Time Delay Between Dst Index and Magnetic Storm Related Structure in the Solar Wind

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Abstract

Benson et al. (2015, this volume) selected 10 large magnetic storms, with associated Dst minimum values δ -100 nT, for which high-latitude topside ionospheric electron density profiles are available from topside-sounder satellites. For these 10 storms, we performed a superposition of Dst and interplanetary parameters B, v, Np, and Tp. We have found that two interplanetary parameters, namely B and v, are sufficient to reproduce Dst with correlation coefficient cc ~ 0.96 provided that the interplanetary parameter times are taken 0.15 days earlier than the associated Dst times. Thus we have found which part of the solar wind is responsible for each phase of the magnetic storm. This result is also verified for individual storms as well. The total duration of SRS (storm related structure in the solar wind) is 4 - 5 days which is the same as the associated Dst interval of the magnetic storm.

Plan

- **Introduction: Concept of Storm Related Structure**

- **Superposition of 10 events of Dst and Storm Related Structure**

- **Discussion and Summary**
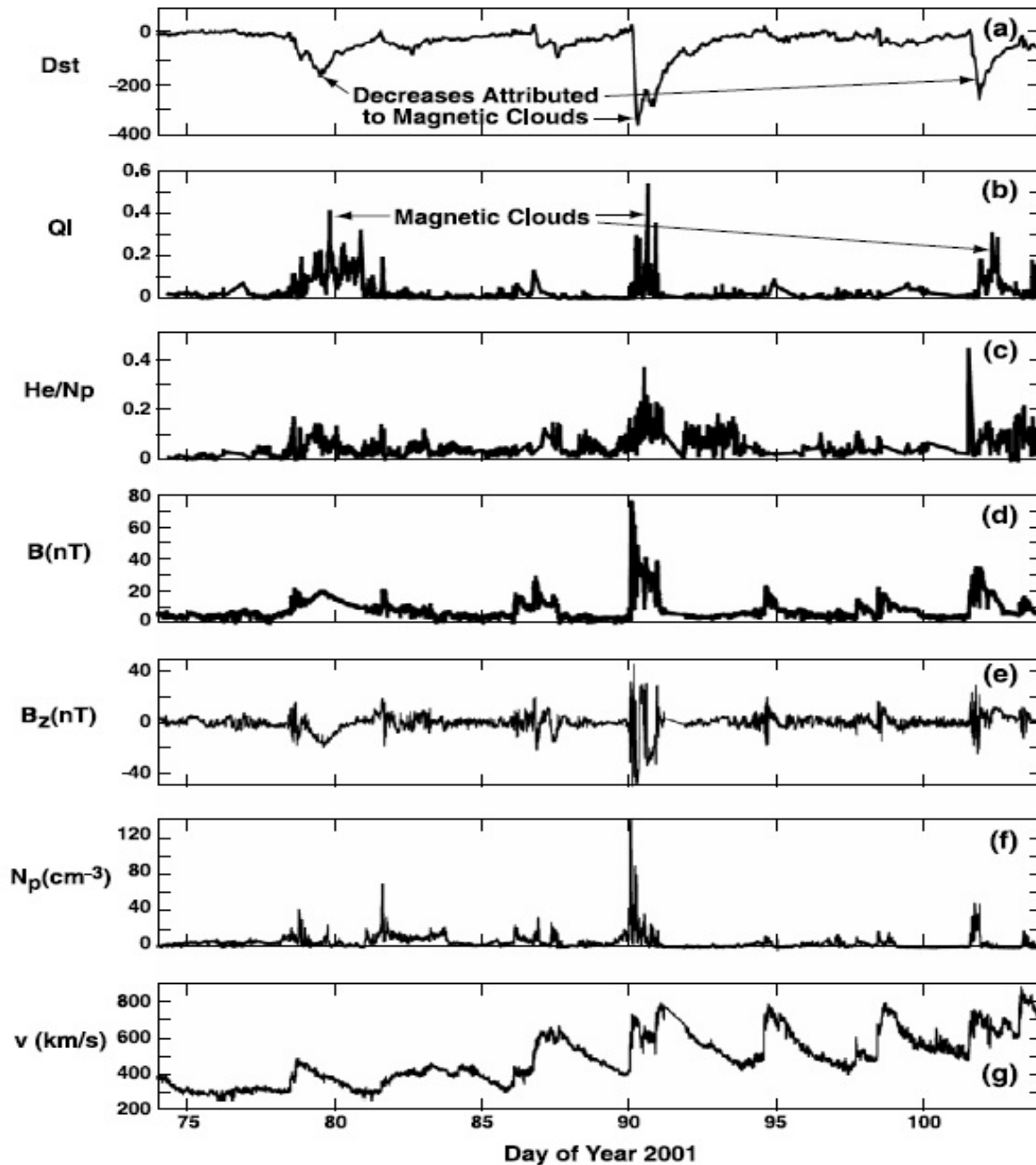
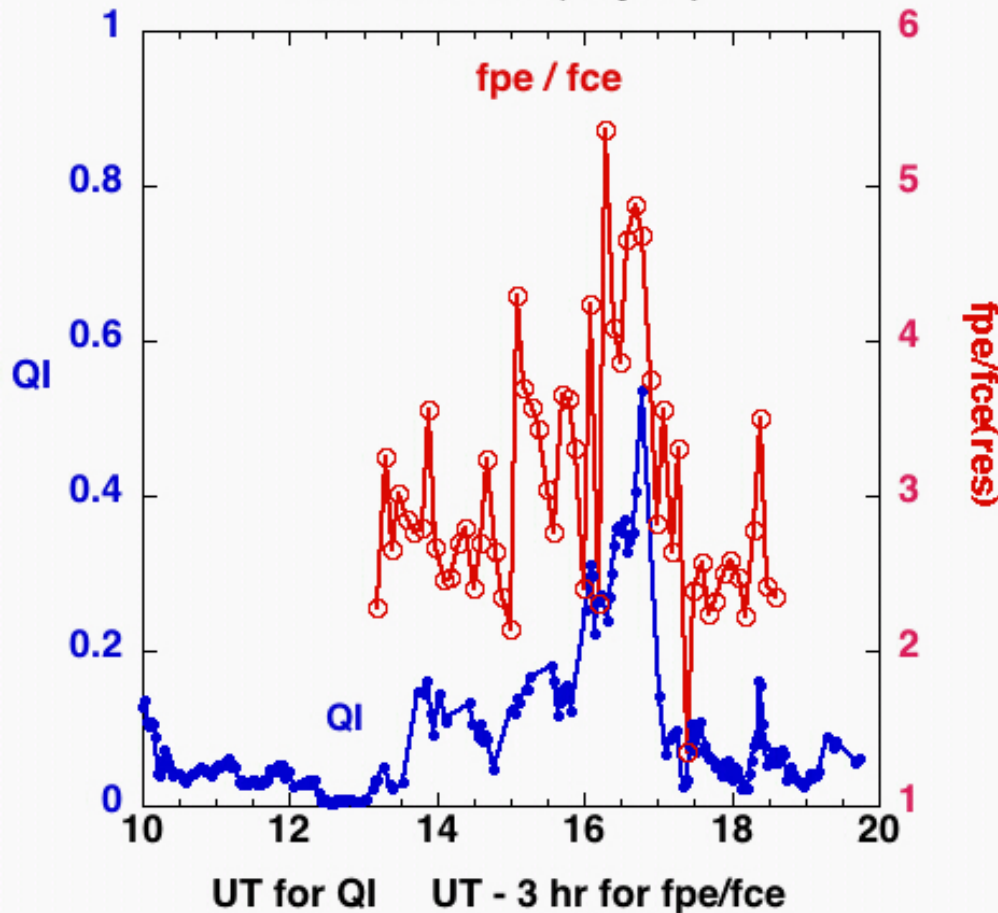$$QI \equiv (B^2/8\pi)/(\rho v^2/2)$$

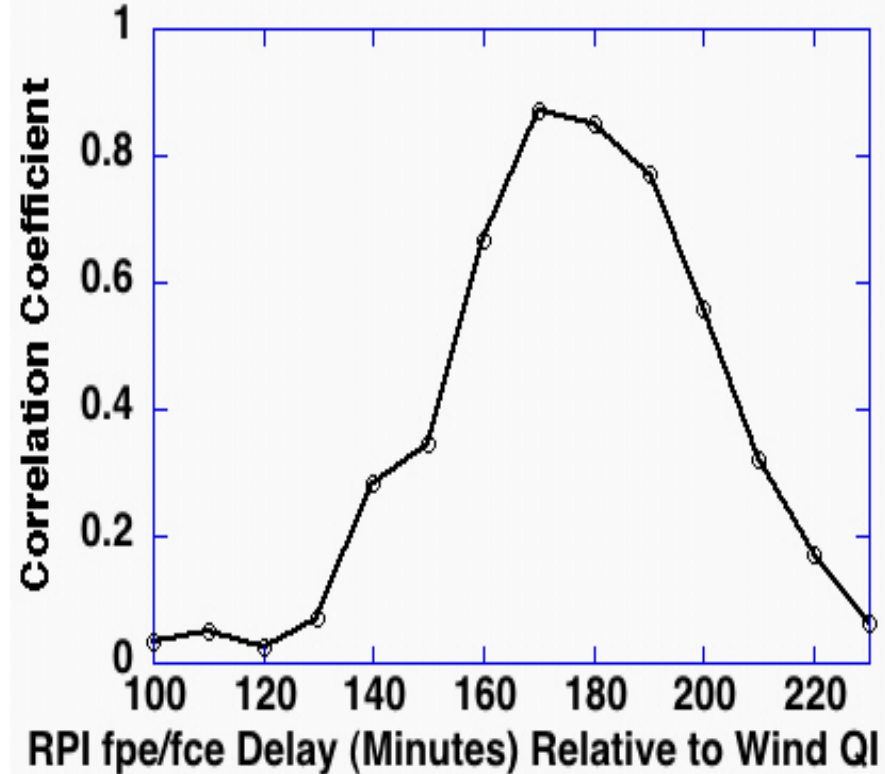**Osherovich, Fainberg, Stone, 1999**

V. A. Osherovich, et al., 2007

31 March 2001 solar-wind QI & magnetospheric fpe/fce
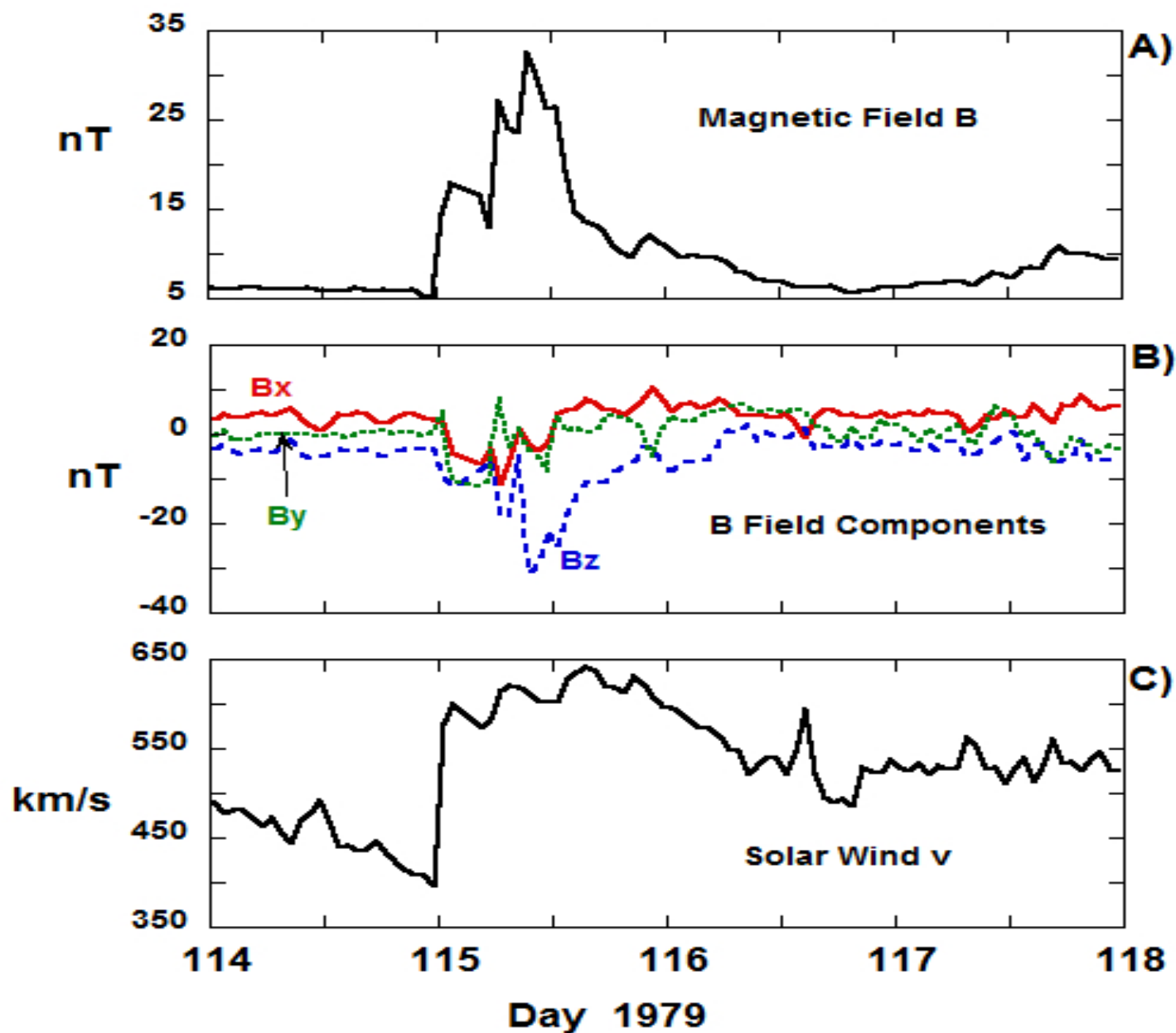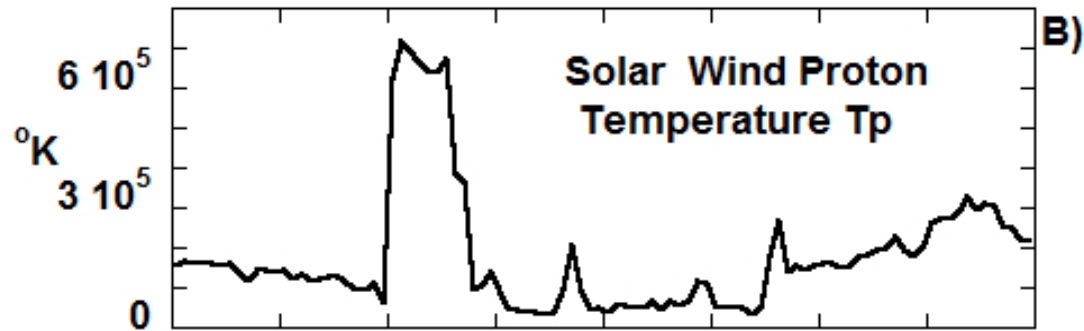
V. A. Osherovich, et al., 2007

**20-min averages
highly correlated near
3 hr time delay
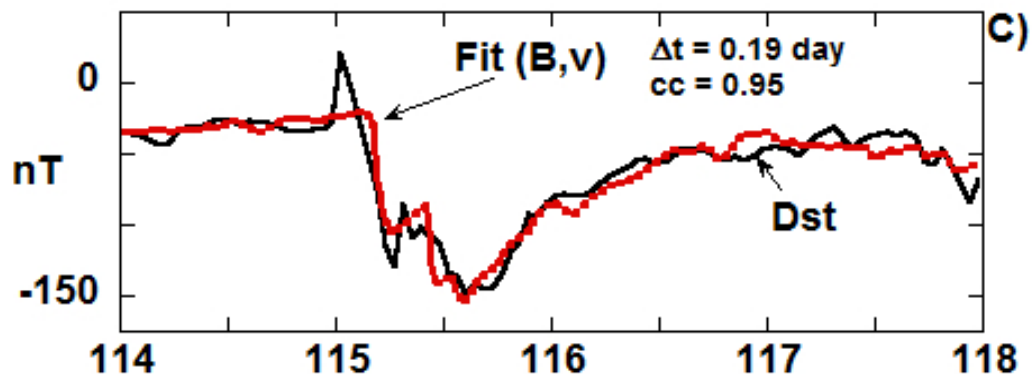(cc = 87% at 170 min delay**

31 March 2001 (Day 90)

Magnetic Cloud and Storm Related Structure

Dst for Magnetic Storm and Storm Related Structure

A) Solar Wind Proton Density Np

B) Solar Wind Proton Temperature Tp

C) Fit (B,v) $\Delta t = 0.19$ day   cc = 0.95   Dst

Day 1979
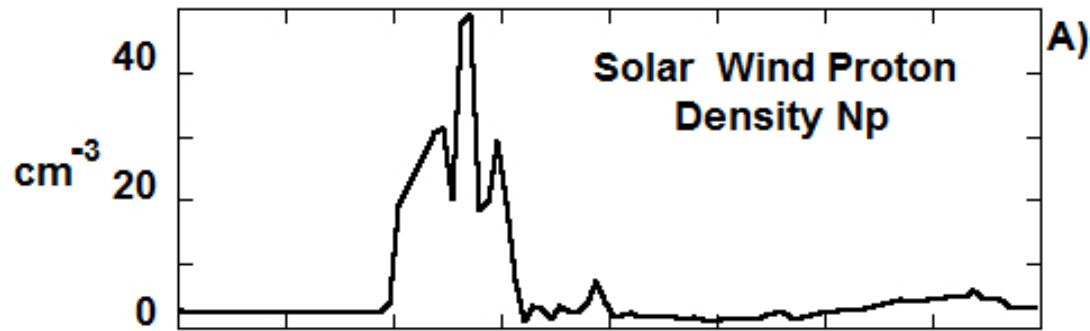
$$Dst(t) = -m1\ B^{m2}(t-\Delta t)\ v^{m3}(t-\Delta t)$$

Superposition of 10 Magnetic Storms with Solar Wind Proxy

A)
Dst Superposition
Fit (B,v)
Δt = 0.15 day
cc = 0.96

B)
B Superposition

C)
v Superposition
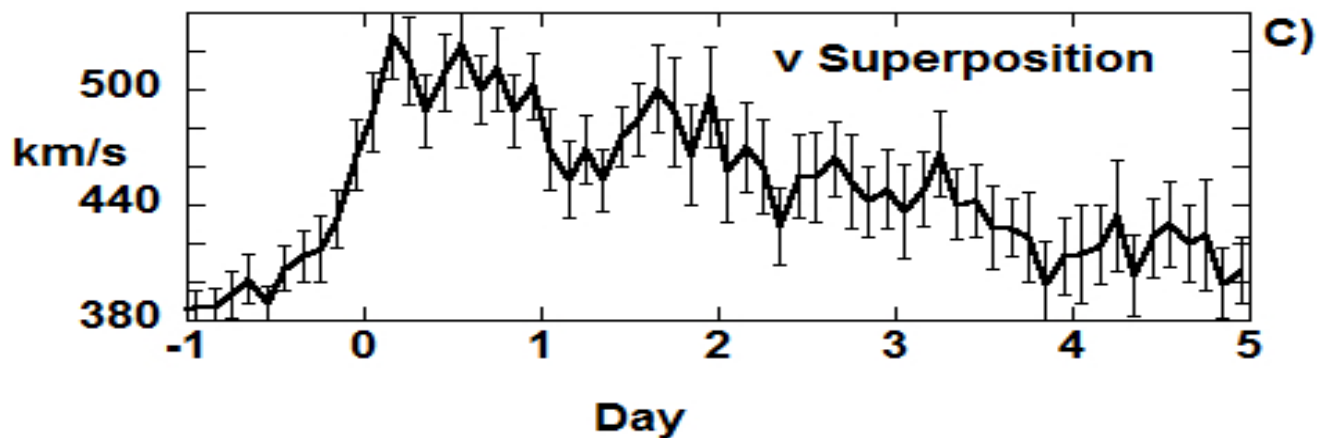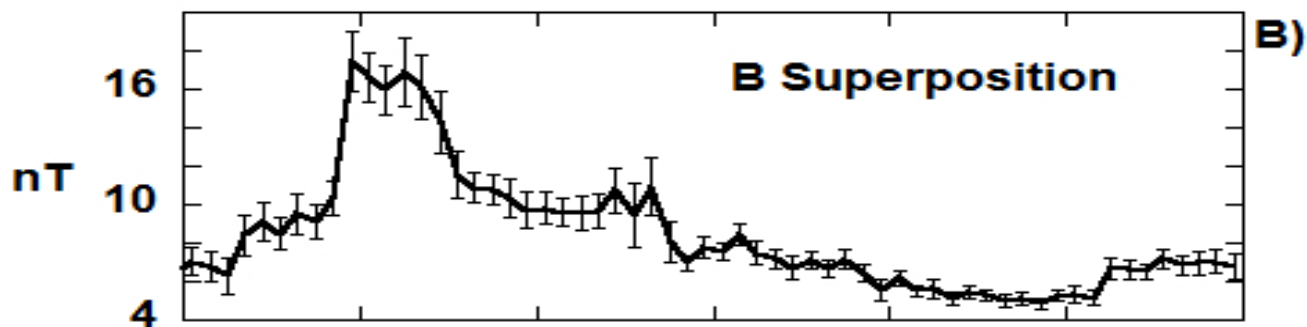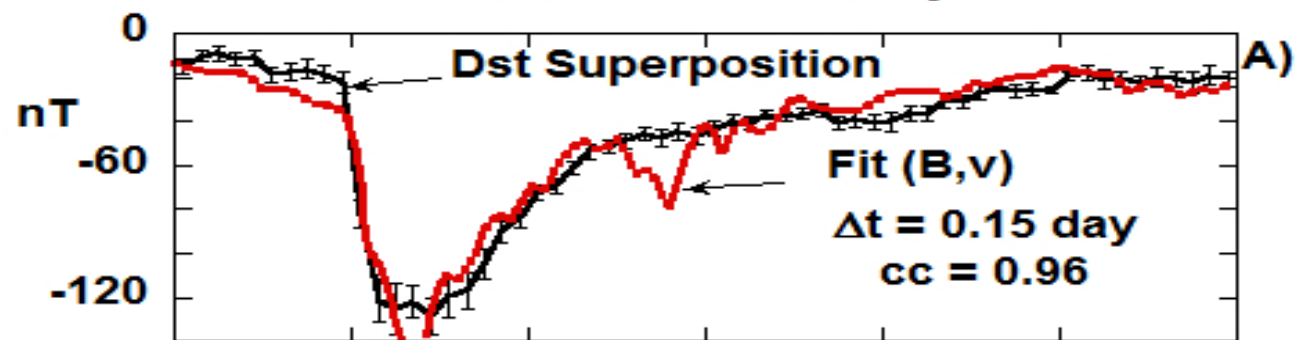
Discussion and Summary

For large magnetic storms (Dst ≤ -100 nT) we have found a solar wind proxy for Dst which depends only on B and v in the solar wind. The dependence on v is stronger than on B. This proxy reproduces the Dst for the magnetic storm of 1979 day 115 with a correlation coefficient cc = 0.95 and with a time delay of Δt = 0.19 days. When applied to a superposition of 10 magnetic storms, cc = 0.96 and Δt = 0.15 days. This time delay between the magnetic storm and storm related structure is comparable but slightly larger than the time delay Δt = 3 hours between the solar wind quasi-invariant and fpe/fce in the polar magnetosphere (Osherovich et al. 2007). Our proxy provides a one to one correspondence between different phases of the magnetic storm with parts of the solar wind that are responsible for related changes of the Dst index.

Acknowledgements