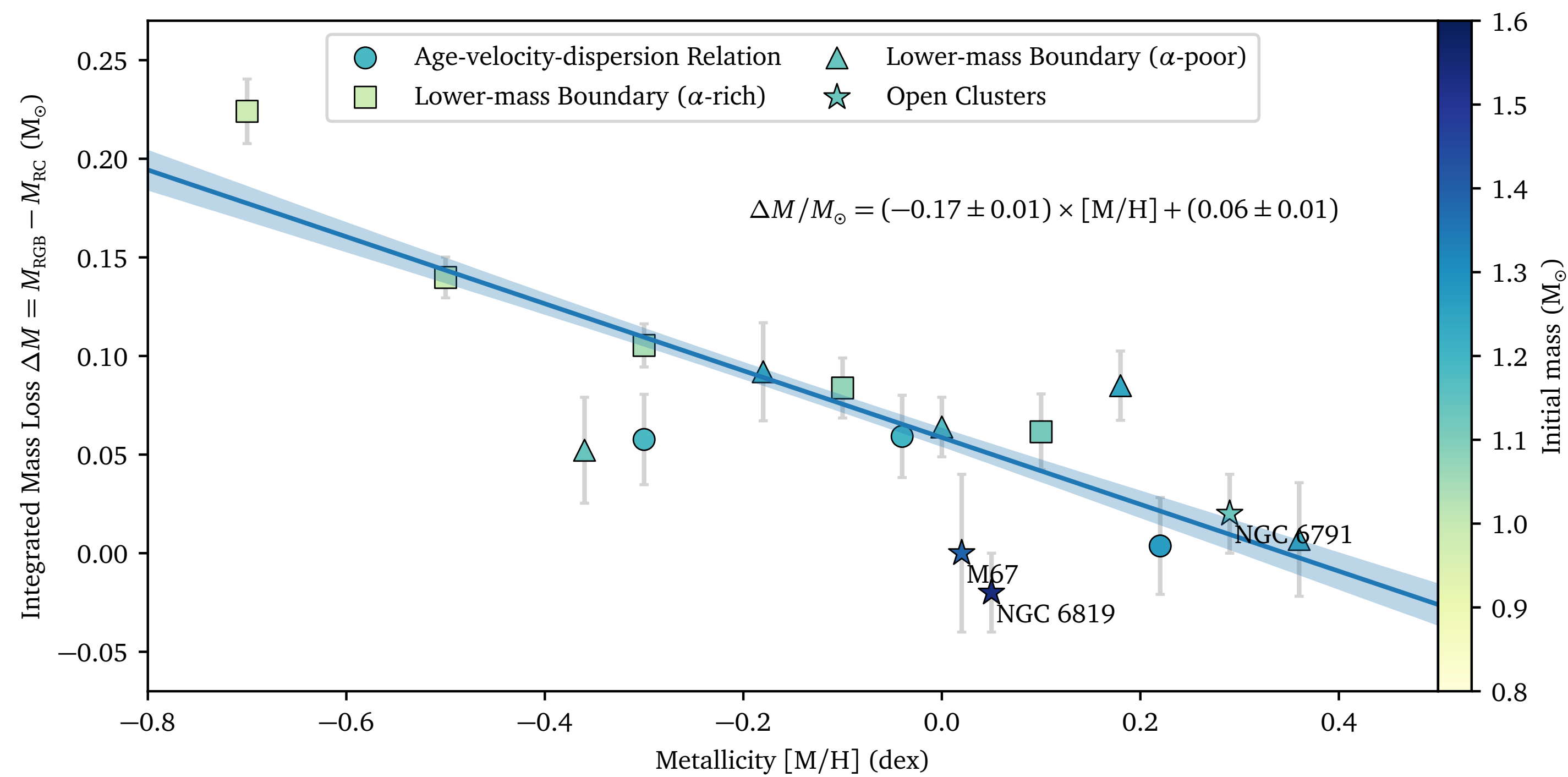


# Mass Loss on the Red Giant Branch Decreases with Metallicity Suggesting an Operating Interior Magnetic Dynamo

Yaguang Li (李亚光) · Institute for Astronomy, University of Hawai'i · yaguangli@hawaii.edu



## Observed $\Delta M$ Decreases with $[M/H]$



Integrated RGB mass loss is measured as the mass difference between lower-RGB and red clump (RC) stars of the same age:

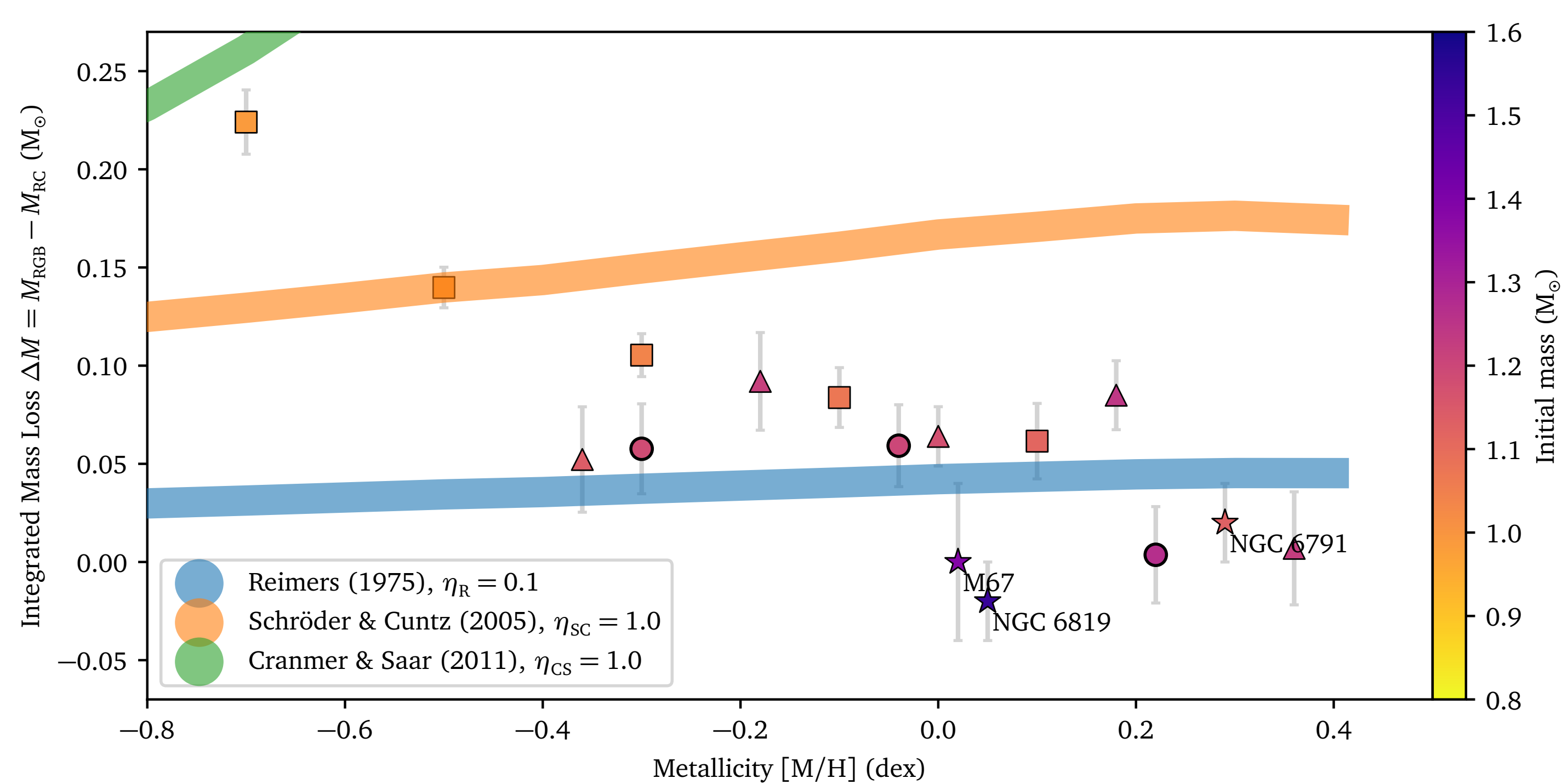
$$\Delta M = M_{\text{RGB}} - M_{\text{RC}}$$

Coeval populations are identified using six independent techniques: open clusters (Miglio+2012; Handberg+2017; Reyes+2025),  $\alpha$ -rich disk stars (Brogaard+2024), lower-mass boundary of red giants (Li 2025), age-velocity dispersion relation (Li 2025),  $[C/N]$  ratios (Roberts+2026), and wide binaries (Chiu+2025; Schimak+2026). All methods consistently find:

**Metal-rich stars lose far less mass on the RGB.**

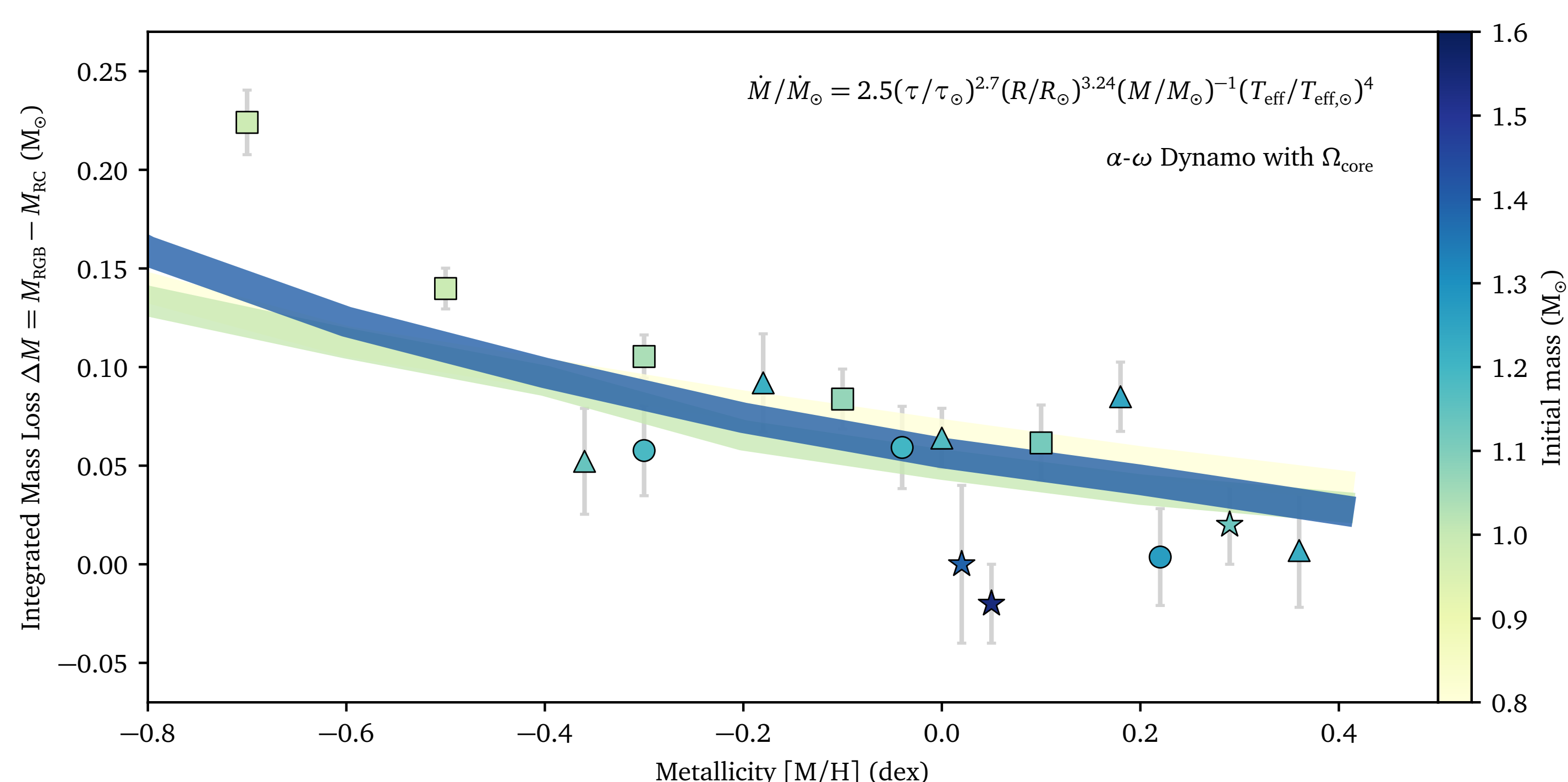
This trend holds for field stars; globular clusters may behave differently (Tailo+2021; Howell+2023).

## Classical Prescriptions Predict the *Wrong* Trend



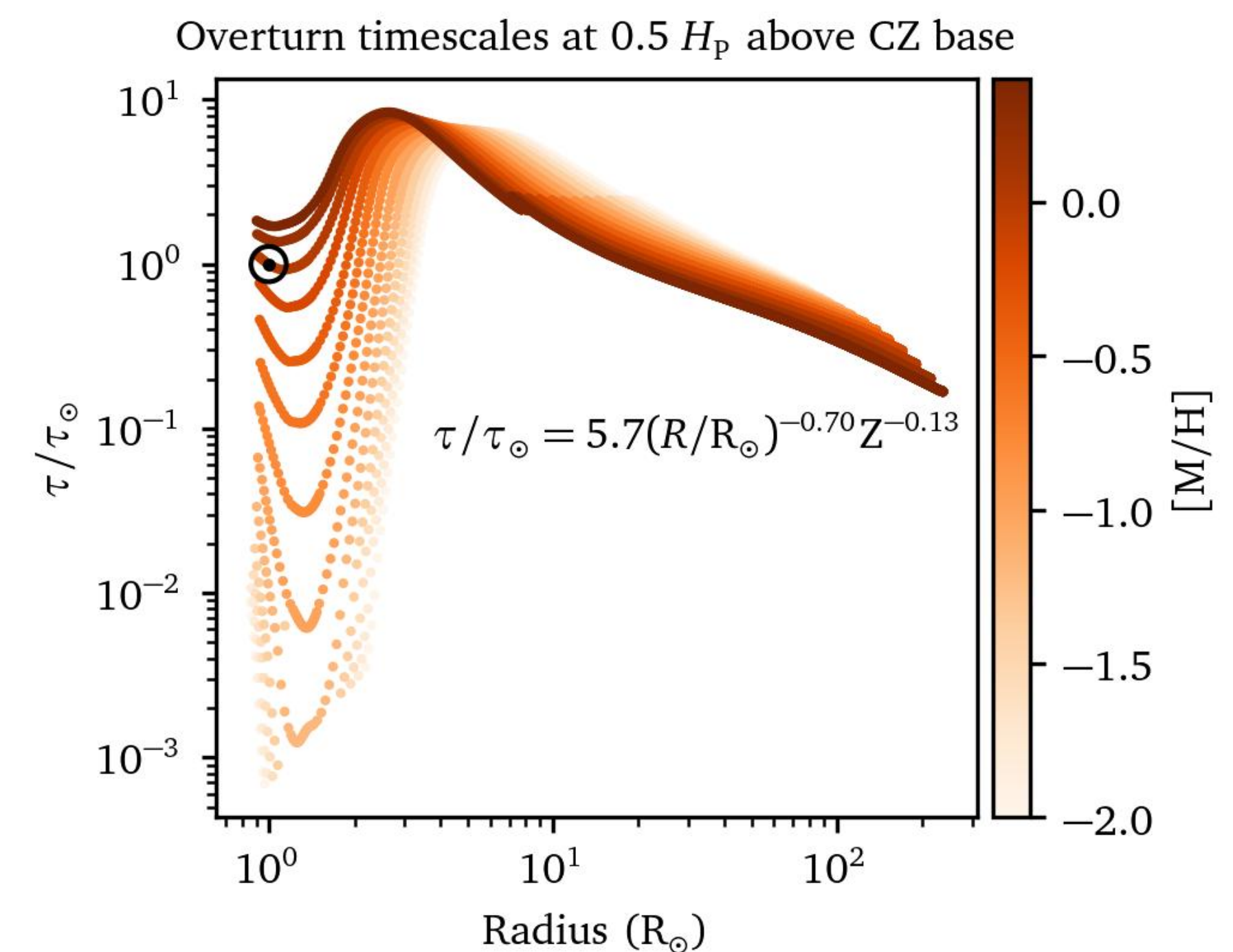
**No prescription reproduces the observed negative slope. New physics is required.**

## Interior $\alpha$ - $\omega$ Dynamo Drives Magnetic Winds



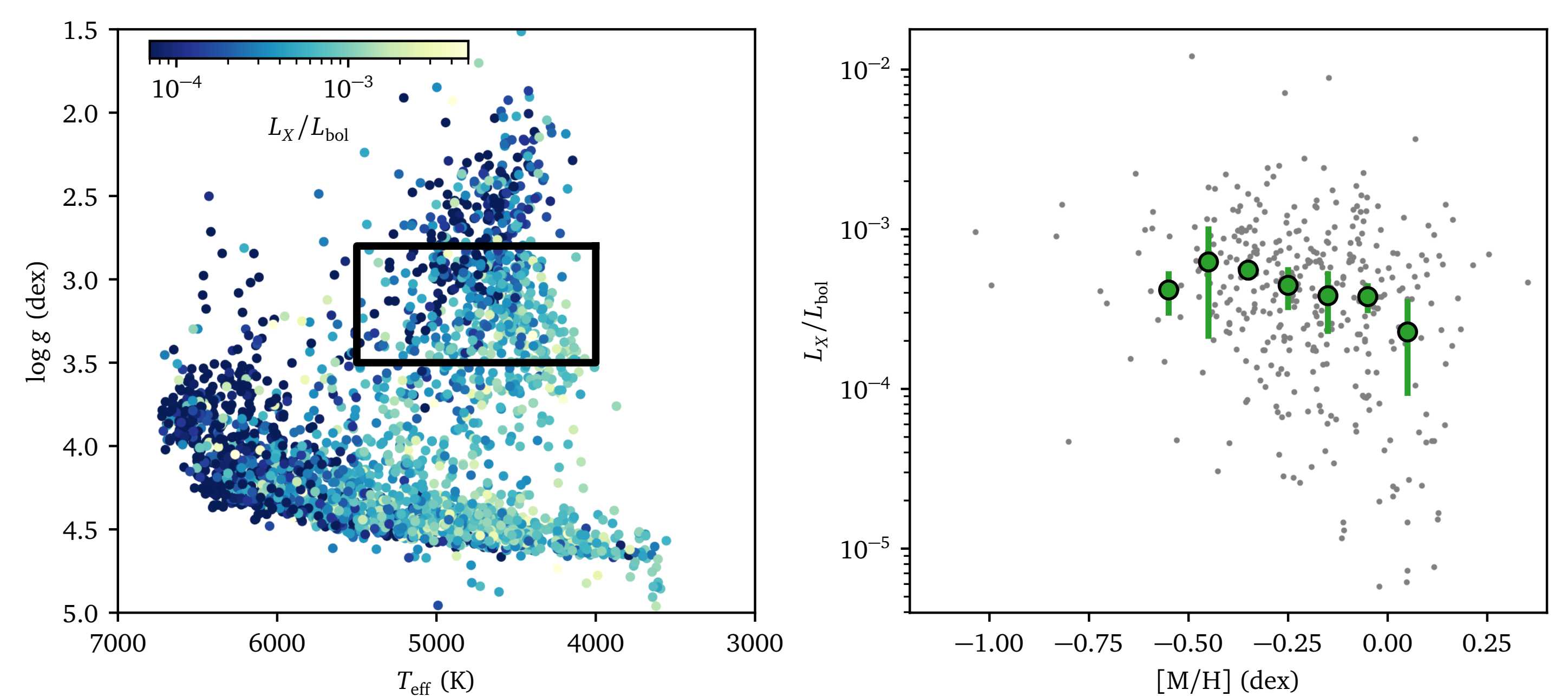
**Proposed mechanism: an  $\alpha$ - $\omega$  dynamo in the stellar interior generates magnetic flux that heats the corona and drives magnetized winds.** (Li+2026, under review)

## Convective Overturn Timescale



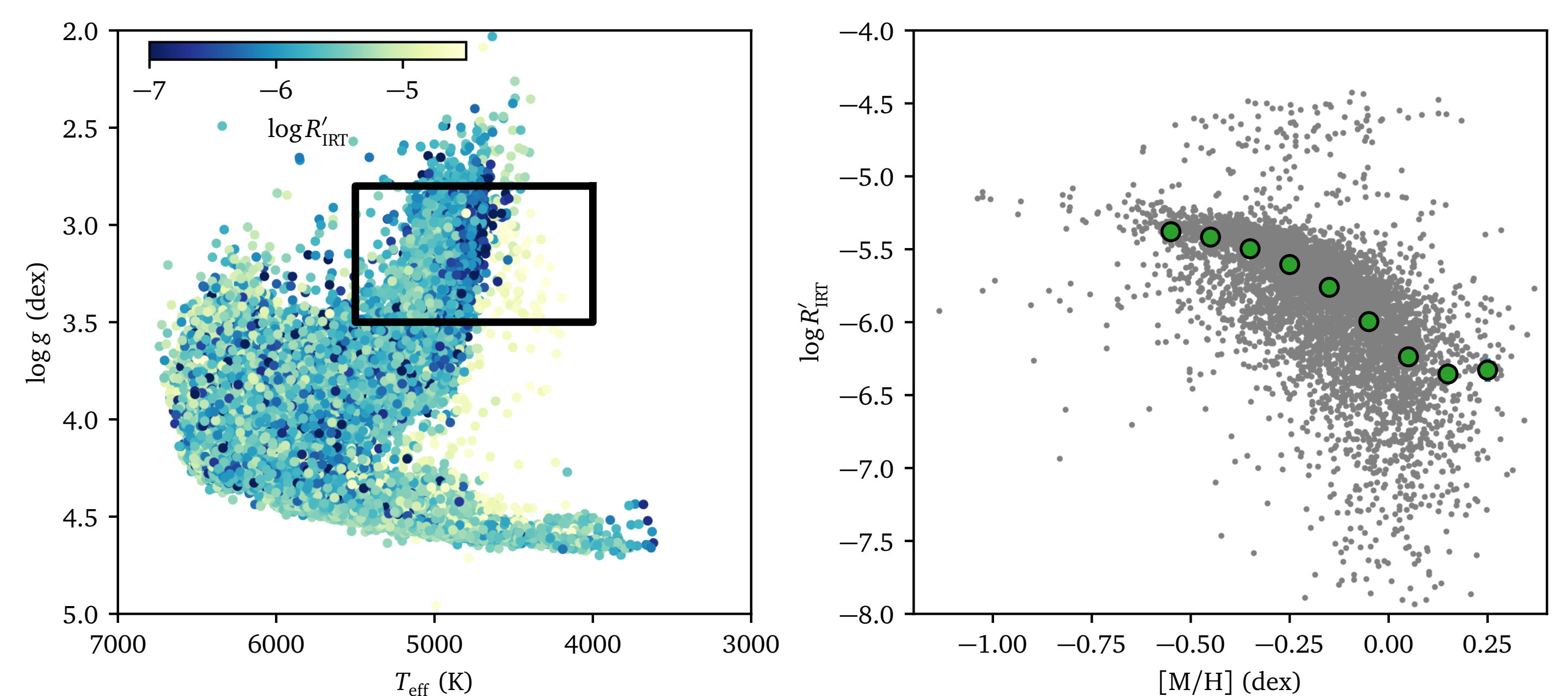
The dynamo efficiency scales as  $D \propto (\Omega\tau)^{2.7}$ , where  $\Omega$  is the core rotational velocity and  $\tau$  is the convective overturn timescale near the base of the convection zone. Higher metallicity raises opacity, deepening the convective boundary and lowering  $\tau$  — thereby lowering dynamo efficiency and mass-loss rate.

## X-ray Luminosity Ratio $R_X$



Coronal X-ray activity declines with increasing  $[M/H]$ , consistent with weaker dynamos in metal-rich stars.

## Ca II IRT Index $R'_{\text{IRT}}$



Chromospheric Ca II activity shows the same metallicity trend.

## Read the paper



Li 2025, *ApJ* 988, 179