Collisionless Damping of Fast MHD Waves in Magneto-rotational Winds

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We propose collisionless damping of fast MHD waves as an important mechanism for the heating and acceleration of winds from rotating stars.
Stellar rotation causes magnetic field lines anchored at the surface to form a spiral pattern and magneto-rotational winds can be driven.
If the structure is a magnetically dominated, fast MHD waves generated at the surface can propagate almost radially outward and cross the field lines. The propagating waves undergo collisionless damping owing to interactions with particles surfing on magnetic mirrors that are formed by the waves themselves. The energy damping rate is especially effective where the angle between the wave propagation and the field lines becomes moderately large (~ 20 to 80°). The angle tends naturally to increase into this range because the field in magneto-rotational winds develops an increasingly large azimuthal component.
The dissipation of the wave energy produces heating and acceleration of the outflow.
We show using specified wind structures that this damping process can be important in both solar-type stars and massive stars that have moderately large rotation rates.
This mechanism can play a role in coronae of young solar-type stars which are rapidly rotating and show X-ray luminosities much larger than the sun.
The mechanism could also be important for producing the extended X-ray emitting regions inferred to exist in massive stars of spectral type middle B and later.

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