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Density jump as a function of magnetic field strength for parallel collisionless shocks in pair plasmas. ANTOINE BRET, University of Castilla-La Mancha, RAMESH NARAYAN, Harvard-Smithsonian Center for Astrophysics — Collisionless shocks follow the Rankine–Hugoniot jump conditions to a good approximation. However, for a shock propagating parallel to a magnetic field, magnetohydrodynamics states that the shock properties are independent of the field strength, whereas recent particle-in-cell simulations reveal a significant departure from magnetohydrodynamics behavior for such shocks in the collisionless regime [1]. This departure is found to be caused by a field-driven anisotropy in the downstream pressure, but the functional dependence of this anisotropy on the field strength is yet to be determined. Here, we present a non-relativistic model of the plasma evolution through the shock front, allowing for a derivation of the downstream anisotropy in terms of the field strength [2]. Our scenario assumes double adiabatic evolution of a pair plasma through the shock front. As a result, the perpendicular temperature is conserved. If the resulting downstream is firehose stable, then the plasma remains in this state. If unstable, it migrates towards the firehose stability threshold. In both cases, the conservation equations, together with the relevant hypothesis made on the temperature, allows a full determination of the downstream anisotropy in terms of the field strength. Similar results can be obtained for perpendicular shocks [3]. [1] Journal of Plasma Physics, vol. 83, 715830201 (2017). [2] Journal of Plasma Physics, vol. 84, 905840604 (2018). [3] Phys. Plasmas 26, 062108 (2019).

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