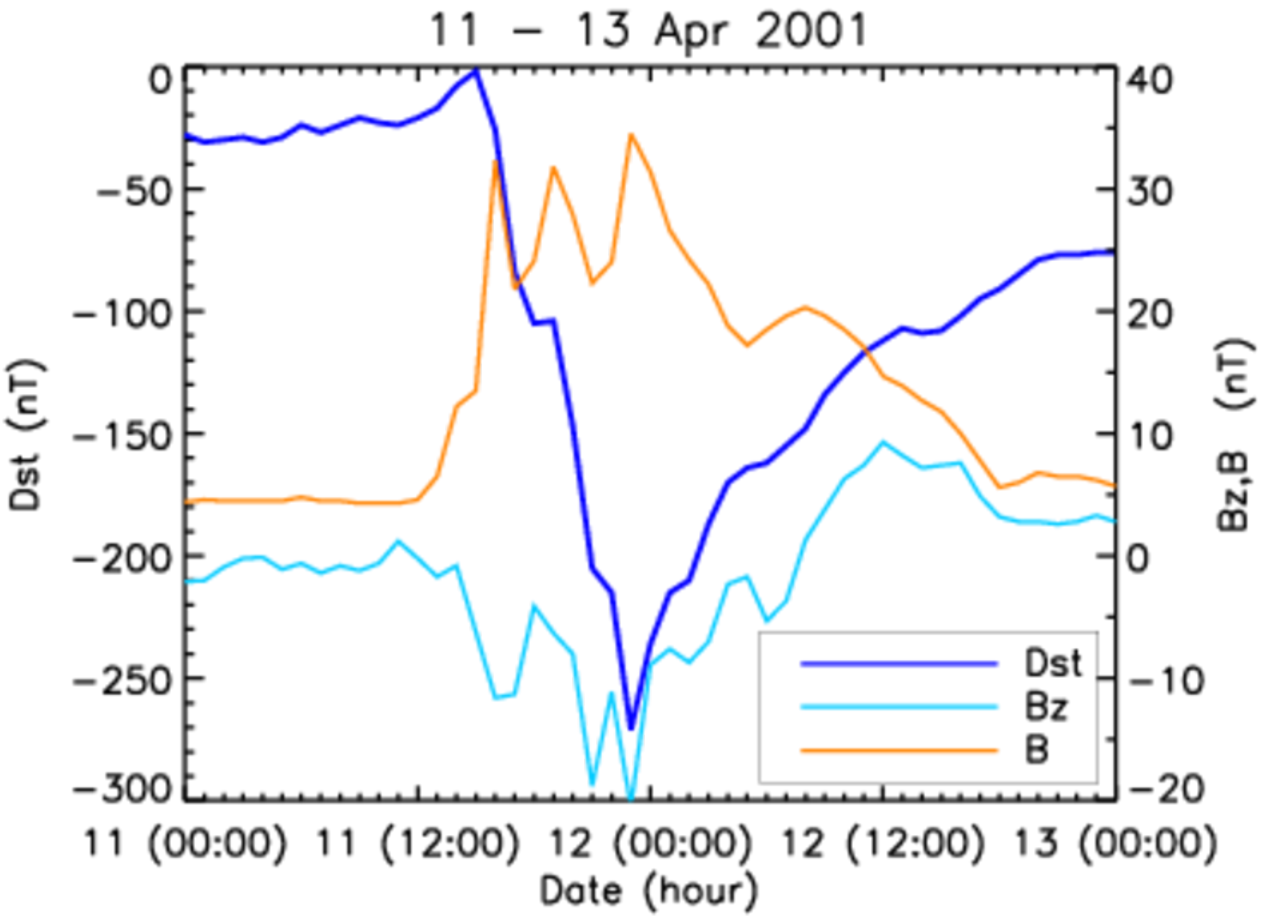
AR 9415 ($\beta\gamma\delta$) - X2.3

Apr 11 22:00 UT – Apr 13 7:00 UT



$$V_{mean} = 640 \text{ km/s}$$
$$V_{max} = 740 \text{ km/s}$$

Dst – Sudden Commencement – Apr 11 13:43 UT



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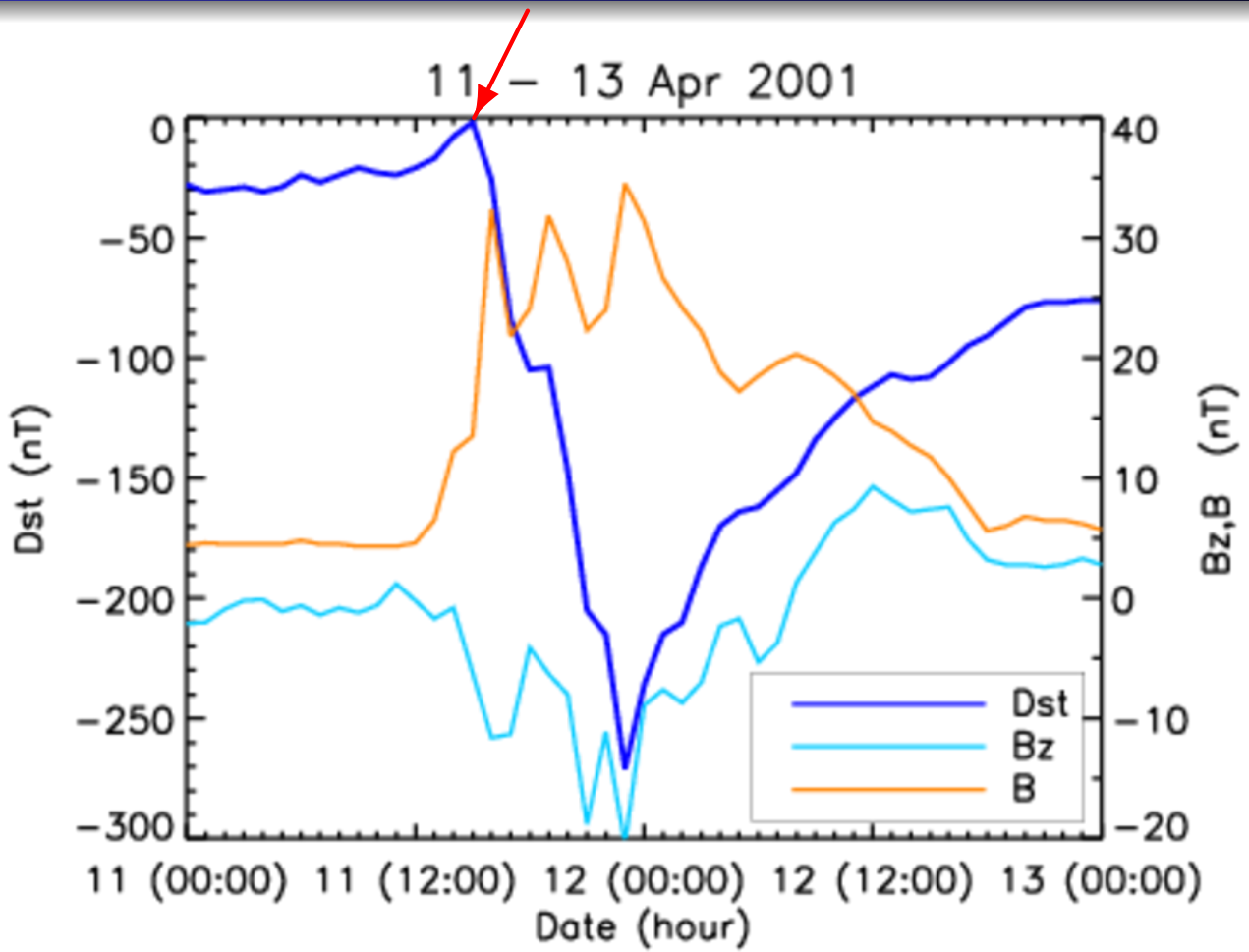

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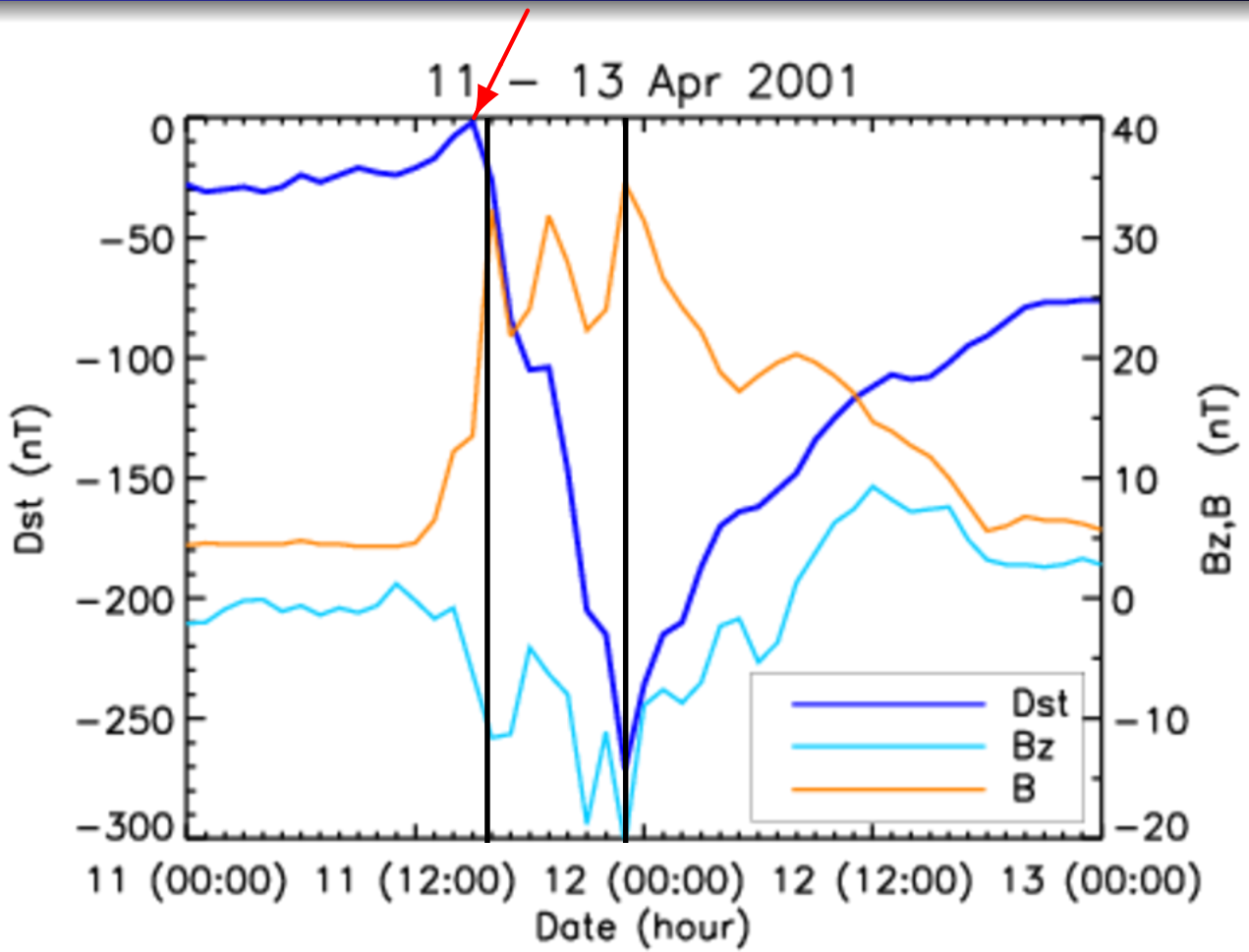

Probability Computation

Modified version of the Srivastava (2005) logistic regression model to predict the occurence of intense and super-intense GS (D_{st} < -150 nT)

There are 9 independent variables – CME projected speed, **acceleration**, **neutral line orientation**, **flare importance**, position (latitude and longitude), **magnetic classification of AR**, average magnetic field and the B_z component of the magnetic field ~~halo~~, ~~flare-bin~~, ~~ram-pressure~~

$$\Pi = \frac{1}{1+e^{-zi}}, \text{ where}$$
$$Zi = b_0 + b_1 \times x_{i1} + ... + b_j \times x_{ij}$$

where Πi - probability of the occurrence of intense geomagnetic storm given by the i-th observation of the solar variable
b_j (j=0 to J) - model parameters (regression coefficients) x_{ij} (i=0 to I; j=0 to J) - the independent variables; I and J are total number of observations

In SC23 there were 25 ICMEs to be followed by intense and super-intense geomagnetic storms (-200 nT < D_{st} < -150 nT, respectively D_{st} < -200 nT). We have trained the model with 21 events, and used the remaining 4 for validation.

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For Apr 10, 2001 CME: **100%** to have an intense GS

$\epsilon - E_{IN}$

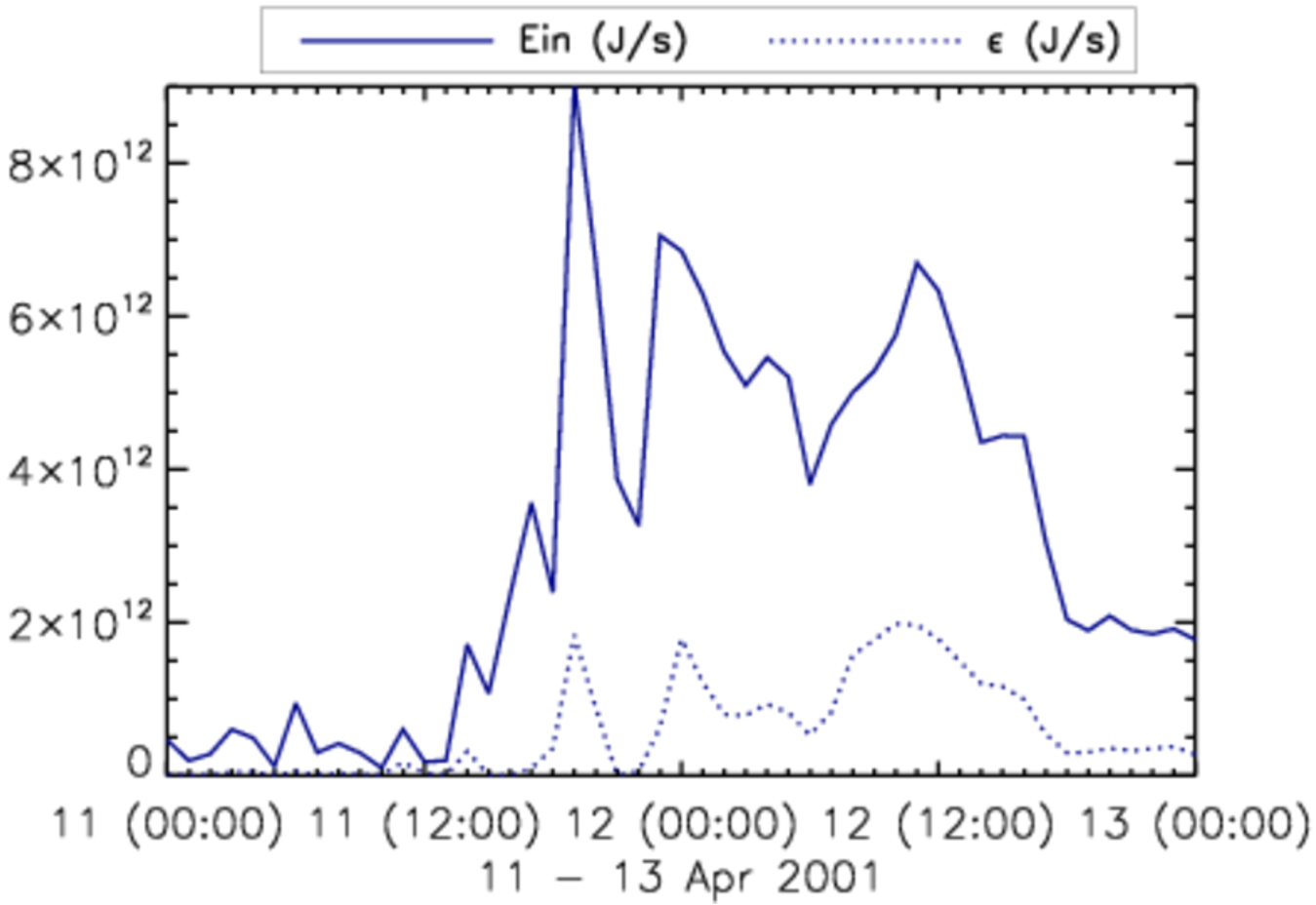
Akasofu, 1981

$$\epsilon = 10^7 \; V \; B^2 \; l_0^2 \; sin^4\left(\frac{\theta}{2}\right) [J/s]$$

Wang et al, 2014

$$E_{IN} = 3.78 \times 10^7 \; n_{SW}^{0.24} \; V_{SW}^{1.47} \; B_T^{0.86} \; \left(sin^{2.7}\left(\frac{\theta}{2}\right) + 0.25\right) [J/s]$$

ϵ – E_{IN} – Results



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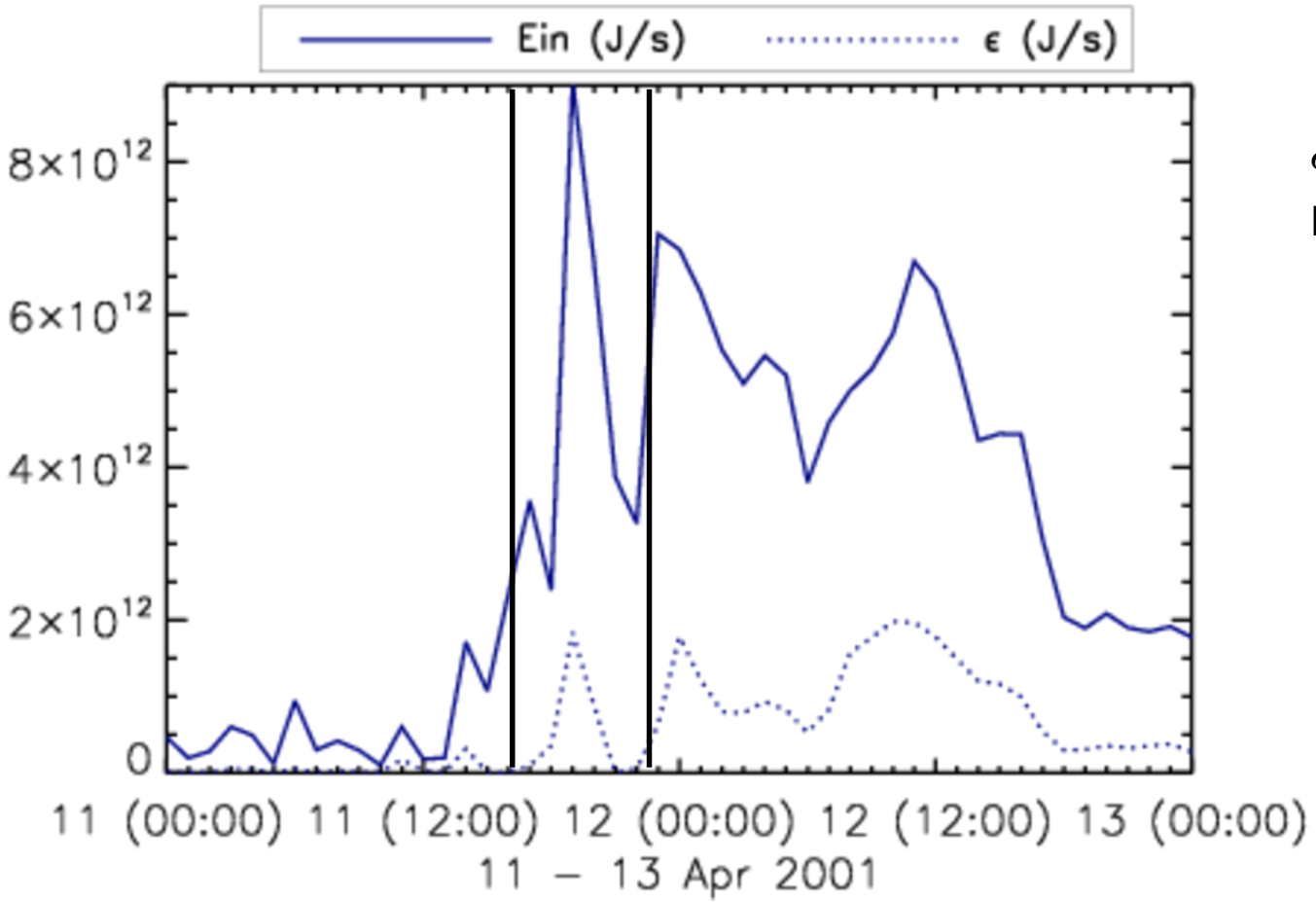
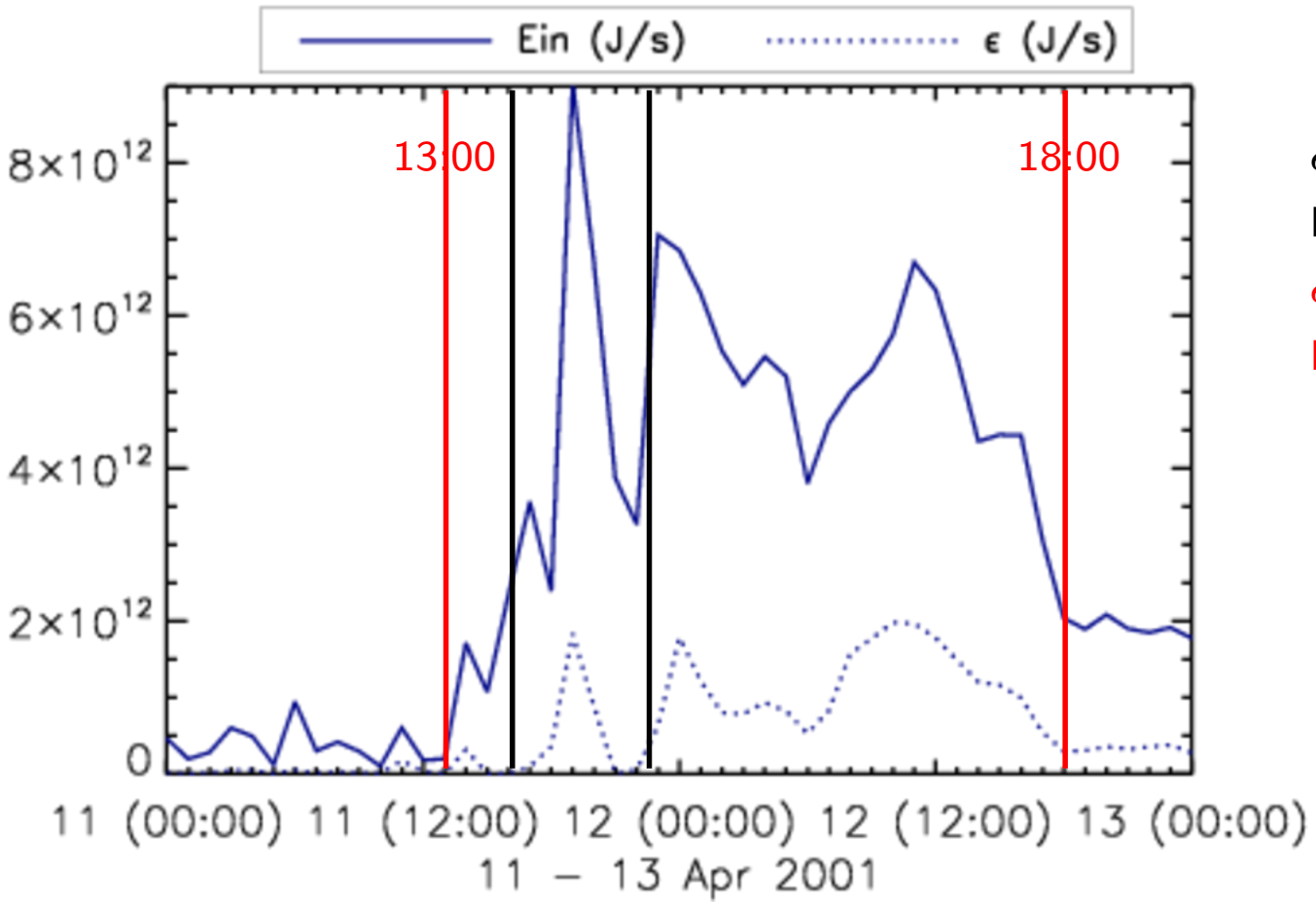


$\epsilon = 1.35 \times 10^{17}$ J

$E_{IN} = 1.33 \times 10^{18}$ J

ϵ – E_{IN} – Results



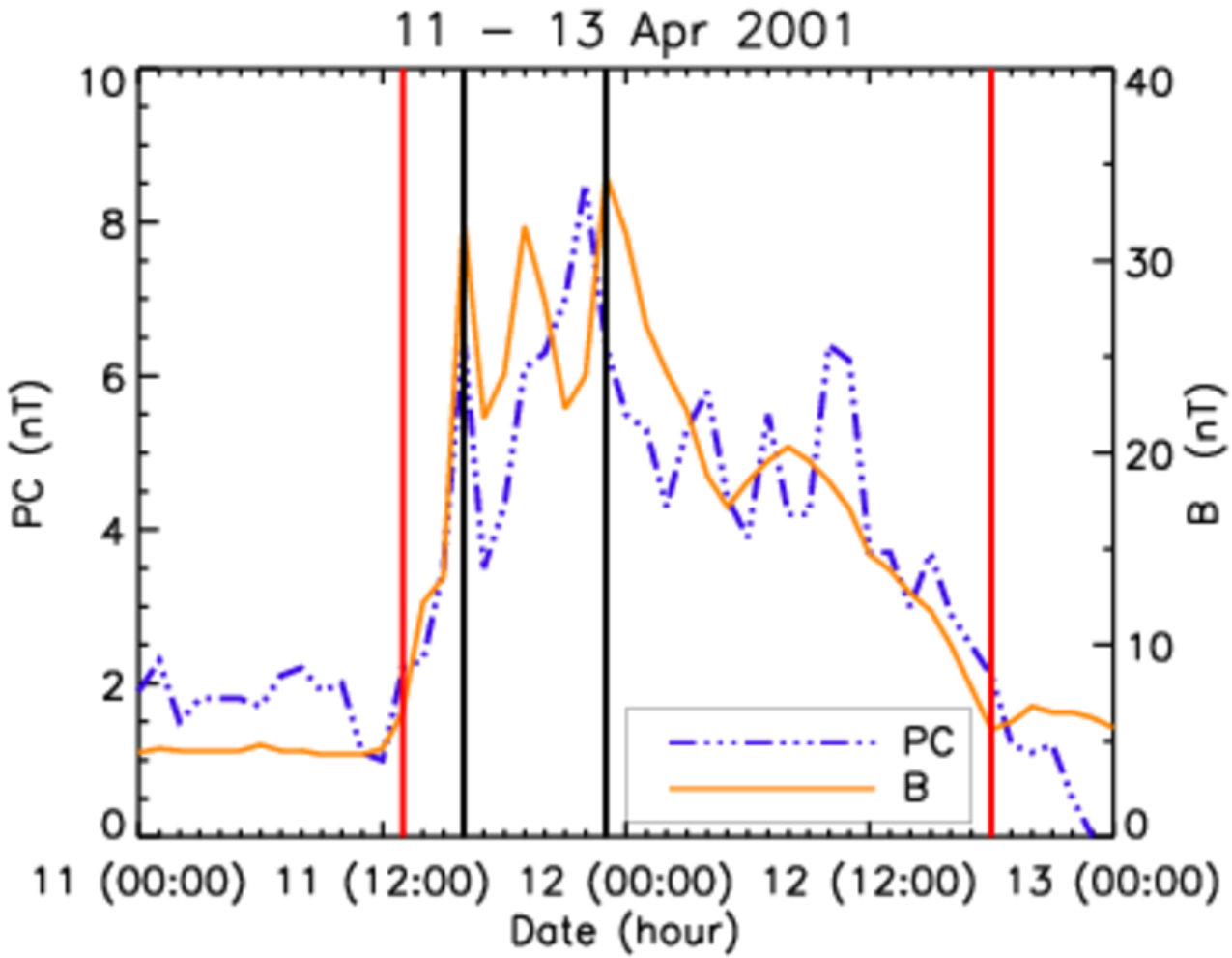
$\epsilon = 1.35 \times 10^{17}$ J

$E_{IN} = 1.33 \times 10^{18}$ J

$\epsilon = 2.88 \times 10^{18}$ J

$E_{IN} = 1.48 \times 10^{19}$ J

PC – |B|


11 – 13 Apr 2001
PC (nT)
B (nT)
PC
B
11 (00:00)
11 (12:00)
12 (00:00)
12 (12:00)
13 (00:00)
Date (hour)

Discussion

- Apr 10, 2001 FH CME was geo-effective
- CME source location was close to solar centrum
- SC registered after 32 h
- SC correlated to sudden increase in ρ, V and |B|
- GS main phase $\Longleftrightarrow$ negative values Bz
- Probability of Apr 10, 2001 CME to be geo-effective = 100%
- Energy transfer does not resume to main phase only
- Energy transfer relates to |B| and PC index excess

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Acknowledgments

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Thank you!

Acknowledgments

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