

A self-consistent numerical model of the Shear-Layer Oscillation for massive stars

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Decades of observations of the Earth's equatorial stratosphere reveal a regular oscillation where winds alternate between eastern and western directions. Similar phenomena have also been detected in the atmospheres of other planets such as Jupiter or Saturn. While the same situation occurs in massive stars where a stably-stratified layer (the radiative zone) lies on top of a convectively unstable one (the convective zone), no observations have yet been able to report it, raising question about its existence in a stellar context.

It is believed that internal gravity waves, excited by an underlying convective region – the troposphere in the case of the Earth – can propagate in the stably stratified layer and lead to this large scale oscillation through angular momentum deposition. While reduced models of this mechanism have been proposed in the past to investigate this behaviour, in which the action of the waves is taken into account through nonlinear closure models, very few studies have investigated the interaction between convective and stable media due to the very constraining time scale separation. In this presentation, I will present global simulations in polar geometry where both regions are simulated without resulting to any such parameterisation. Through a systemic parametric study, I will discuss how typical properties of the flows generated in the radiative zone evolve, such as their period, mean velocity or regularity. I will conclude by giving estimates of the period of this oscillation for massive stars, discussing future models.

Joint work with Daniel Lecoanet