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Journey to the center of the stars: the realm of low Prandtl number fluid dynamics[1]

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Recent technological advances in observational astronomy have caused a paradigm shift in the way astrophysicists see (and therefore model) stars. Far from the spherically symmetric balls of plasma they were perceived to be throughout the majority of last century, stars are now known to undergo fluid dynamical processes whose complexity rivals that of the Earth's oceans and atmosphere. Many known processes in geophysical fluid dynamics are also found in stellar interiors, albeit in a very different parameter regime. Most notably, the Prandtl number (the ratio of the kinematic viscosity to the thermal diffusivity) of stellar plasma is always much smaller than one, while it is typically of order unity or much larger than one in geophysical fluids. In this talk, I will describe recent progress in understanding low Prandtl number fluid dynamics, focussing in particular on two types of instabilities, namely double-diffusive instabilities and shear instabilities. I will point out similarities and differences between astrophysical and geophysical manifestations of these processes. I will conclude by discussing how improved models of fluid dynamical processes are moving the field of stellar astrophysics forward.

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