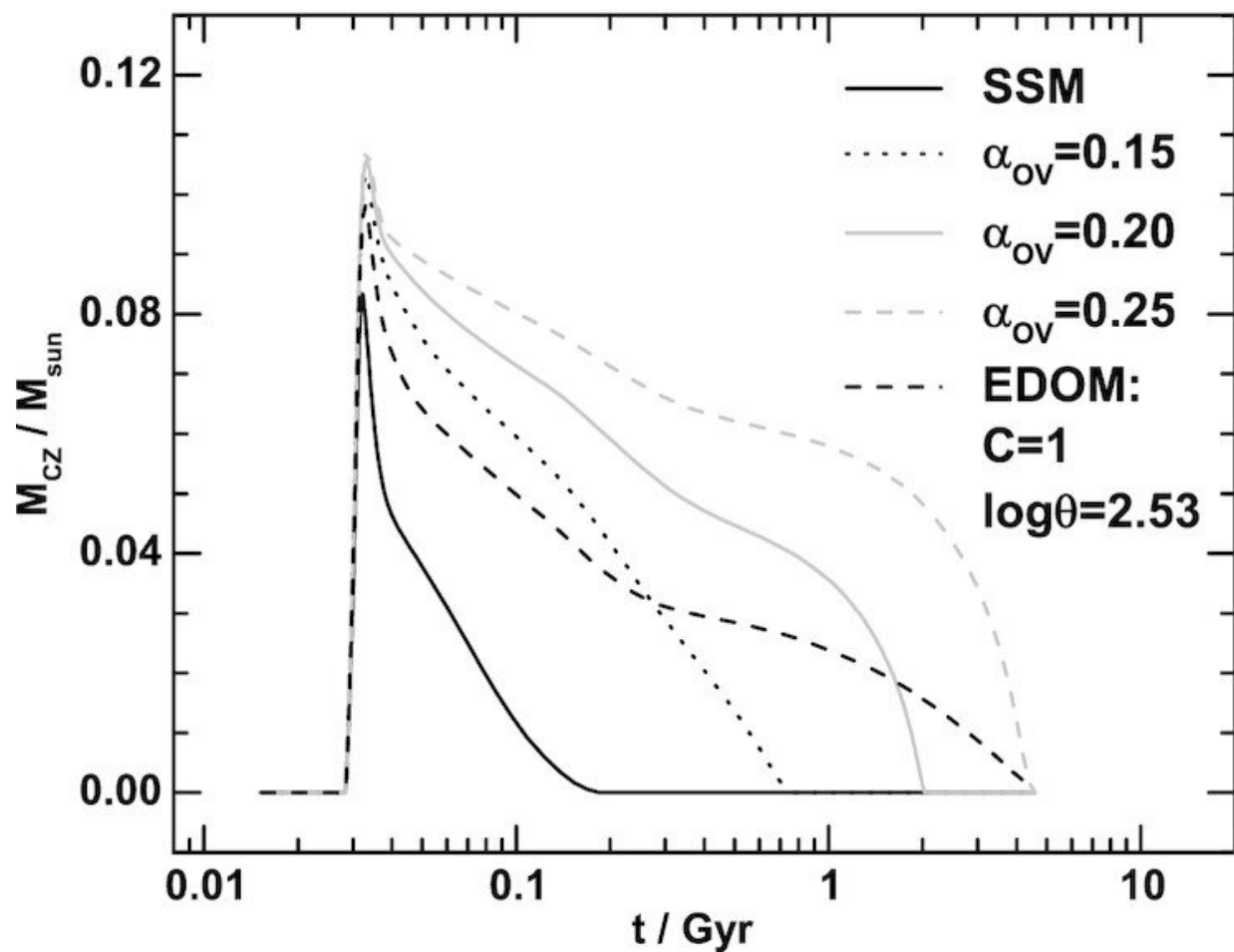


Core overshoot constrained by the absence of a solar convective core and some solar-like stars

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Evolution of the fraction of convective-core mass for the COM overshoot with different α_{ov} (see equation 2) and the EDOM solar model with $\log C = 0$ and $\log \theta = 2.53$. Credit: *Monthly Notices of the Royal Astronomical Society* (2022). DOI: 10.1093/mnras/stac766

A joint research team from the Yunnan Observatories of the Chinese Academy of Sciences and Aarhus University has found a constraint of the convective core overshoot in low-mass stars and a correlation between the strength of overshoot and the stellar mass.

The results were published in *Monthly Notices of the Royal Astronomical Society*.

The convective overshoot mixing refreshes fuel in the [stellar core](#) and then prolongs the lifetime of stars. However, it is the largest uncertainty in the current theory of the stellar evolution. It is crucial for the stellar structure and evolution and the age determination of star clusters.

For the solar-mass stars, the ${}^3\text{He}$ fusion is efficient enough to drive a convective core in solar-mass stars near the zero-age main sequence. If the overshoot is not taken into account, the convective core should vanish in the ${}^3\text{He}$ burning timescale of about 1–10 Myr. The core overshoot mixing refuels ${}^3\text{He}$ in the core and significantly prolongs the lifetime of the convective core, affecting the structure of the core of stars.

Therefore, the observations sensitive to the core, e.g., helioseismic/asteroseismic data and the neutrino fluxes caused by [nuclear fusion](#), can be used to probe the convective overshoot mixing in stellar interior.

Based on this idea, the research team modeled the sun and some Kepler solar-like stars with varied strength of the convective core overshoot mixing, and compared the helioseismic/asteroseismic properties and the solar neutrino fluxes of the stellar models with the observations.

For the sun, the helioseismic inferences of sound speed and density profiles and the observations of the solar neutrino fluxes strongly excluded a convective core at the present solar age, resulting a reliable upper limit of the strength of the convective core overshoot.

For the Kepler solar-like stars, the researchers compared the observations of the ratio of small to large separations of oscillation frequencies with the model, and obtained the range of the parameters in the overshoot model for each star. They found that the strength of the convective core overshoot mixing increased with the [stellar mass](#) for 1.0–1.5 solar mass stars.

More information: Qian-Sheng Zhang et al, Core overshoot constrained by the absence of a solar convective core and some solar-like stars, *Monthly Notices of the Royal Astronomical Society* (2022). [DOI: 10.1093/mnras/stac766](#)

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