Hydrodynamical stellar tachoclines: how to model them and to include the effect of the evolution of the differential rotation in their convective envelope.

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Stellar tachoclines are thin transition regions located between the radiative core and the convective envelope of solar-type stars. As these two regions generally rotate differently and differentially for the convective region, tachoclines are naturally the seat of strong shear and turbulence. Therefore, they link the dynamics of both regions and, as such, understanding the dynamics of the transport and mixing inside the tachocline would shed light on how the dynamical processes of the convection zone might affect the secular transport inside the radiative zone.

In particular, we expect the evolution of the differential rotation in the convection zone to affect the dynamics of the tachocline. Indeed, as solar-type stars are braked on the Main Sequence, the differential rotation in the convection zone is expected to evolve from a cylindrical rapidly-rotating regime (columns of varying velocities, aligned with the rotation axis) to a conical solar-like regime (with an equatorial acceleration as in the case of the Sun) and finally to a conical anti-solar-like regime (with a polar acceleration).

As of today, stellar evolutionary codes only consider the solar conical regime to study the dynamics of stellar tachoclines throughout the evolution of stars. We discuss different possibilities to model hydrodynamical tachoclines and we show that Mathis & Zahn 2004's formalism is able to treat coherently hydrodynamical stellar tachoclines when taken in the thin layer approximation. We use it to model the differential rotation, meridional circulation and mixing coefficients inside the tachocline in order to examine the effect of the different rotation regimes on the transport.