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Mixing by internal gravity waves and its possible roles in the origin of the Li-rich red-clump stars and formation of the ^{13}C pocket in AGB stars

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The observed evolutionary decrease of the ^{12}C/^{13}C isotopic ratio, Li and C abundances, accompanied by the increase of the N abundance, in low-mass stars on the upper RGB is caused by extra mixing in their radiative zones. Multi-dimensional hydrodynamic simulations of thermohaline convection have demonstrated that its rate of mixing is almost two orders of magnitude as low as what is required to reproduce the observational data. Therefore, the search for an alternative mechanism of the RGB extra mixing still continues. To simultaneously explain the observed Li depletion on the lower part of the upper RGB followed by a presumed fast Li enhancement in the vicinity of the RGB tip, we consider a model of RGB extra mixing in which the diffusion coefficient strongly increases with the luminosity. With analytical prescriptions for the rates of mixing by internal gravity waves (IGWs) generated by turbulent convection in the envelopes of RGB stars, that are partly supported by our 3D hydrodynamical simulations, we can reproduce the high Li abundances recently revealed in red-clump stars. The results of our simulations also support the hypothesis that the ^{13}C pocket in thermally-pulsing AGB stars, necessary for the main s process to occur under radiative conditions, could be formed as a result of proton ingestion by IGW mixing.

Session

Stellar evolution

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