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Stellar Evolution Lecture week

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Problem Sheet 2

1. (a) Create a script for the $T_c - \rho_c$ diagram that includes the boundaries between radiation-dominated, ideal gas, non-relativistic and relativistic degenerate electron gas domains.
   (b) Add the evolutionary track of the model you calculated
   (c) Create another plot with the $T_c - \rho_c$ from a few "profiles" file, e. g. at the start and end of the MS and at the last model calculated.
2. (a) Create a script that calculates the mean molecular weight, μ, from the chemical composition
   (b) Use your script to plot μ from one of the profiles. Compare it to the μ printed out by the MESA code. Discuss the differences, if any
   (c) Plot the opacity from one of the profiles and discuss the different opacity regimes.
3. Using a reference textbook if needed, re-derive the Ledoux criterion for convection starting from the condition considering the change in density between the rising bubble and its environment. List the assumptions that you make along the way.
4. (a) Create a script that calculates the actual temperature gradient ("∇") from one of the profiles you generated, if possible after the end of the MS.
   (b) Create a plot with the actual "∇" and compare to the values that the code prints out for $\nabla_{\rm rad}$ and $\nabla_{\rm ad}$.

The end.