Stellar Multiplicity Through the APOGEE Lens

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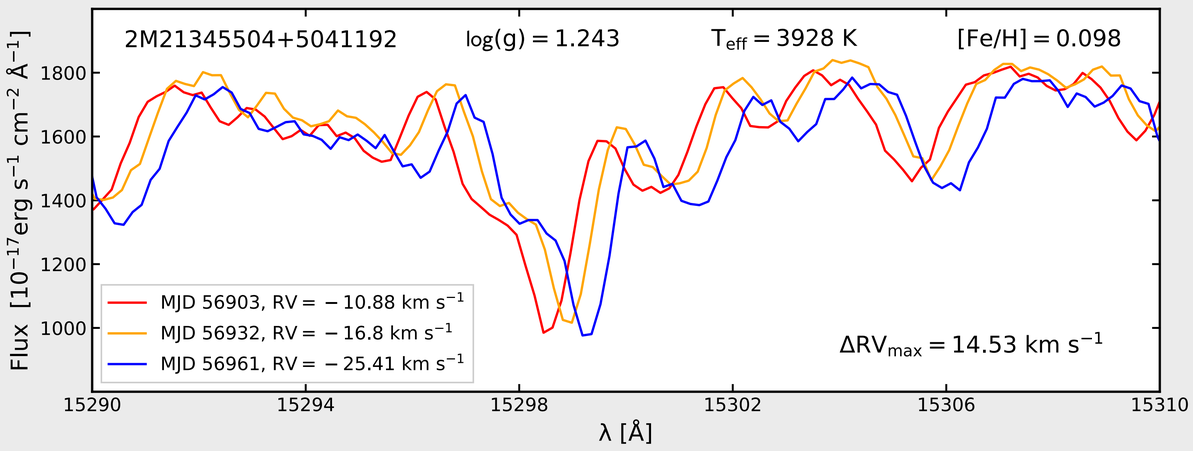
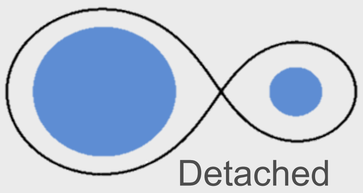
Multiplicity statistics in the era of multiplexed spectroscopic surveys



- APOGEE's high-resolution IR spectra provide precise radial velocities (RV), with 2+ visits each for 200,000 stars
- Stars with **high RV variance** are **far more likely to have a companion**, though it limits you to **short period *P*** systems

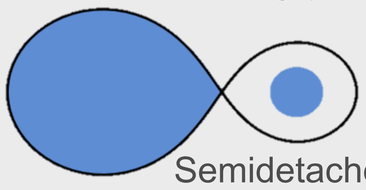
$$\Delta RV_{\rm max} = |RV_{\rm max} - RV_{\rm min}| \qquad P_{\rm crit} = 2\pi f(q)\sqrt{\frac{GM}{g^3}}$$

$P > P_{crit}$

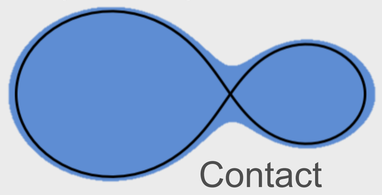


- High-*M* X-ray binaries
- Future double-deg. Type Ia SNe & LIGO/LISA sources

$P < P_{crit}$: mass transfer due to Roche lobe overflow (RLOF)

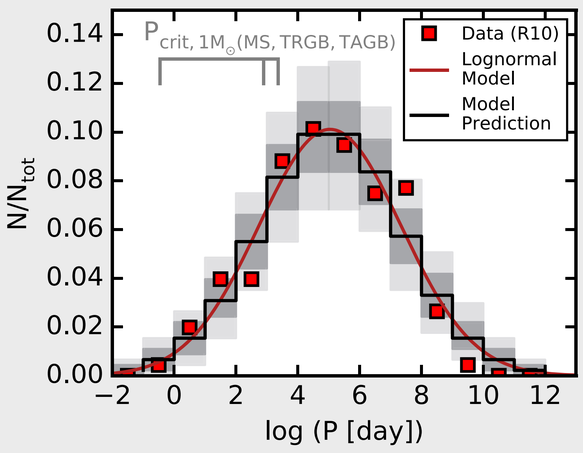


- Cataclysmic variables, novae
- Low-*M* X-ray binaries
- Algols
- Single-deg. Type Ia & many core collapse SNe



APOGEE parameters reveal the effects stellar evolution

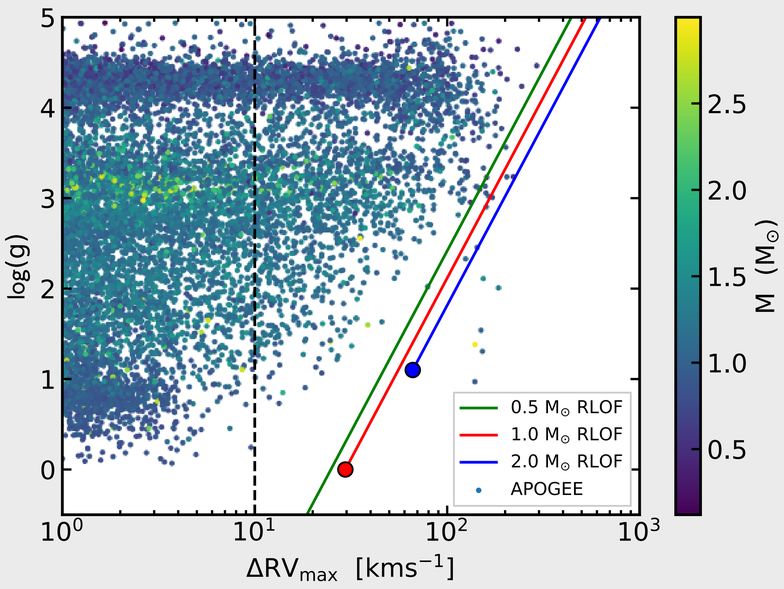
Badenes et al. 2018

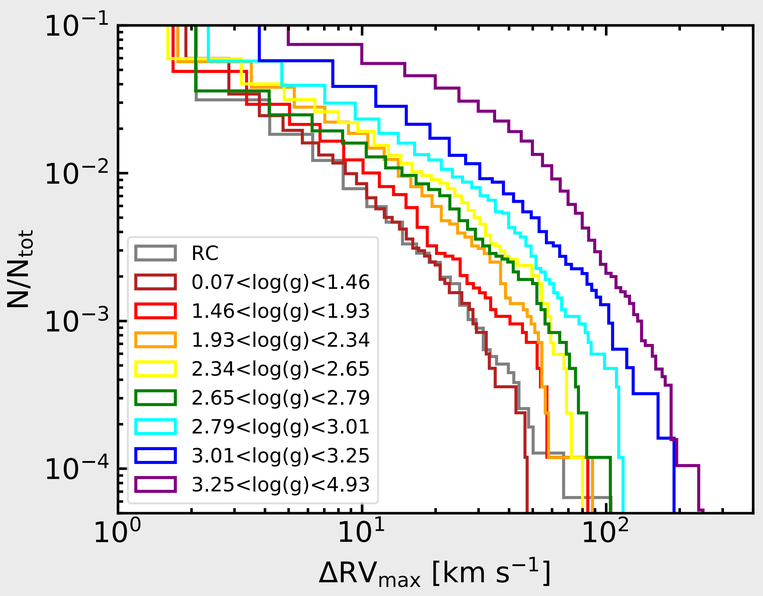


Raghavan et al. 2010 *P*-distribution for Sun-like stars; peaks ~ 870 yrs

APOGEE DR14 with $M_\star$ from Sanders & Das 2018; the outliers are known Algols

Stars with **larger log(g)** have smaller *P* before RLOF occurs; thus, they have **larger maximum ΔRV$_{max}$**

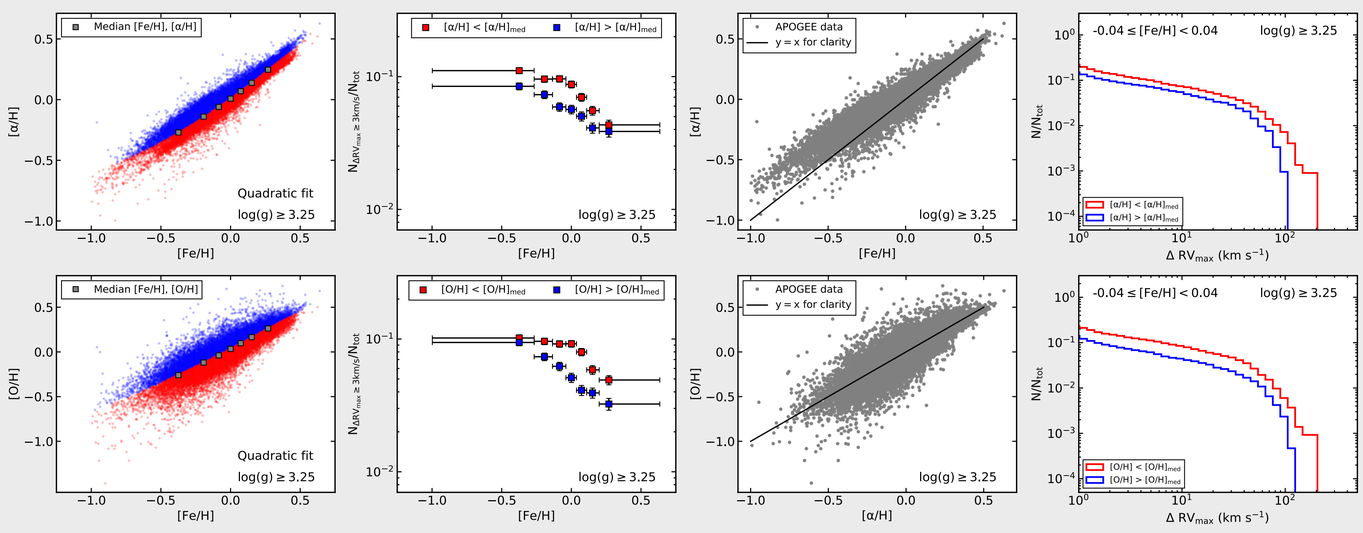




The **Red Clump** (RC) behave like the lowest log(g) bin--they **"recall" their former size**

APOGEE abundances probe the impact of star formation

Mazzola et al. in prep

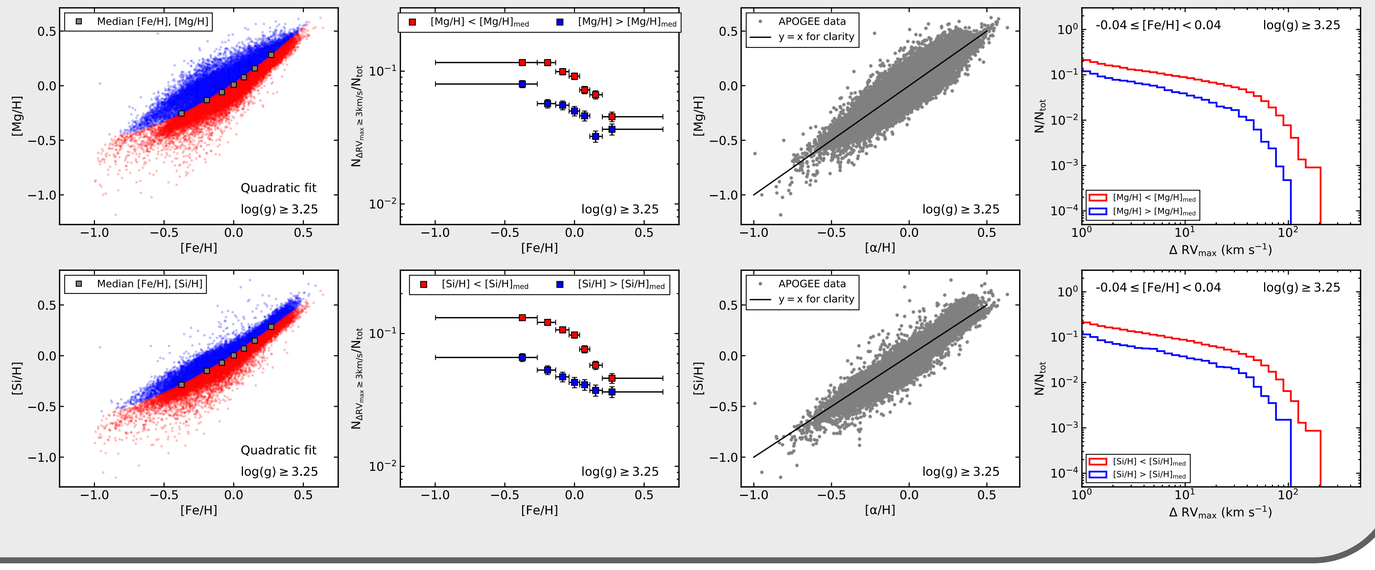


From Badenes et al. 2018, it was found that **frac(ΔRV$_{max}$ > 10 km s^{-1}) decreases with [Fe/H]** in APOGEE DR13 red giants and dwarfs

$$f(M,\ P,\ q,\ e,\ \log(g),\ [\mathrm{Fe/H}],\ ...?)$$

Summary plots of APOGEE DR14 subgiants/dwarfs comparing the effects on multiplicity of **[α/H]** and **[O/H]** abundances across bins in [Fe/H], each with ~5500 stars

Summary plots of APOGEE DR14 subgiants/dwarfs comparing the effects on multiplicity of **[Mg/H]** and **[Si/H]** abundances across bins in [Fe/H], each with ~5500 stars



APOGEE DR14 dwarfs show **lower RV variability** with higher [α/H], [O/H], [Mg/H] and [Si/H]

APOGEE DR14 red giants (2.0 < log(g) < 3.25) do also, although the tip of the red giant branch sample (log(g) ≤ 2.0) is less clear