

# Solar Wind Acceleration Driven by Velocity-Space Diffusion and the Ambipolar Electric Potential

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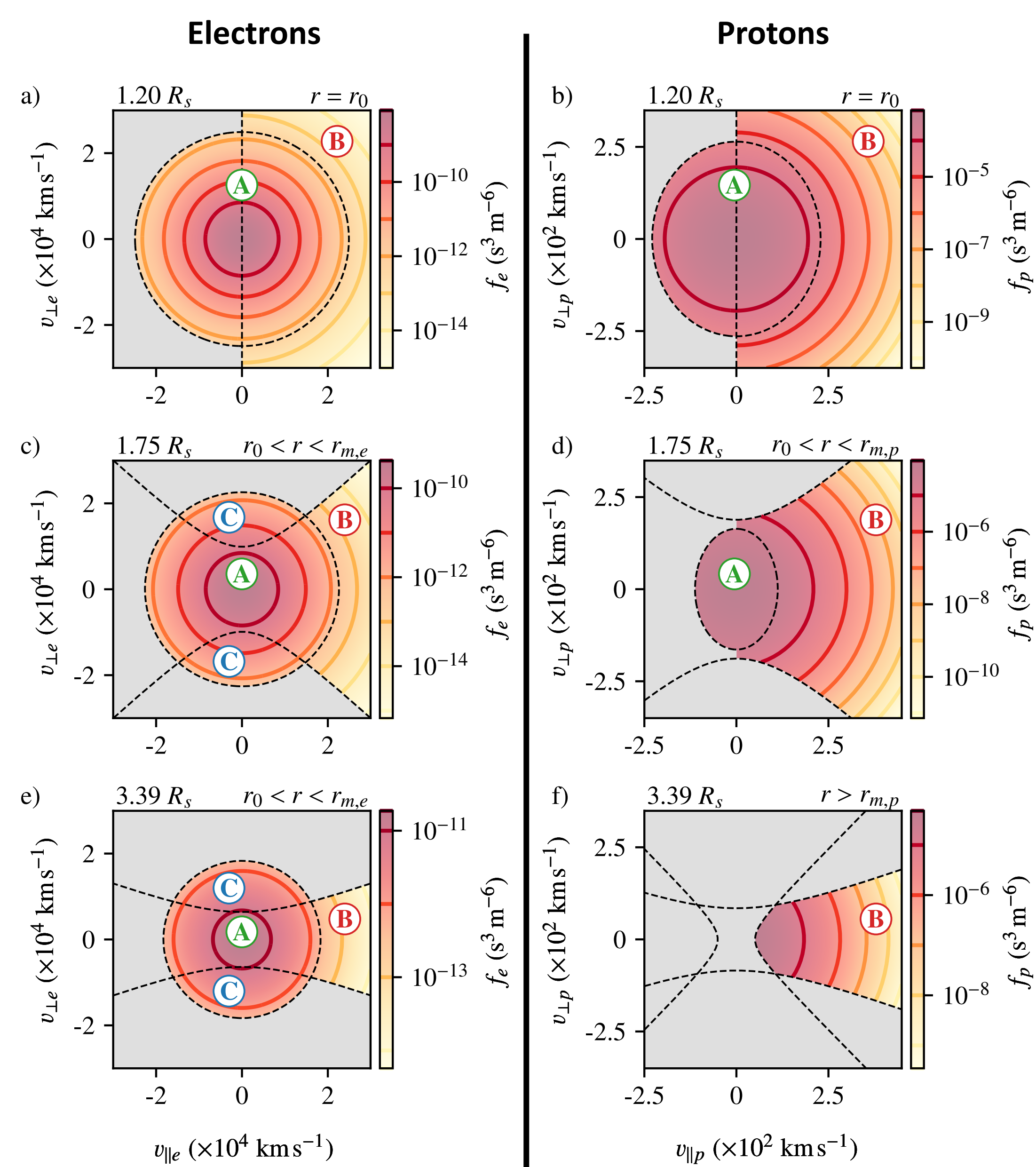
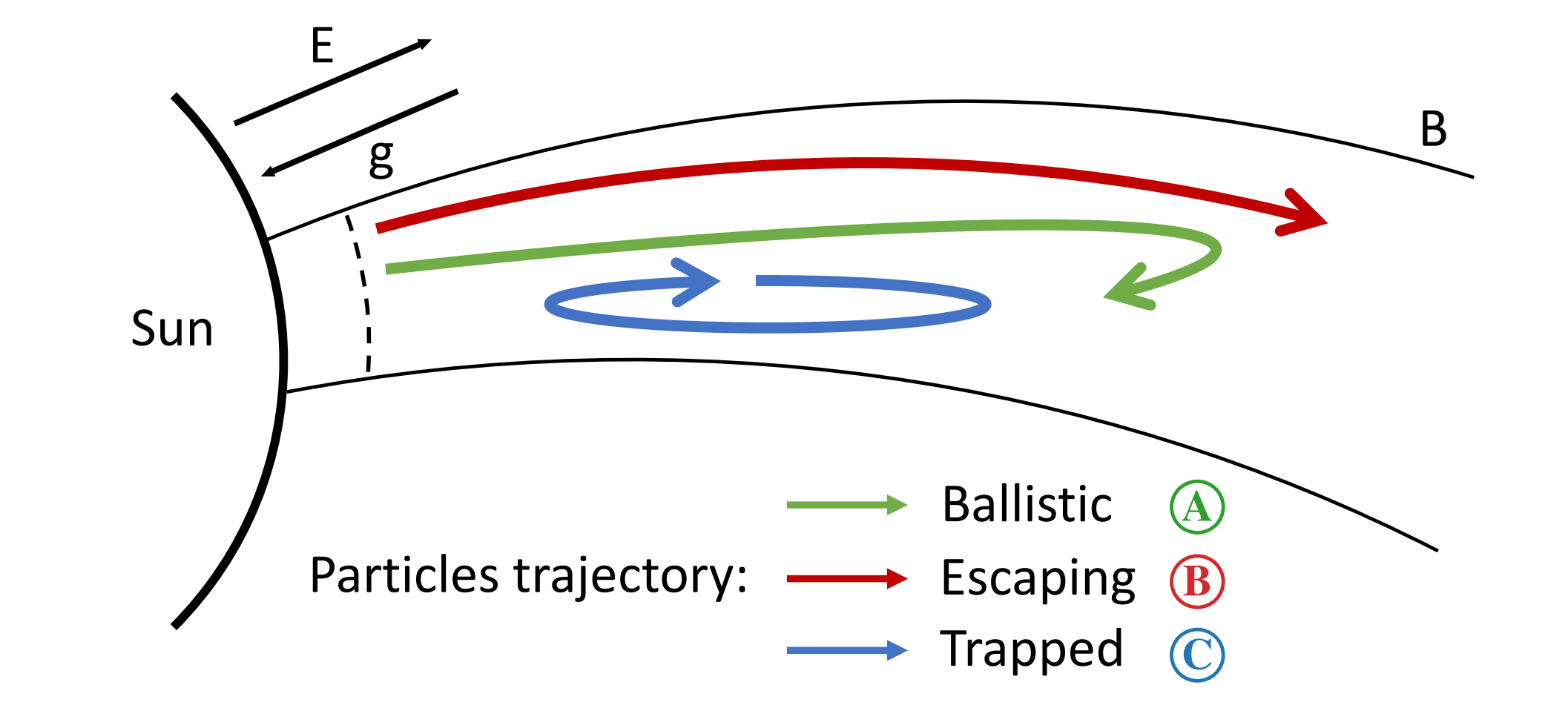
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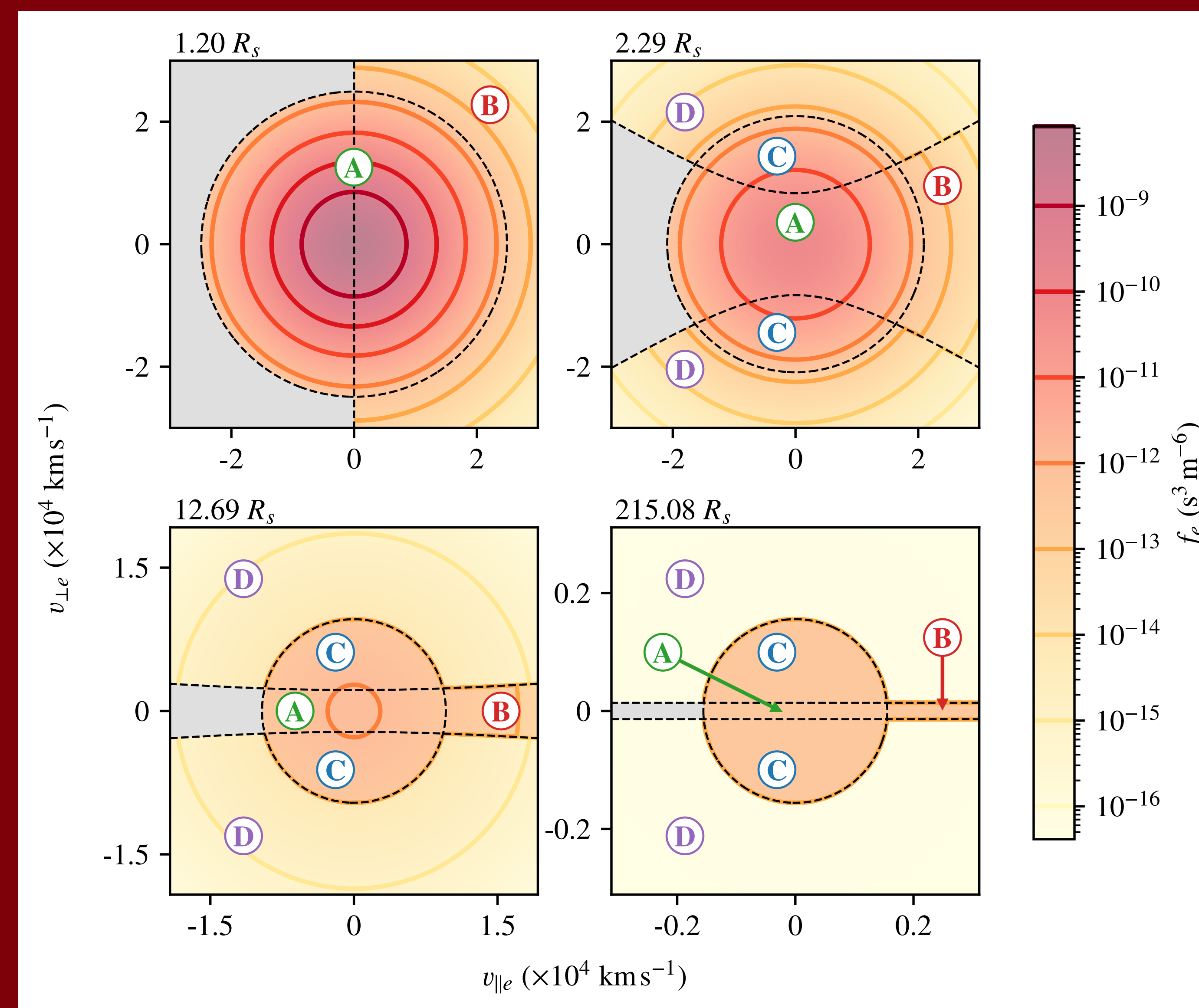


**BACKGROUND:** The solar wind, the continuous outflow of material from the solar surface, is mainly composed of protons and electrons that are accelerated throughout the heliosphere up to a few hundred km/s. Parker Solar Probe (PSP) observations have revealed that most of the solar wind acceleration occurs very close to the Sun. This acceleration is partly due to the global electric potential originating from the mass disparity between electrons and protons, coupled with the constraints of charge quasi-neutrality and zero-current conditions in the solar wind plasma. However, the exact mechanism that accounts for the remaining acceleration has not yet been identified.

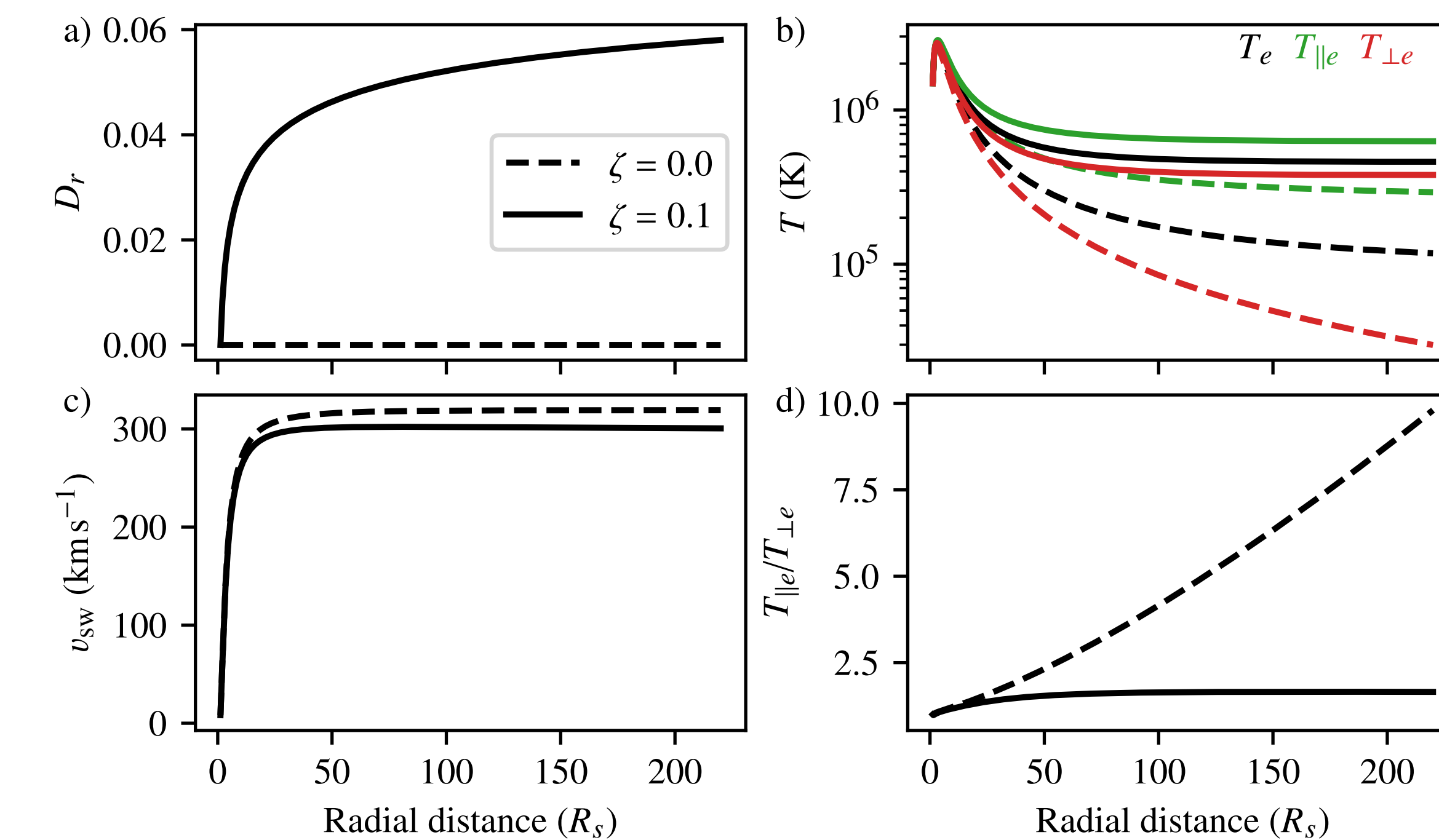
## MODEL PRINCIPLE



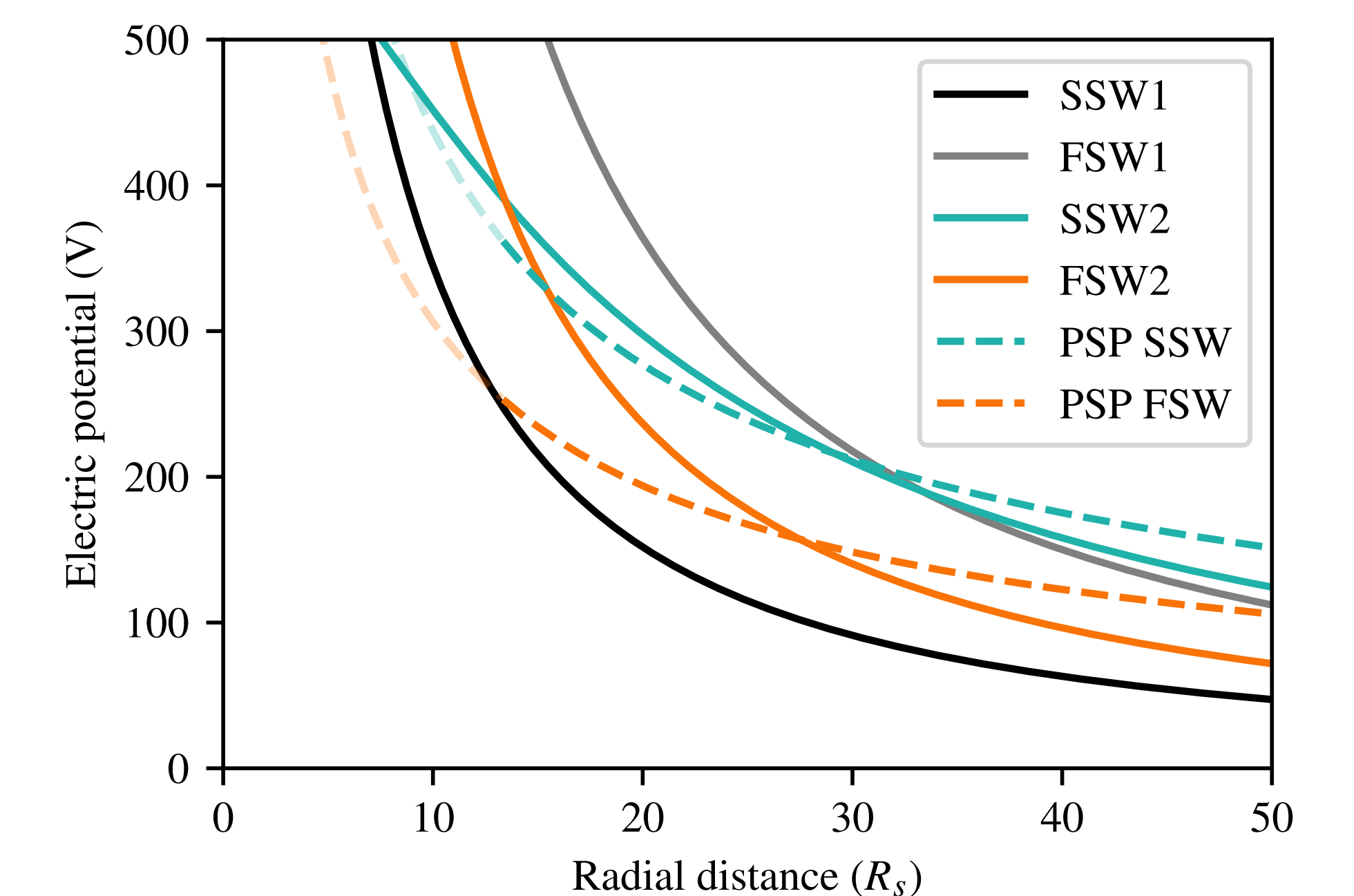
The interplay between electron diffusion and the ambipolar electric potential could explain the solar wind acceleration.



## RESULTS



## DISCUSSION



Parameter name	Notation	SSW1	FSW1	SSW2	FSW2	Unit
Exobase level	$r_0$	1.2	1.2	7	1.01	$R_s$
Electron temperature at exobase	$T_{0e}$	1.5	1.5	1	1	MK
Proton temperature at exobase	$T_{0p}$	1.2	1.2	0.8	2	MK
Kappa	$\kappa$	6	3	6	3	/

## CONCLUSIONS

- Velocity-space diffusion of electrons effectively reduces the temperature anisotropy to values comparable to those of the observed fast solar wind (FSW) at 1 AU.
- This diffusion enables us to adjust the solar wind acceleration without modifying the self-consistent ambipolar electric potential found by the kinetic exospheric model.
- The observed anticorrelation between wind speed and terminal velocity can be reproduced using the kinetic exospheric model with realistic temperatures and exobase levels. This suggests that further analysis of PSP data is necessary to either confirm or rule out the electric potential as the primary acceleration mechanism for the FSW.
- If no indication of the presence of a crossing point between the deduced electric potentials of the FSW and SSW (slow solar wind) is found within PSP data, an alternative mechanism — likely a velocity-space diffusion of particles via wave-particle interactions — must dominate the FSW acceleration by increasing the flux in the anti-sunward direction.



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