

# Role of Solar Wind Tangential Discontinuity Inclination on Earth's Dayside Magnetosphere Dynamics: A Global MHD study using OpenGGCM

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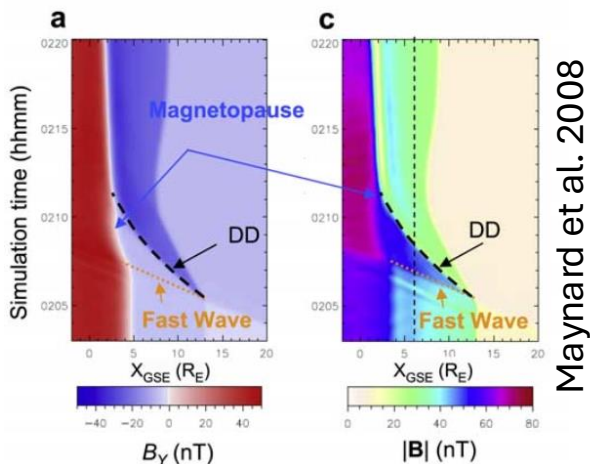
5<sup>th</sup> May 2026

Boulder, CO

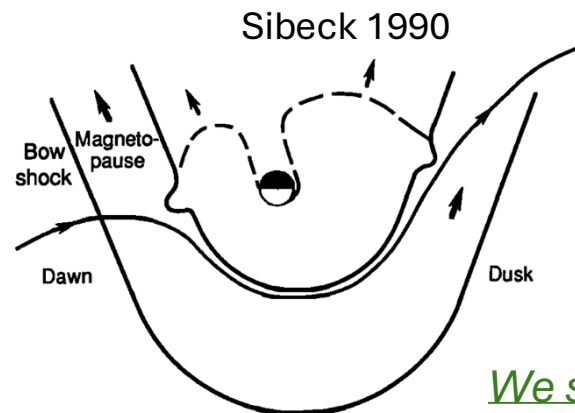


Discontinuity Type	Mass Flow (G)	Magnetic Fields ( $B_n, B_t$ )	Bulk Velocity (U)	Mass density ( $\rho$ )	Pressure (p)
Contact (CD)	$G = 0$	$B_n \neq 0;$ $[B_t] = 0$	$[U] = 0$	$[\rho] \neq 0$	$[p] = 0$
Tangential (TD)	$G = 0$	$B_n = 0;$ $[B_t] \neq 0$	$[U_t] \neq 0$	$[\rho] \neq 0$	$[p + \frac{B_t^2}{2\mu_0}] = 0$
Rotational (RD)	$G \neq 0$	$B_n \neq 0$	$[U_t] \neq 0$	$[\rho] = 0$	$[p] = 0$
Shocks	$G \neq 0$	$B_n \neq 0$	$[U_t] \neq 0$	$[\rho] \neq 0$	$[p] \neq 0$

**Tangential discontinuities (TDs)**, also rotational discontinuities, are abundant in the solar wind, occurrence rate at least once per hour. TDs with density variations can be attributed to dynamic pressure variations.



Maynard et al. 2008

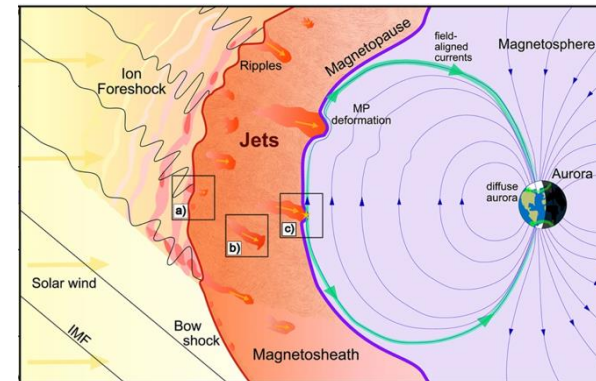


Sibeck 1990

TD and MP interaction when  $P_{dym}$  increases - MP bulges

Density enhanced TD and BS interaction - 7 possible new waves/discontinuities

Kramer et al. 2025

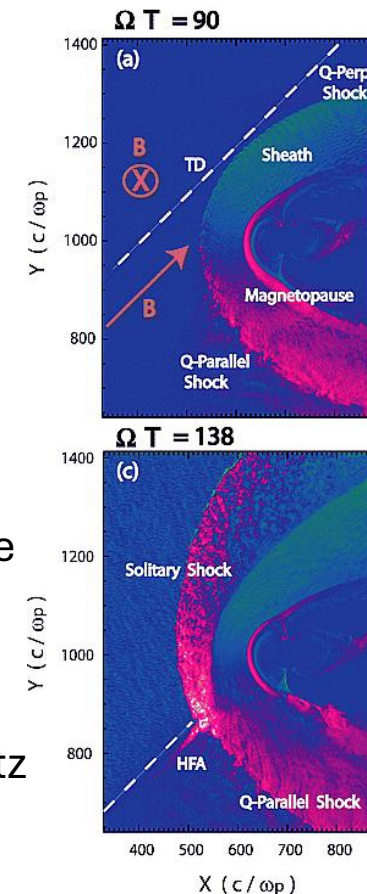


Downstream magnetospheric effects

Fast-mode disturbances / pressure pulses in MSH, ULF waves, Pc waves, Whistler waves, Foreshock transients, hot flow anomalies (HFAs), MSH jets / Kelvin-Helmholtz waves (via velocity shear)

*We studied complete evolution of TD and TD-driven disturbances from BS-MSH-MP system using global MHD model, OpenGGCM*

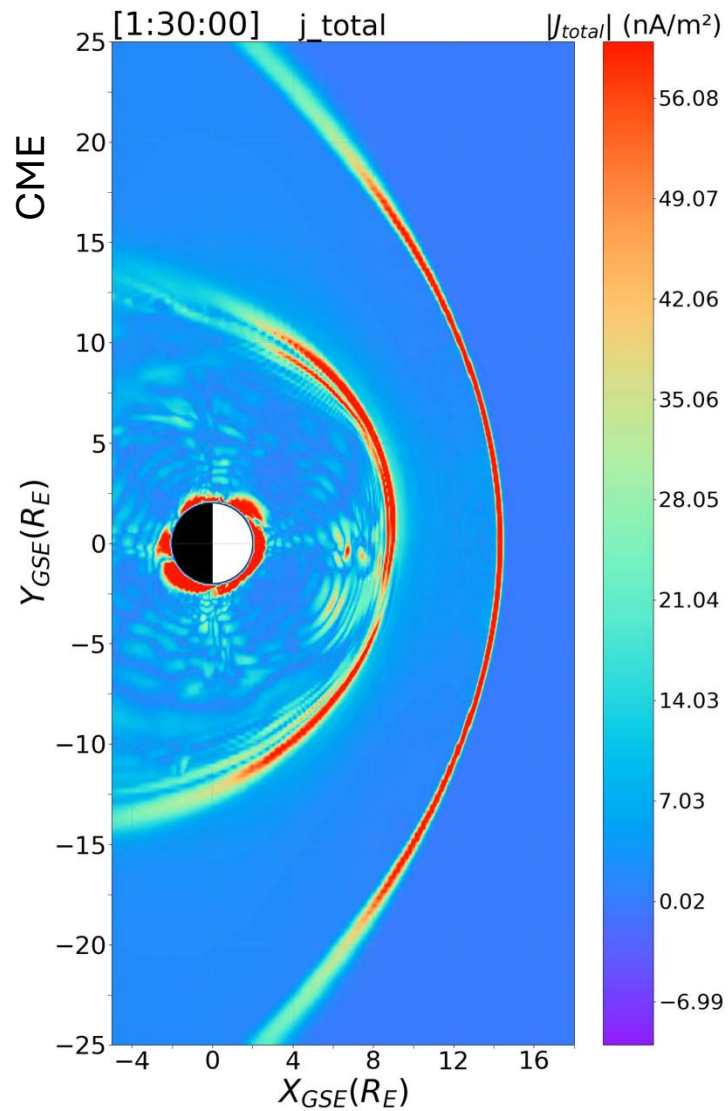
Omidi & Sibeck 2007



Case Studies with varying inclination in the ecliptical plane (strictly northward IMF  $B_z = 15\text{nT}$ , Density jumps from 6 to 30/cc,  $V_x = -450\text{ km/s}$ )

**CASE I: Frontal ( $\theta_{xn} = 0^\circ$ )**

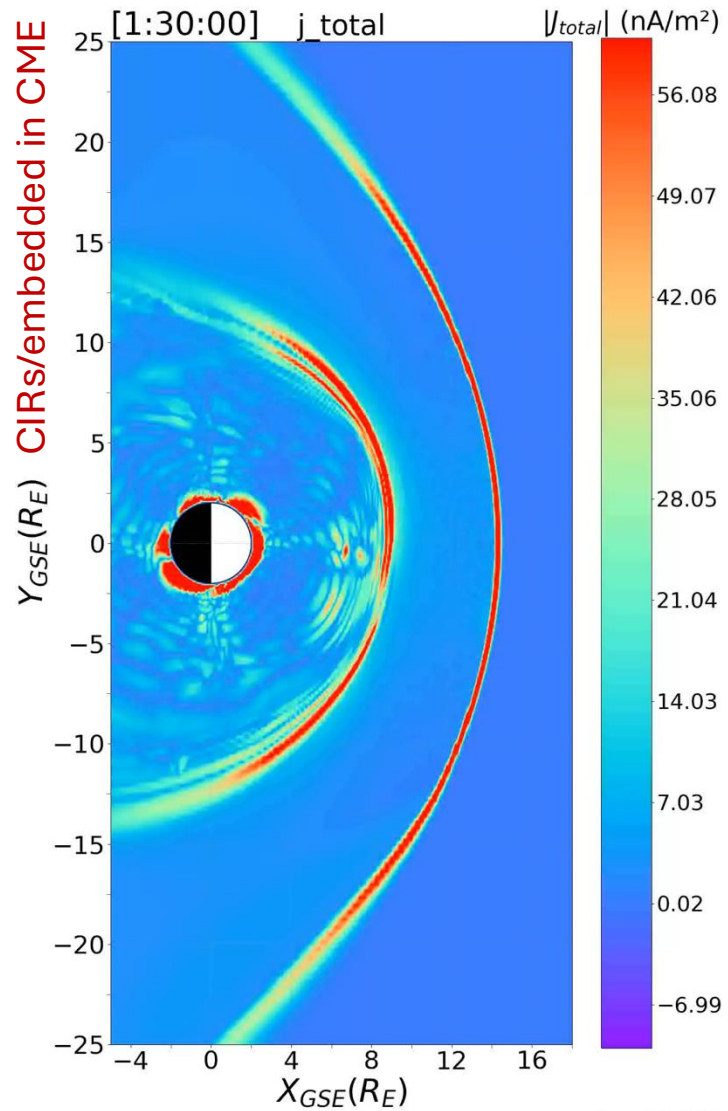
First contact: Subsolar BS  
 Generation of fast forward shock,  
 reflected waves, transmitted waves



Nearly symmetric dawn-dusk response

**CASE II: Moderately Inclined ( $\theta_{xn} = 45^\circ$ )**

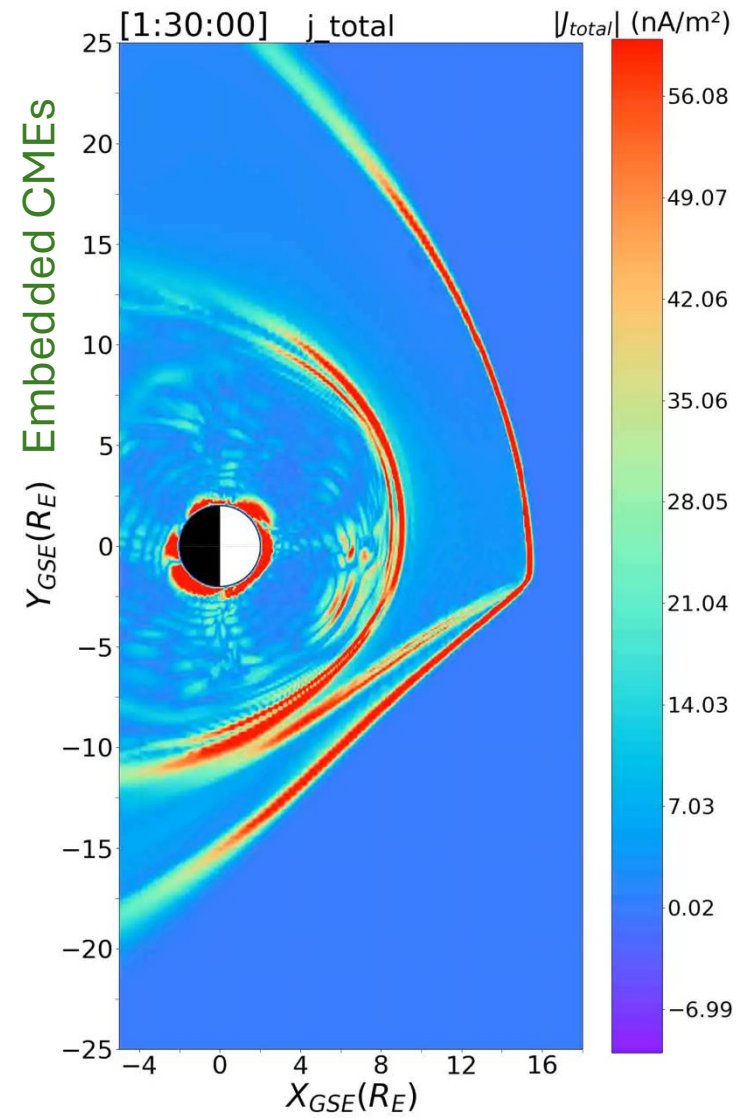
First Contact: Prenoon BS  
 Generation of waves along with huge  
 wave-like magnetopause deformation



Asymmetric dawn-dusk response

**CASE III: Highly Inclined ( $\theta_{xn} = 80^\circ$ )**

First Contact : Dawn Flank  
 No new wave is generated, large vortex-  
 like MP deformation



Highly asymmetric dawn-dusk response