Wave-rotation interaction close to the radiative-convective boundaries in stars : revisiting a model of the Quasi-Biennal Oscillation in the Earth stratosphere.

The seismic data provided by the space-borne missions CoRoT, Kepler, and TESS, have permitted to probe the core rotation of thousands of stars from the main sequence to the red giant branch. The result of these analyses is crystal clear: the rotation contrast between the core and envelope of stars is much lower than predicted from the current stellar evolutionary codes. These shortcomings demonstrate the actual uncertainties in the modeling of the redistribution mechanisms in stars and our difficulties to characterize them, especially the age. With the PLATO mission in our line of sight, it is now urgent to remedy this issue. In this respect, the angular momentum redistribution induced by magnetic fields originating from Tayler-Spruit dynamo or by internal gravito-inertial waves in the radiative zone of stars is today actively investigated. These physical processes are difficult to include into 1D stellar evolutionary codes since they are three-dimensional and involve spatio-temporal scales much smaller than the global scales defininig the stellar structure (e.g., radius, age). Regarding the transport by internal waves, previous works have demonstrated their ability to generate an oscillation of the rotation profile very close to their excitation sites, that is, at the boundary with convective regions, and with a very short period (i.e., on the order of few years in the Sun). This phenomenon, called Shear Layer Oscillation (SLO), is similar to the Quasi-Biennal Oscillation (QBO) observed in the Earth stratosphere close to the Equator. This mechanism is expected to mix locally chemical elements and to filter the angular momentum wave flux transmitted toward the middle of the radiative regions. It is however not properly taken into acount in the current stellar models. In this work, we revisit a semi-analytical model of the QBO to study the effect of the SLO on the global angular momentum redistribution budget in stars. For our purpose, we adapt the model to the stellar case, taking into account shear-turbulent mixing, non-adiabatic effects and a wide spectrum of waves. Previous results and their implications for the update of stellar evolutionary code will be addressed.