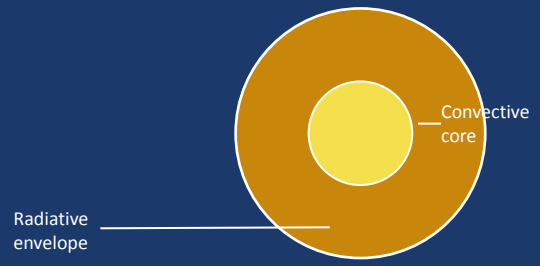
The IACOB Project XVII

Nitrogen Abundances in Galactic O-type Stars:

Further hints for separating binary-interaction products from effectively single stars

What are O-type Stars?



Massive stars fusing H via the CNO cycle
He I and He II in the spectrum

CNO Cycle Prediction

N enrichment must precede He enrichment
at the stellar surface
in single-star evolution

Why it matters

O-type stars trace massive star evolution.
Separating single stars from binary-interaction products
is essential to calibrate stellar models.

Binary contamination = biased stellar physics

Our Sample & Methods

117 Galactic O-type stars (LC III–V)

v sin i ≤ 150 km/s · IACOB spectra · S/N > 50

Three He abundance groups:

He-low
$Y_{He} \leq 0.08$ (~27%) — likely spurious (light pollution)

He-normal
$0.08 < Y_{He} \leq 0.12$ (~56%) — best single-star tracer

He-rich
$Y_{He} > 0.12$ (~16%) — binary interaction products

N abundance method:

Curve-of-growth on N II, N III, N IV lines
Optimized FASTWIND grid (T_{eff} 25–60 kK)
ξ and ε_N determined simultaneously
Validated against 6 independent literature studies

Systematic offset: $\Delta\varepsilon_N = 0.06 \pm 0.11$ dex
(well within typical uncertainty of 0.15 dex)

✓ **No significant systematics in our methodology compare to other works**

Our Results

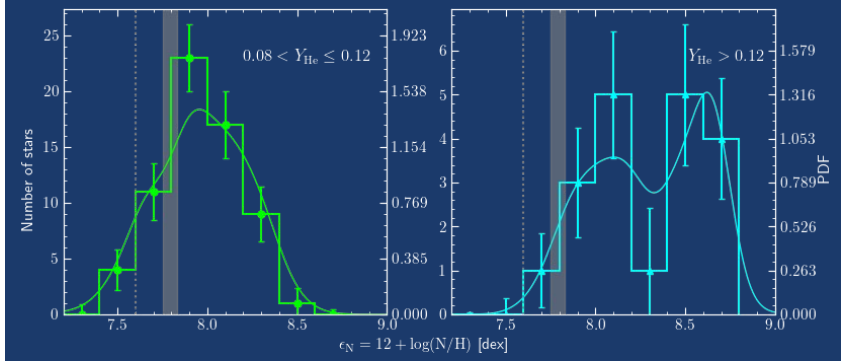
He-normal stars

- N peaks near birth value (~7.9 dex).
- Consistent with slow-rotating single stars ($v_{ini}/v_{crit} \leq 0.2$).

He-rich stars — Bimodal N distribution

- First peak (~8.1 dex) — mildly N-enriched⟶ Consistent with past mass-transfer (accretors)
- Second peak (~8.5 dex) — highly N-enriched (ON stars)
  ⟶ sHRD positions inconsistent with single-star evolution
  ⟶ 50% are runaway stars

Neither subgroup is consistent with state-of-the-art single-star evolutionary models



Binary interaction is the dominant channel for surface He enrichment in main-sequence O-type stars.
Rotational mixing alone cannot explain the observed N pattern.

Based on *Nitrogen abundances in Galactic O-type stars: further hints for separating binary-interaction products from effectively single stars*

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