SA-P1 AAPPS-DPP2020

Possible Generation Mechanism for Alfvenic Velocity Spikes and Magnetic Field Switchbacks as Observed by PSP

Jiansen HE(1); Die DUAN(1); Xingyu ZHU(1); Liping YANG(2); Chuanpeng HOU(1); Lei ZHANG(2); Ying WANG(1)

(1) School of Earth and Space Sciences, Peking University, Beijing, 100871, China,
(2) State Key Laboratory of Space Weather, National Space Science Center, Chinese Academy of Sciences, Beijing 100190, China

According to Parker's theory in the 1950s, the magnetic lines of force extending from the sun to the interplanetary appear to be Archimedean spirals. From 1960 to 1970, it was found that the interplanetary magnetic field not only follows the Archimedes spiral structure, but also has the characteristics of Alfvenic turbulence. How do these Alfvenic turbulence occur? What will be the characteristics when getting close the Sun? Parker Solar Probe at 0.17au has found that there are often intermittent Alfvenic pulses (or called Alfvenic velocity spikes) in the solar wind. These pulses are high enough that the disturbed magnetic lines may even turn back. What's more interesting is that there is always a compressibility disturbance along with the Alfven pulse: the temperature and density inside and outside the Alfven pulse are different, the internal temperature is often higher than the external temperature, some of the internal density is higher than the external and some is lower than the external. The Alfven pulse often shows asymmetry on both sides: the magnetic field and velocity on one side are "clean" jumps, while on the other side are multiple small-scale disturbances of variables in the transition boundary layer. In view of this new phenomenon of magnetic field line switch back with compressed Alfven pulse, how it is generated is raising a hot debate. It is thought that the exchange magnetic reconnection of the solar atmosphere may be the underlying physical mechanism. But in the traditional exchange magnetic reconnection image, after reconnection, the zigzag magnetic field line can easily become smooth, which can not maintain the distortion of the magnetic field line, and may not be able to explain the observed Alfven pulses. In this work, we propose a new model called "Excitation of Alfven Pulses by Continuous Intermittent Interchange Reconnection with Guide Field Discontinuity" (EAP-CIIR-GFD). By analyzing and comparing the simulation results and observation results, we find that the model can explain the following observation features: (1) Alfven disturbance is pulse type and asymmetric; (2) Alfven pulse is compressible with the enhancement of internal temperature and the increase or decrease of the internal density; (3) Alfven pulse can cause serious distortion of the magnetic field line. Improvements to the model will also be discussed in the report.