B T3 Magnetorotational instability in Ap star envelopes

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Ap stars are a slowly rotating subgroup of A stars. Convection and disk-coupling are supposed to generate differential rotation in the early days of A stars. Microscopic viscosities are extremely small and will not be able to reduce the rotation rate of the core of the star. We investigate the question of whether the magneto-rotational instability can provide turbulent angular momentum transport. Numerical MHD simulations of thick stellar shells are performed. The emerging flows and magnetic fields efficiently transport angular momentum outwards. Weak dependence on the magnetic Prandtl number ($\sim 10^{-2}$ in stars) is found from the simulations. Since the estimated time-scale of decay of differential rotation is 10^7–10^8 yr, and comparable to the life-time of A stars, we find the braking of the core to be an ongoing process in many Ap stars. The evolution of the surface rotation of Ap stars with age will be an observational challenge, and of considerable value in verifying these simulations.