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Semiconvection

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Semi-convective mixing, as an example of double-diffusive convection, is of general importance in multi-component fluid mixing processes. In astrophysics it occurs when the mean molecular weight gradient caused by a mixture of light material on top of heavier one counteracts the convective instability caused by a temperature gradient. Direct numerical simulations of double-diffusive fluid flows in a realistic stellar parameter space are currently not feasible. Hence, a model describing compressible and incompressible semi-convection was developed, which allows to extrapolate in terms of a power law into this parameter range. Previous theoretical work has disagreed on the presence or absence of layer formation. To investigate properties of pre-assigned layers high resolution numerical simulations of such multi-layers have been performed for the 2D case. Theoretical estimations for the thermal- and mass fluxes through semi-convective layers could be validated and extended. Even single semi-convective layers can be stabilised under realistic conditions in a multi-layer environment. An extension in terms of a power law to a parameter regime relevant to stellar astrophysics has been done. Based on this power law it could be shown that semi-convective layers in stars of our interest are temporarily stable and provide only a small contribution to convective mixing processes.