The IACOB Project XVIII

Prevalence of Short-Period Binaries Among Galactic He-rich O Stars:

Binary interaction is the dominant origin of helium enrichment in O-type stars

The Open Question



The Helium Discrepancy

The origin of helium enrichment in O-type stars is unclear

This work's hypothesis

He enrichment is the fingerprint of past binary interaction
He-rich O stars are post-interaction products

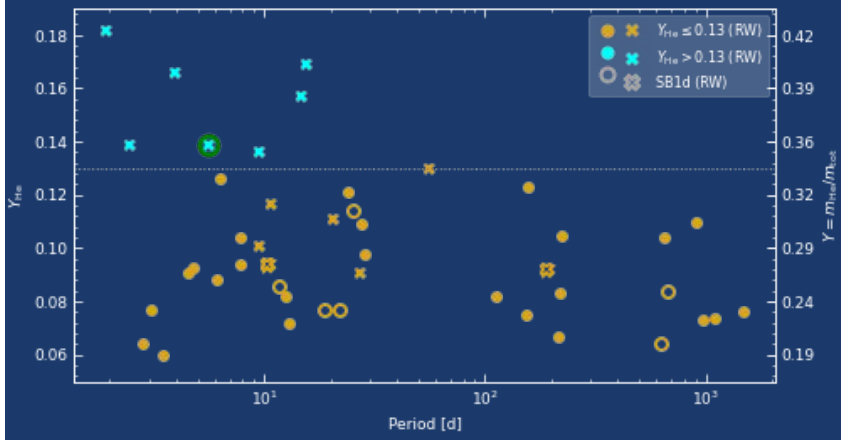
→ He enrichment = binary interaction tracer

Our Sample & Key Result

45 Galactic O-type SB1 systems

7 He-rich (Y_He > 0.13) · 38 He-normal · incl. Cyg X-1

Helium abundance vs. Orbital Period:



ALL 7 He-rich systems: P ≤ 15 days

$p < 10^{-4}$ vs He-normal (Fisher exact test)

All He-rich are also Runaways (RW)
(vs ~26% of He-normal)

Interpretation

Eccentricity signature

4 He-rich systems have high eccentricities
Naturally explained by a past supernova (SN) explosion of the initially more massive companion

Runaway origin

Low peculiar velocities ($v^2_{PEC} \lesssim 50$ km s^{-1} for 6/7) favour the binary supernova scenario over dynamical ejection.
The SN imparted a systemic velocity → runaway + eccentric orbit.

Binary evolution model support

Jin et al. (2026) mass transfer models ($M_1 = 20\ M_\odot$, $q_0 = 0.6$, $P_0 = 4$ d) reproduce both the observed He enrichment and short periods.

Implications

He-rich O stars are powerful laboratories for binary interaction physics. He enrichment serves as a simple yet robust tracer of past mass-transfer events

All He-rich O-type SB1 systems have short orbital periods and are runaways
Those are direct evidences that binary mass transfer is the dominant origin of surface He enrichment in O-type stars

Based on *The IACOB project: XVIII. Prevalence of short-period binaries among Galactic He-rich O stars*

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