A stringent limit on the amplitude of Alfvénic perturbations in high-beta low-collisionality plasmas

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I will discuss and explore a stringent nonlinear limit on the amplitude of shear-Alfvén waves in low-collisionality plasmas. In particular, the result states that collisionless plasmas cannot support linearly polarized shear-Alfvén fluctuations above the critical amplitude \( \frac{\delta B}{B_0} \sim \beta^{-1/2} \) where \( \beta \) is the ratio of thermal to magnetic pressure. Above this cutoff, a developing fluctuation will generate a pressure anisotropy that is sufficient to destabilize itself through the parallel firehose instability. This causes the wave frequency to approach zero, interrupting the fluctuation before any oscillation, and the magnetic field lines relax into a sequence of angular zig-zag structures. I will conclude by discussing a variety of interesting implications that stem from this restrictive amplitude maximum, focusing in particular on our ongoing work on magnetized turbulence and the solar wind around 1AU.