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Finite amplitude Alfvén waves in hot collisionless plasmas: An exact solution

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We demonstrate monochromatic, circularly polarized finite amplitude Alfvén waves, which are special solutions of the Vlasov-Maxwell system in hot plasmas. It is shown that a bi-Maxwellian distribution with oscillating transverse bulk motion suggested by the maximum entropy principle is one of the solutions. Alfvénic correlation between transverse bulk motion and magnetic field given by the distribution is consistent with the equilibrium point of the single particle system. The parallel to perpendicular temperature ratio is explicitly related with the wave frequencies. A stability of the distribution function is numerically discussed by using an ion-hybrid simulation code.

Keywords: Alfvén wave, Vlasov-Maxwell system, exact solution, equilibrium state, solar wind plasma