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The Alfvén Critical Surface via Parker Solar Probe: Current Findings and Future Directions

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This work aims to identify and characterize the critical Alfvén surface, which marks the boundary of the solar corona. Within this surface, the solar plasma is in a sub-Alfvénic regime, whereas beyond it, the solar wind becomes super-Alfvénic. The study presents theoretical foundations on the solar structure, plasma characteristics and Alfvén waves in the solar corona. The analysis was performed using data from the Parker Solar Probe from the eighth, ninth and tenth solar flybys. The parameters evaluated to determine the behavior of the plasma in the study region were: the magnetic field, its radial component, the particle density, the Alfvén velocity, the radial velocity, the plasma beta, the ratio between the kinetic energy, the magnetic energy and the Mach number. The results indicate that, during the eighth encounter, it was possible to identify the moment of the spacecraft's entry into and exit from the solar corona, whereas during the ninth and tenth encounters only the entry was identified. Future research perspectives include investigating the energy balance (kinetic, magnetic and internal), along with performing solar wind simulations, incorporating the spacecraft trajectory during intervals in which it is within the sub-alfvénic plasma regime.

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