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Magnetothermal instability in the solar outer corona

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We discussed an application of the magnetothermal instability (MTI) to the solar atmosphere. This instability proposed by Balbus (2000) occurs in weakly collisionless plasmas where non-isotropic thermal conduction plays a role in a magnetized atmosphere. The time scale of the maximum growth is given as approximately sqrt(H/g) where H is the scale height, and g is the gravity. The magnetic field must be weak enough since its tension force contributes as a restoring force.

The solar corona is a dilute hot atmosphere where the thermal conduction is non-isotropic. The MTI is possible to work in the upper corona around a few solar radii above the photosphere where the temperature is decreasing outward and the scale height is about one solar radius. The condition for weak horizontal magnetic field might be satisfied above a closed loop in the lower corona. If the MTI is effective in such regions, it might contribute to generate the waves or perturbations in the solar wind.

We found that the MTI is unlikely to work in the upper corona because of its strong magnetic field that suppress the growth of the geometrically possible wavelength modes. It is found that when the field strength is 0.1 times the real corona, the wavelength for the maximum growth is comparable with the geometrical radius. The growth time for this setup can be consistent with the low frequency fluctuations in the solar wind.

Keywords: Sun, corona, plasma, magnetohydrodynamics