

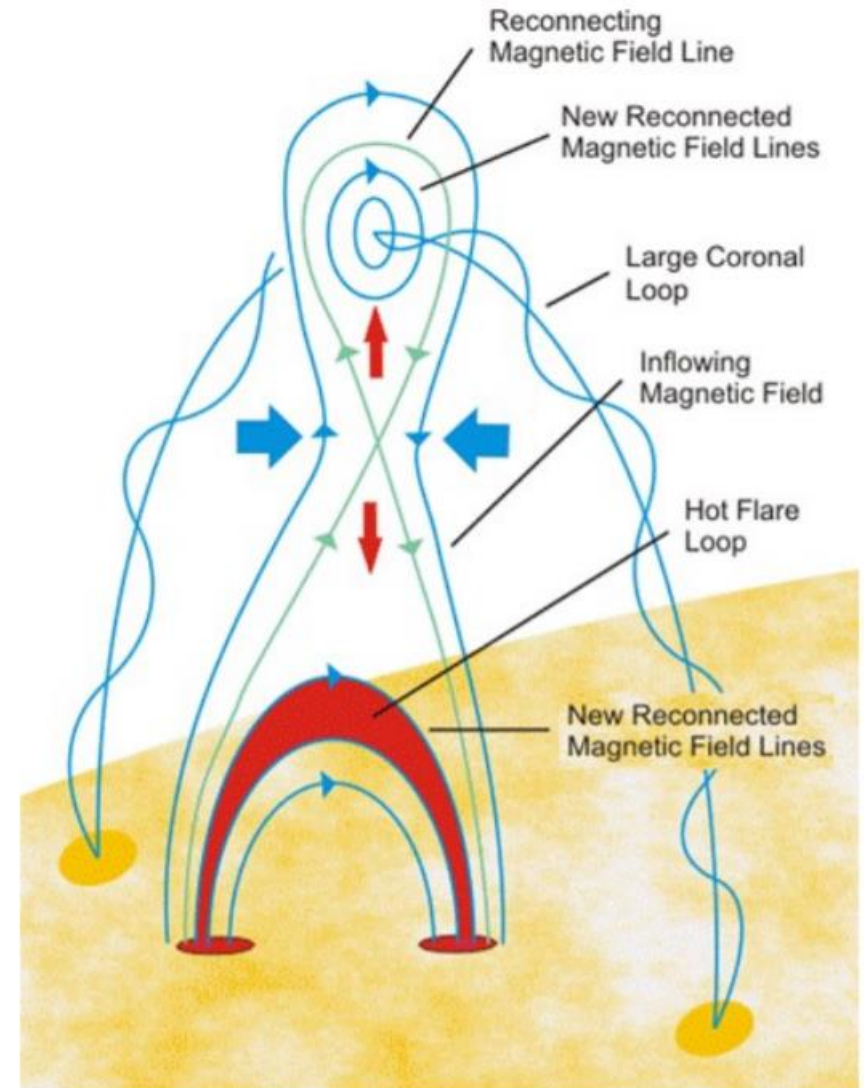
## The Role of Magnetic Reconnection in the Late-Phase Acceleration and Expansion of the 2013 February 27 CME

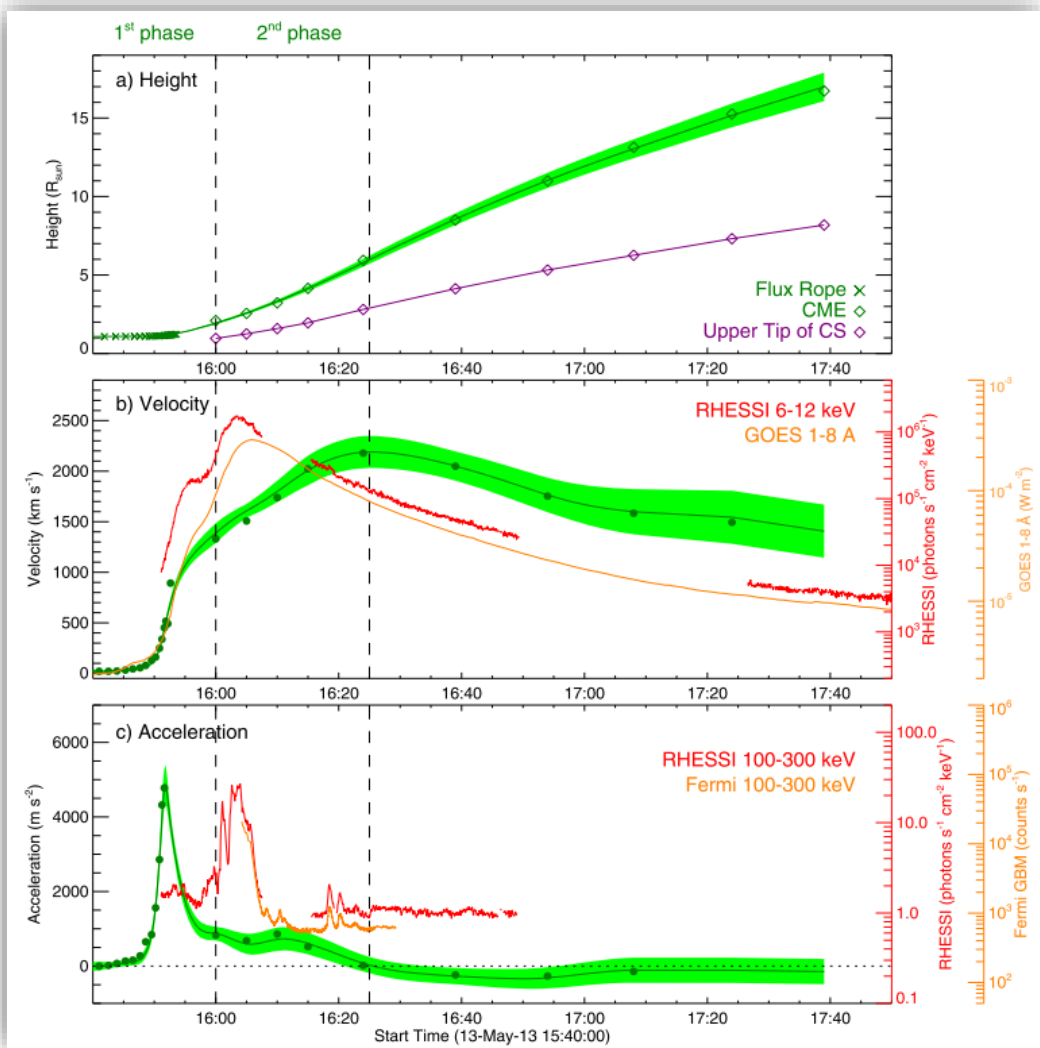
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Tingyu Gou<sup>[3]</sup>, and Nada Al-Haddad<sup>[1]</sup>

[1] University of New Hampshire, Durham, NH

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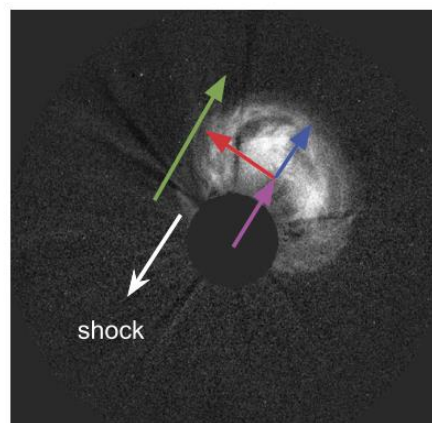
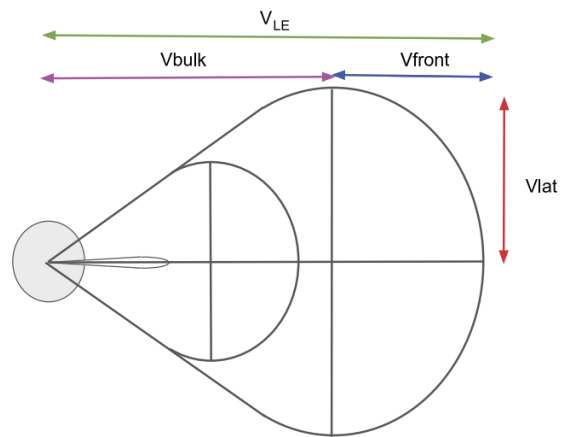
[3] University of Science and Technology of China



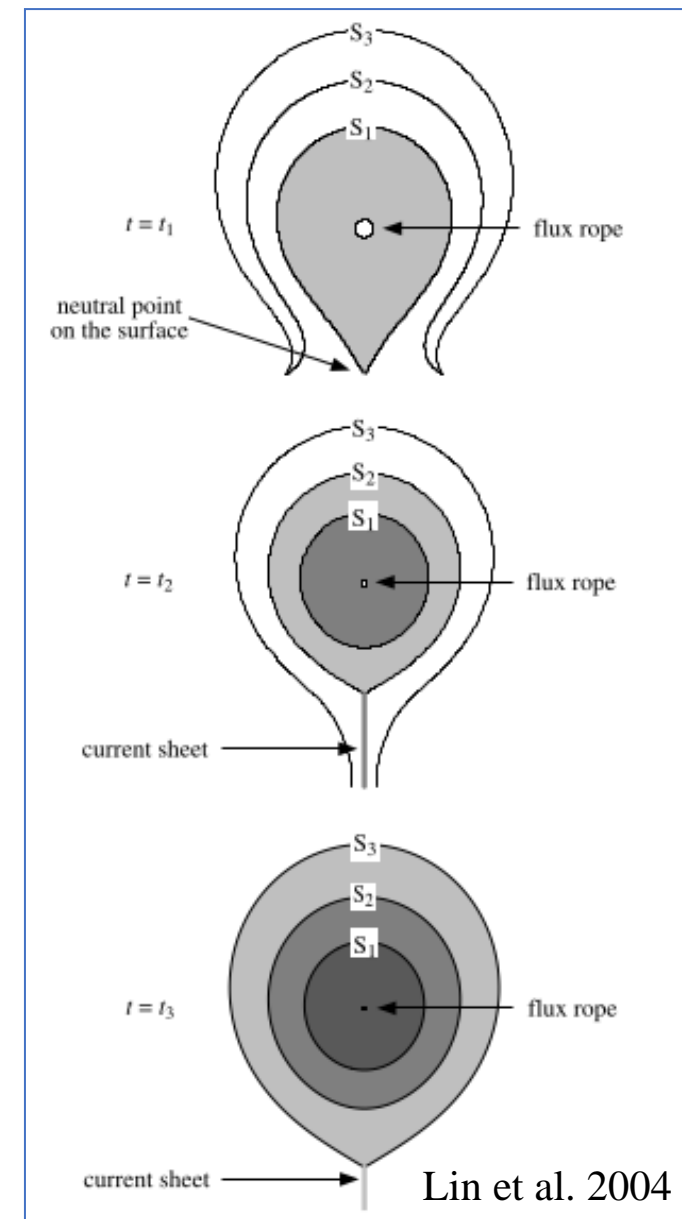


Gou et al. 2020

CME Expansion:  
 $V_{LE} = V_{bulk} + V_{exp}$   
 $a_{LE} = a_{bulk} + a_{exp}$

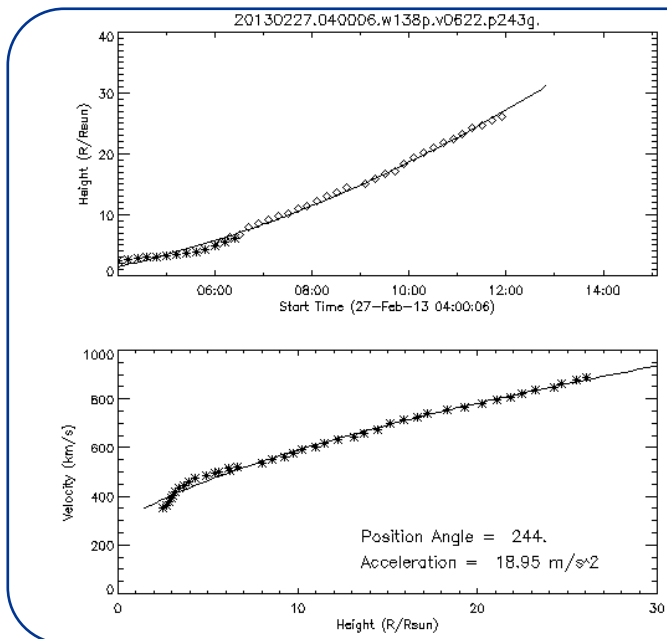
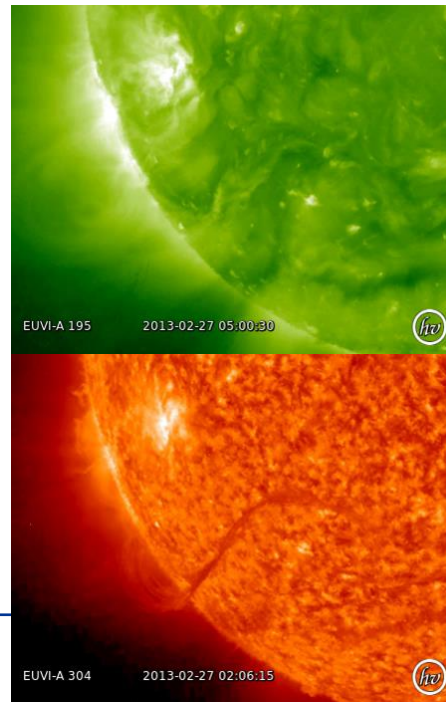
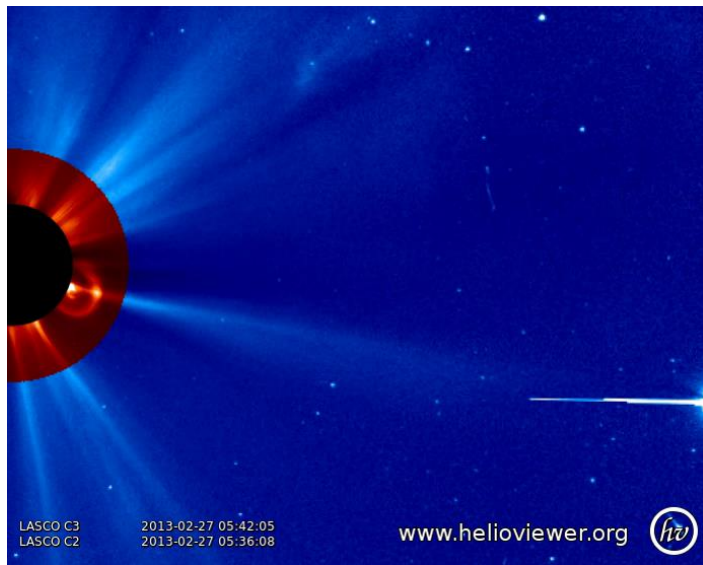


Balmaceda et al. 2020

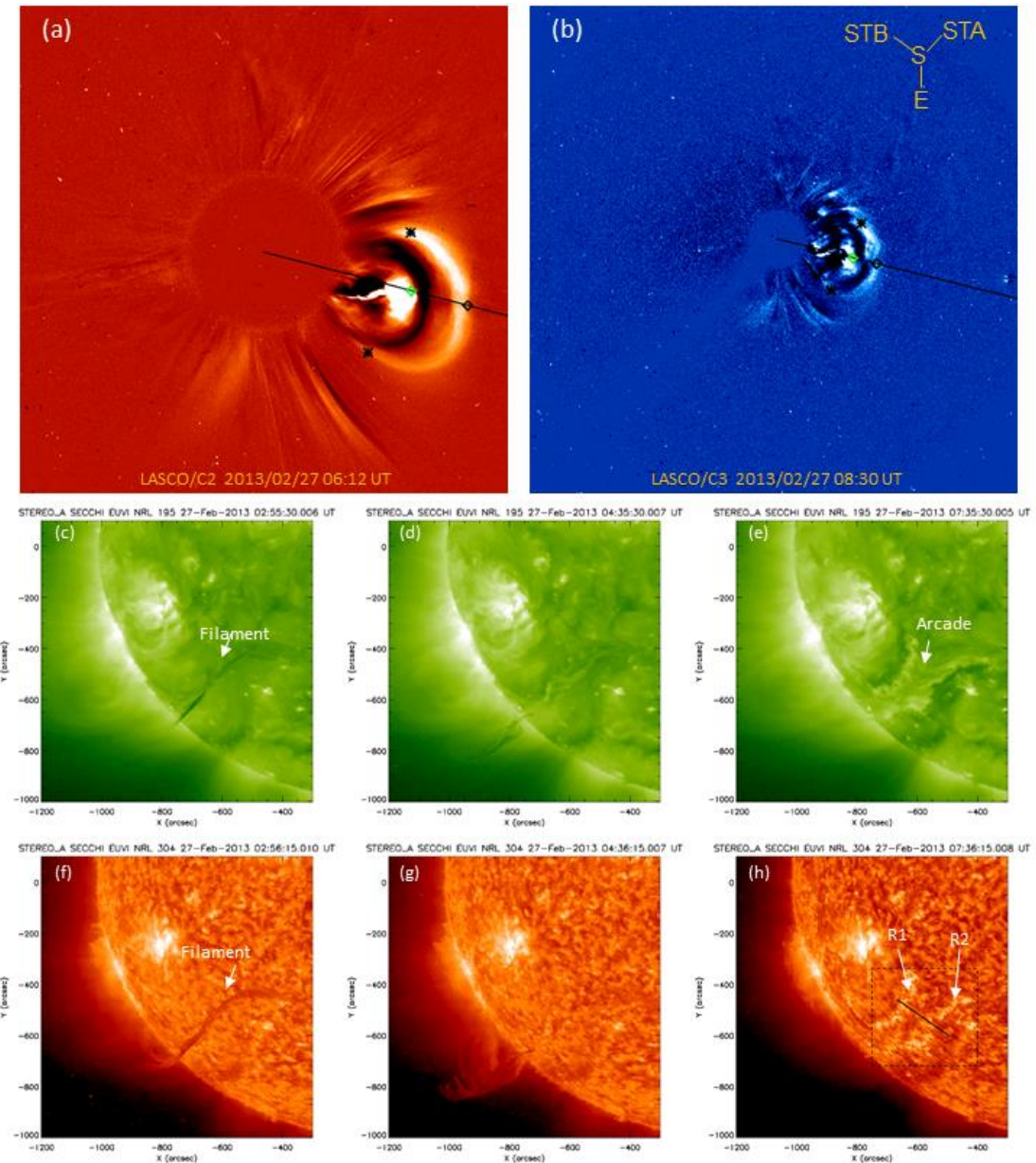


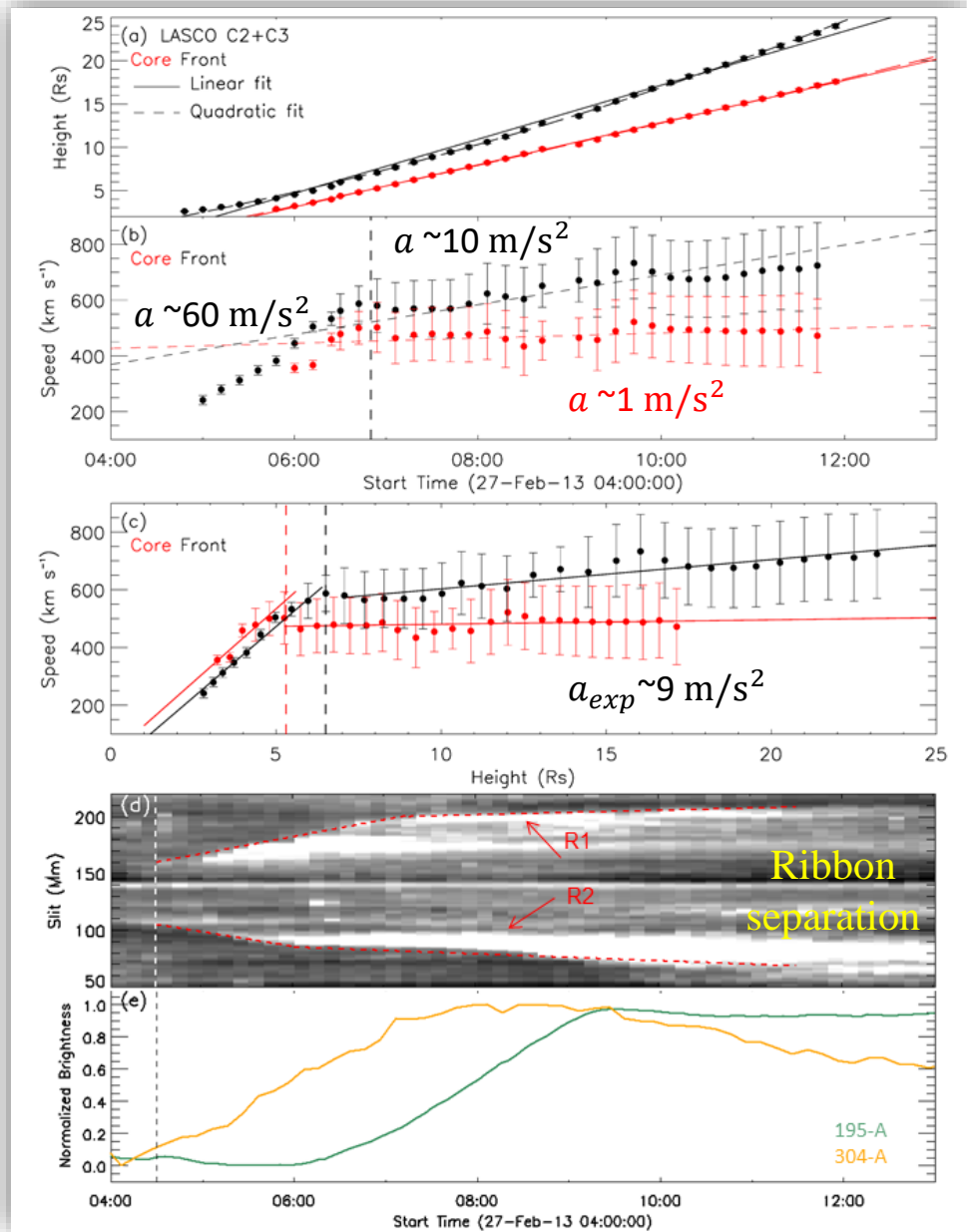
Lin et al. 2004

# Continuous Acceleration of Moderately Fast CME

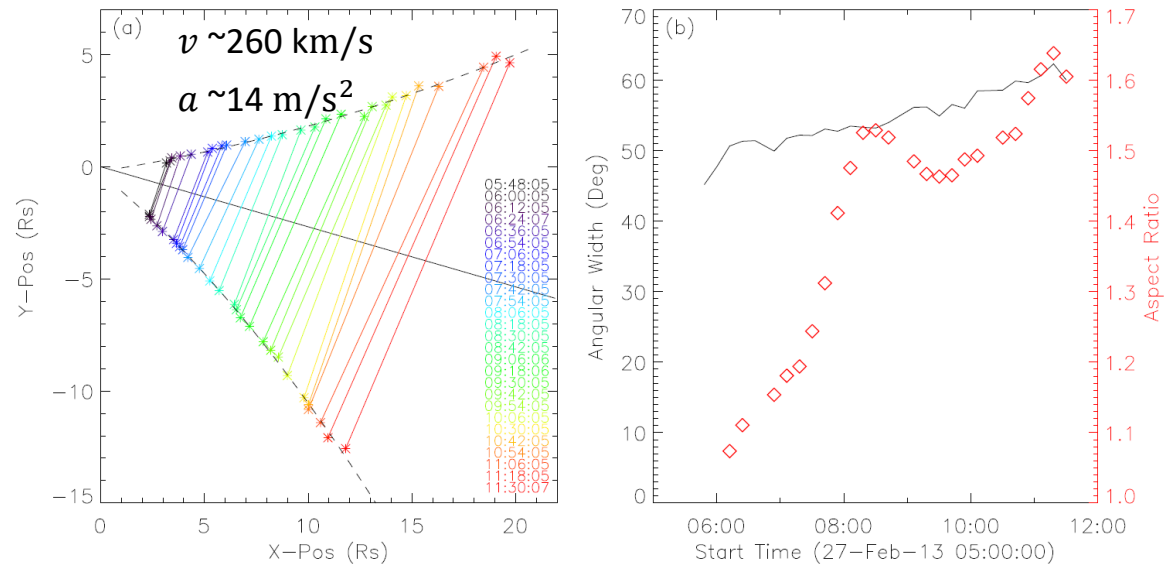


From CDAW catalog: a moderately fast CME (with speed larger than the solar wind speed) has positive and continuous acceleration in the high corona.

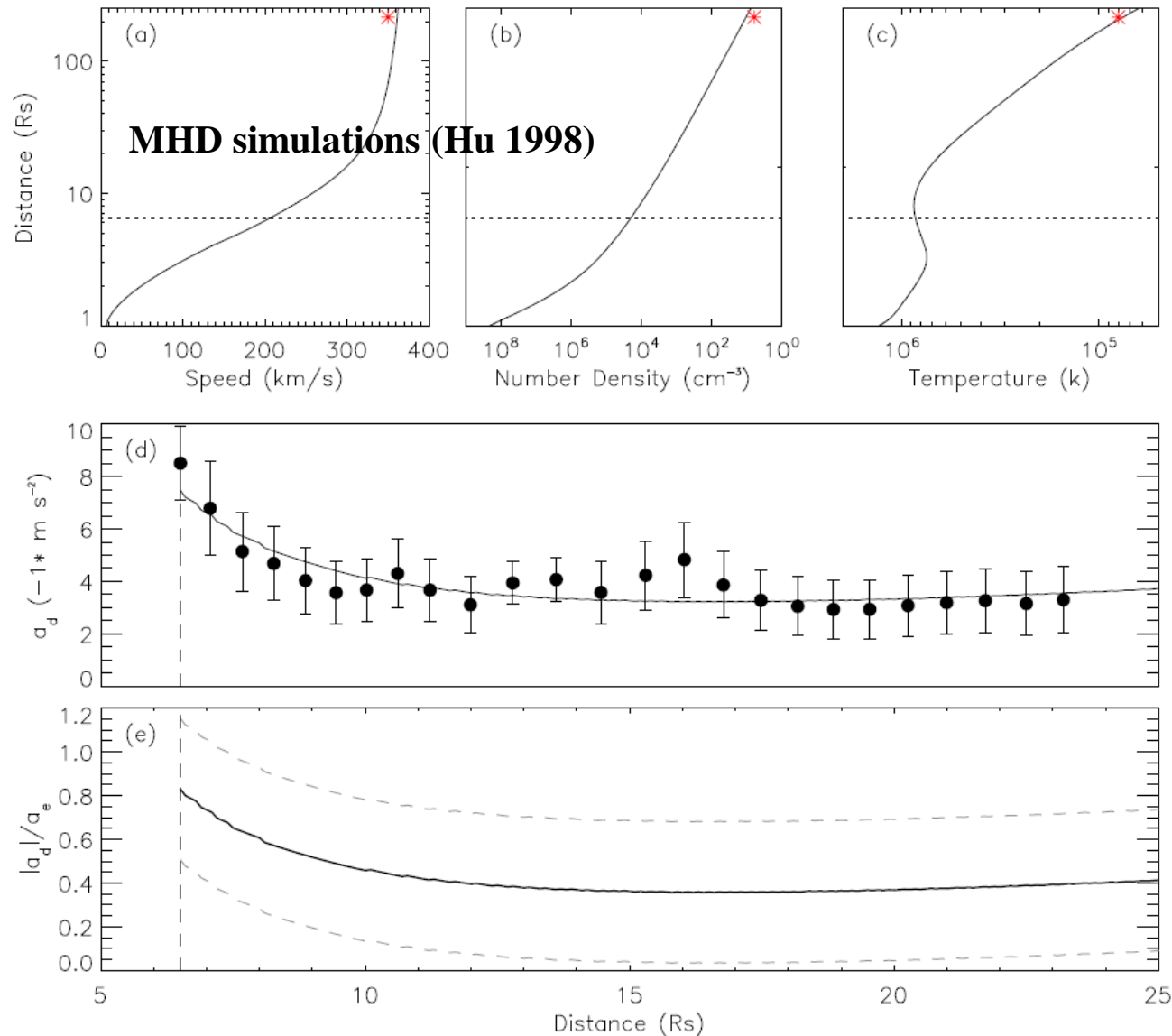




- Two acceleration phases: (1) impulsive (initiation,  $\sim 60 \text{ m/s}^2$ ) + gradual (late-phase,  $\sim 10 \text{ m/s}^2$ ).
- CME is moderately fast, with speed  $\sim 600$  to  $700 \text{ km/s}$ , and faster than the solar wind ( $\sim 300 \text{ km/s}$ ).
- Acceleration in the late-phase lasts for a long time in the high corona (e.g., 10-25  $R_s$ ), leading to an increase of  $\sim 170 \text{ km/s}$  in speed.
- Apparent acceleration of the front may be due to (additional) expansion.
- Signatures of long-lasting magnetic reconnection.
- Additional expansion in lateral direction is comparable to that in radial direction.



CME expansion in lateral direction



Assume the deceleration caused by the solar wind drag force is compensated by the acceleration due to magnetic reconnection.

$$a_{drag} = \frac{F_{drag}}{m_{CME}} = -\frac{C_D A_{CME} n m_p}{2m_{CME}} (V_{CME} - V_{SW}) |V_{CME} - V_{SW}|$$

*Magnetic reconnection not only leads to apparent acceleration (expansion) but also compensates the deceleration due to the solar wind drag. The contribution of magnetic reconnection to CME expansion is comparable to or even larger than that to CME acceleration (in the high corona).*

To be discussed:

- Acceleration of fast CME.
- Structure of the CME bright core (Gibson et al. 2006; Howard et al. 2017; Veronig et al. 2018).
- Reconnection contribution to expansion and acceleration in the low solar corona.
- How does reconnection influence CME dynamics when CME is at large distance (e.g., rate)?

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