

Long term stellar activity variations: impact for the detection of low mass planets

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Some stellar sources of RV “noise”

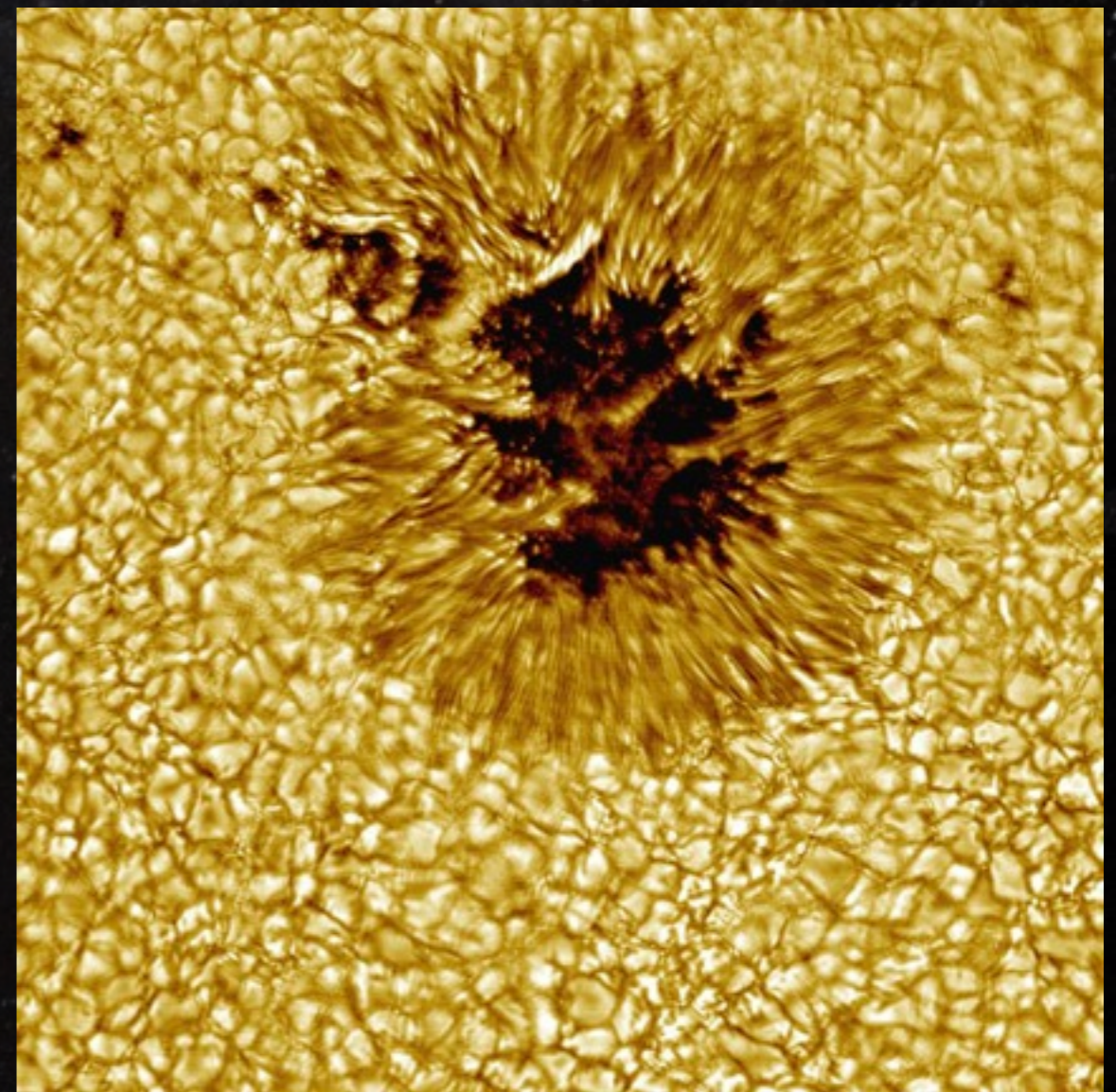
- Pulsation (e.g. for giant stars)
- Oscillations and granulation [see talk by X. Dumusque]
- Stellar blends (orbital period of background binary)
- Stellar spots (or other activity features) in a rotating star
- Long term stellar magnetic cycles

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Long timescales: the effect of stellar magnetic cycles

- Magnetic changes imply changes in convective pattern (e.g. Dravis et al. 1982)
- Meridional circulation patterns also change (Makarov et al. 2010)
- Can these changes alter the radial-velocity?
- How much?
- And can we diagnose it?



Initial program and observations

(Santos et al. 2010)

- 7 early-K dwarfs with known magnetic cycle variations (MW survey - Baliunas et al. 1996)
- Follow-up with HARPS for 5+ years 2003-2008
- Measure from HARPS spectra:
 - Precise radial-velocities (1 m/s level)
 - Activity indexes (CaII, H-alpha, HeI D3 5875A)
 - Parameters of the Cross Correlation Function (BIS, FWHM and Contrast)
- Correlations between different parameters?

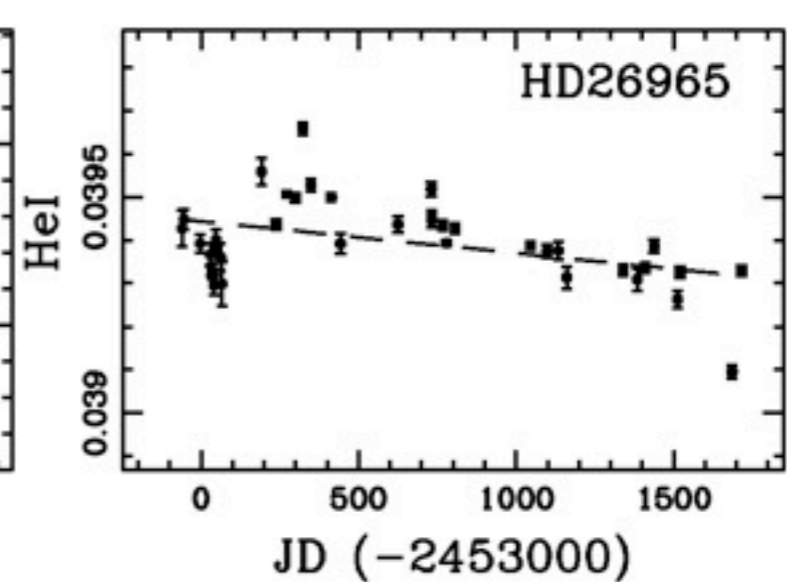
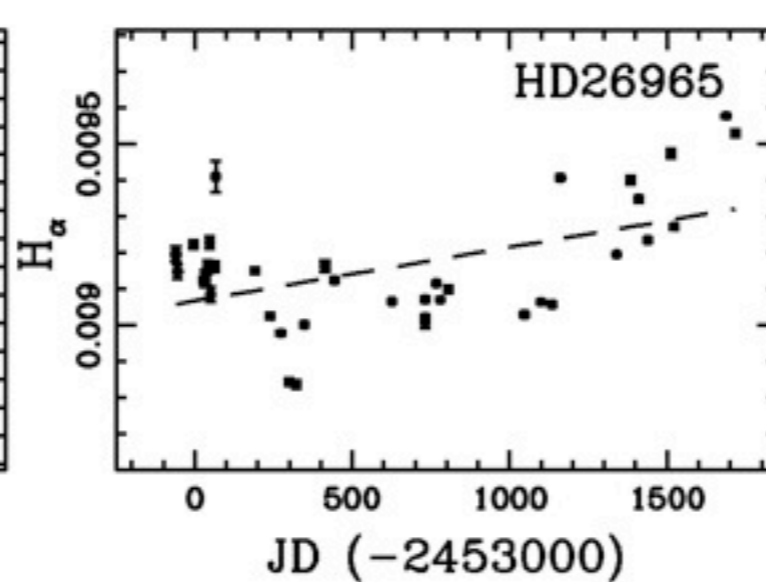
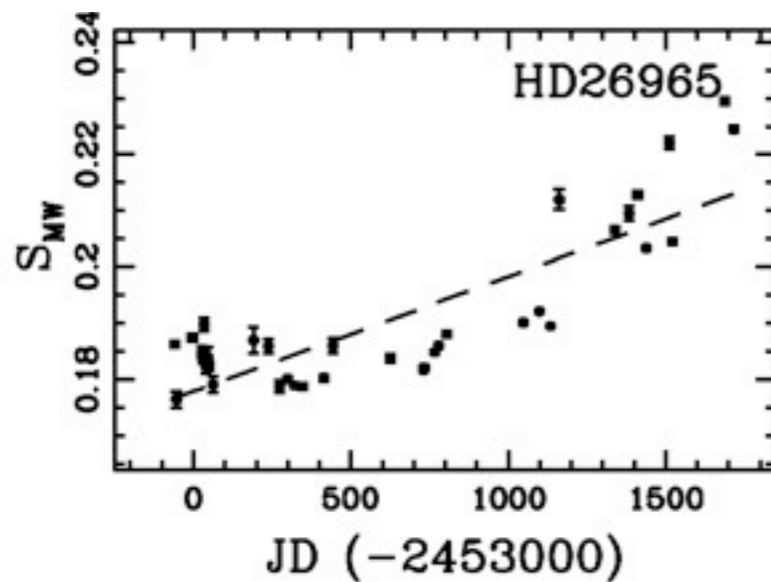
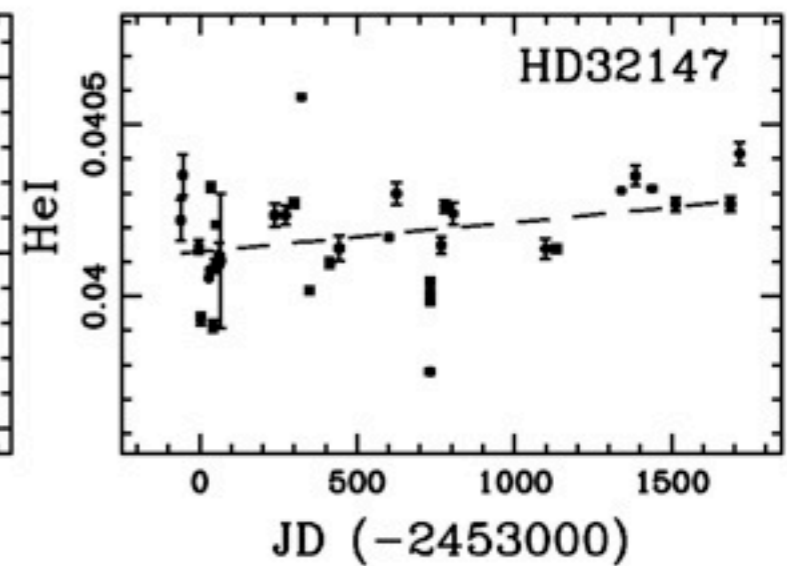
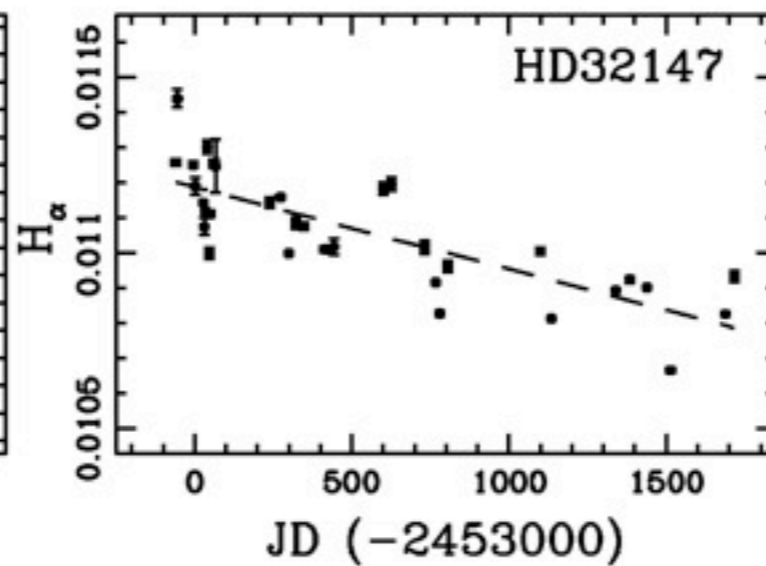
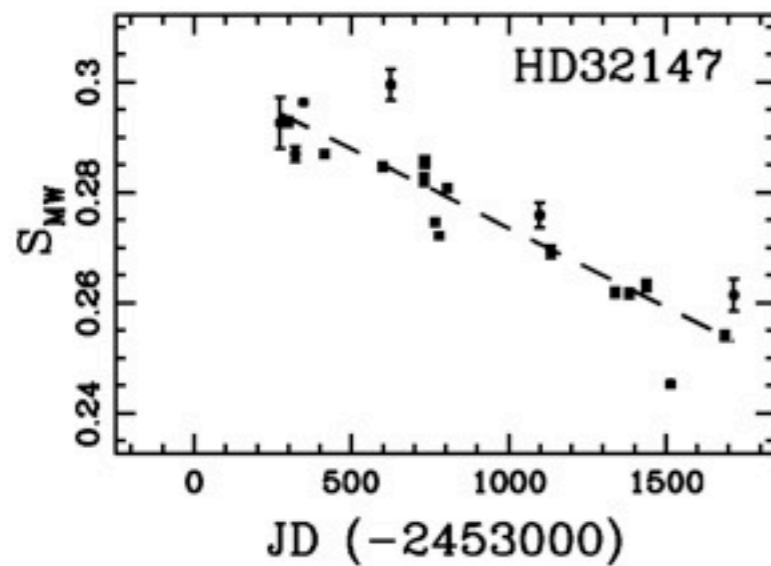
Results (I): Activity using different indexes

All indices used follow activity variations

Call

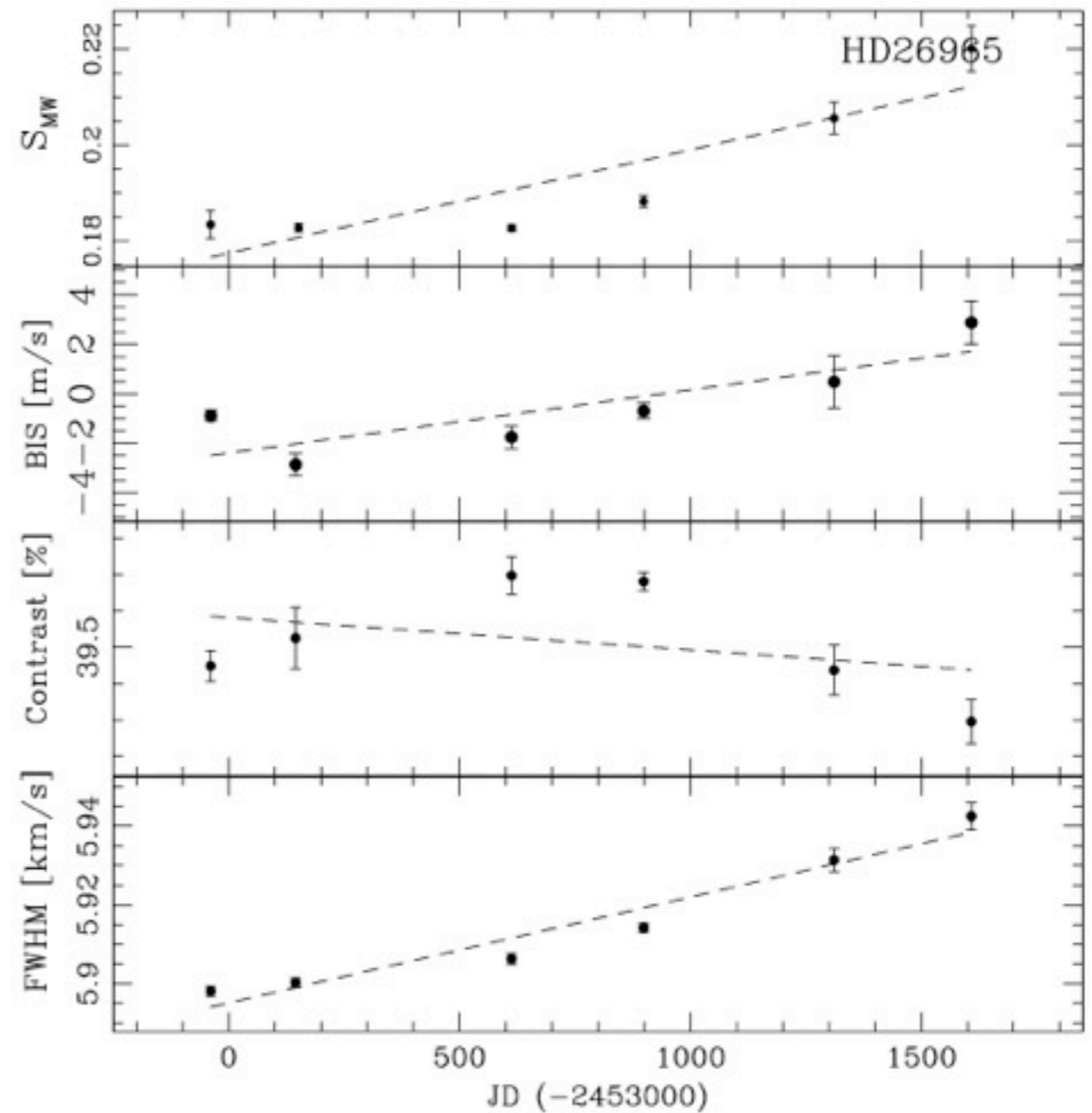
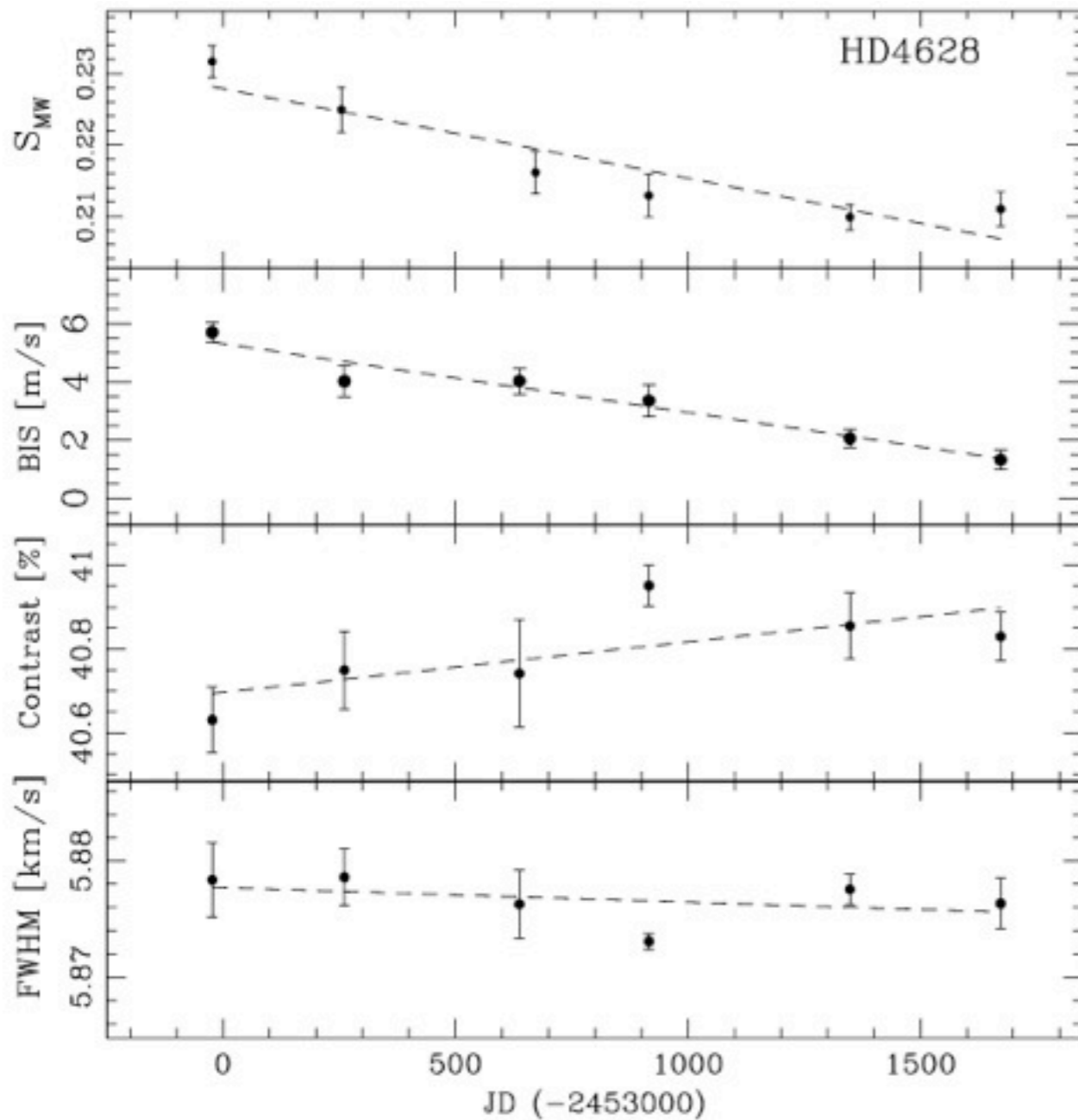
H-alpha

HeI D3



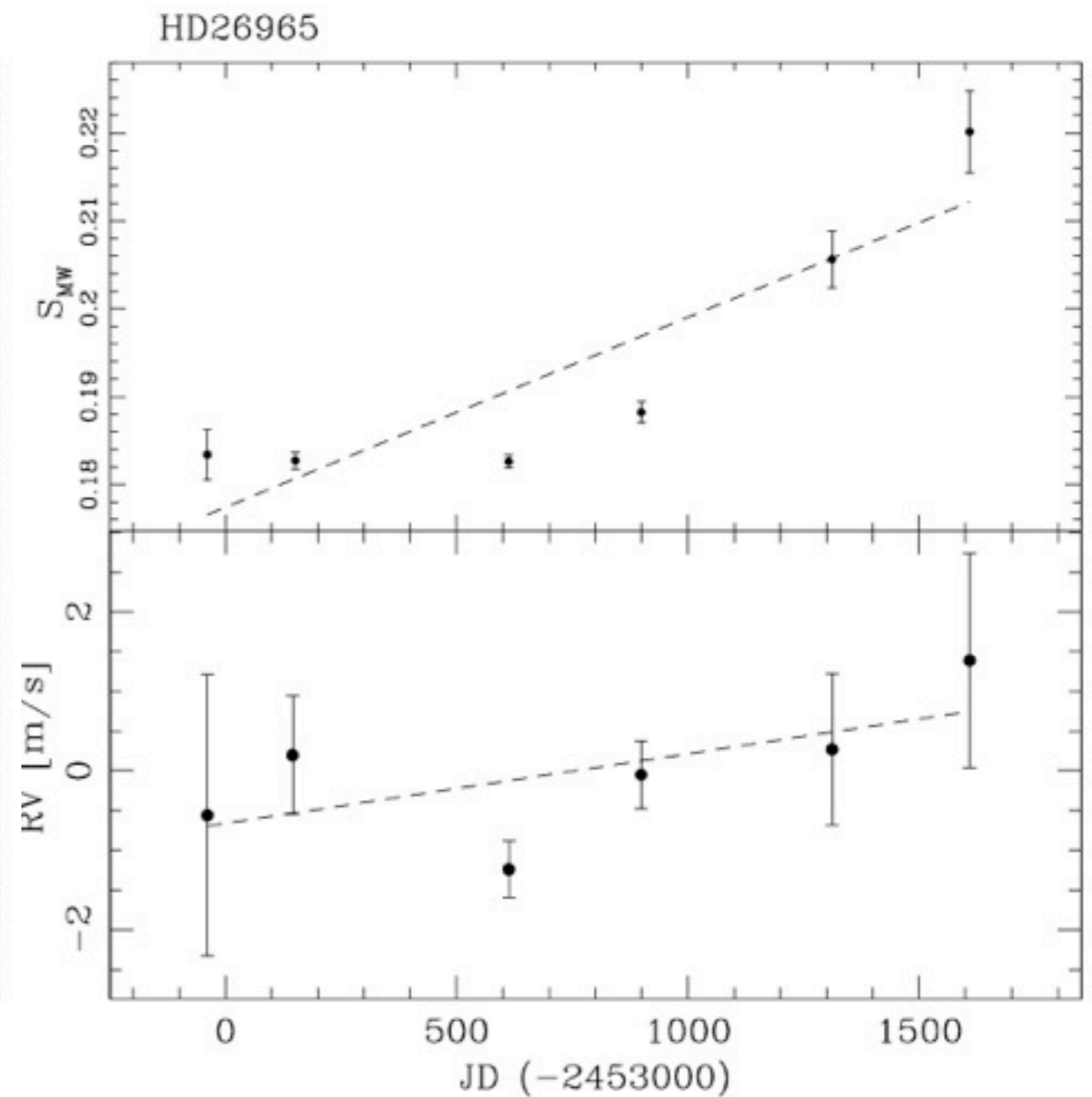
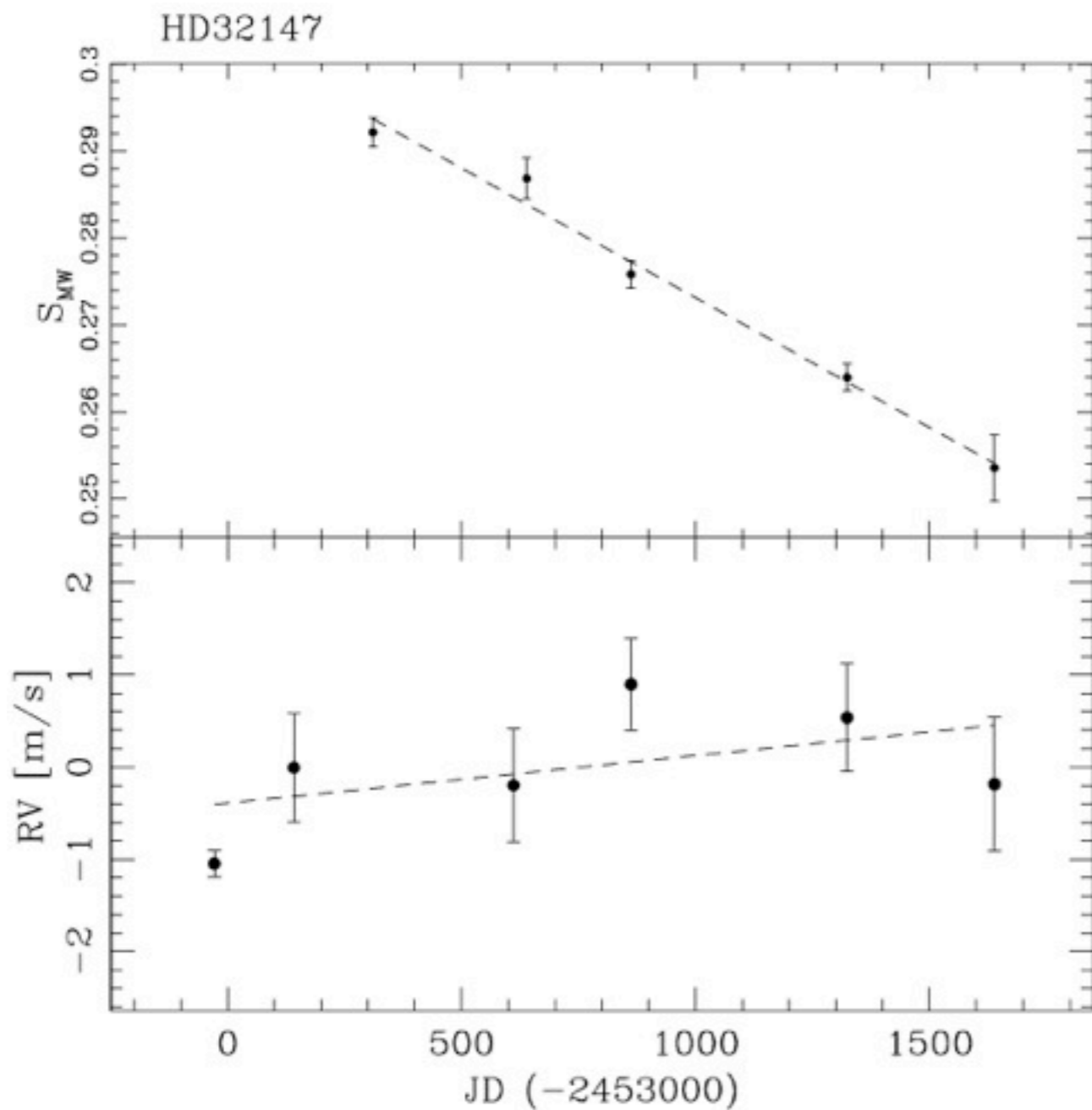
Results (II): Activity and CCF parameters

CCF parameters (BIS, FWHM and Contrast) can be used to diagnose long term magnetic variations!



Results (III): Activity and RV

Correlation between RV and activity?

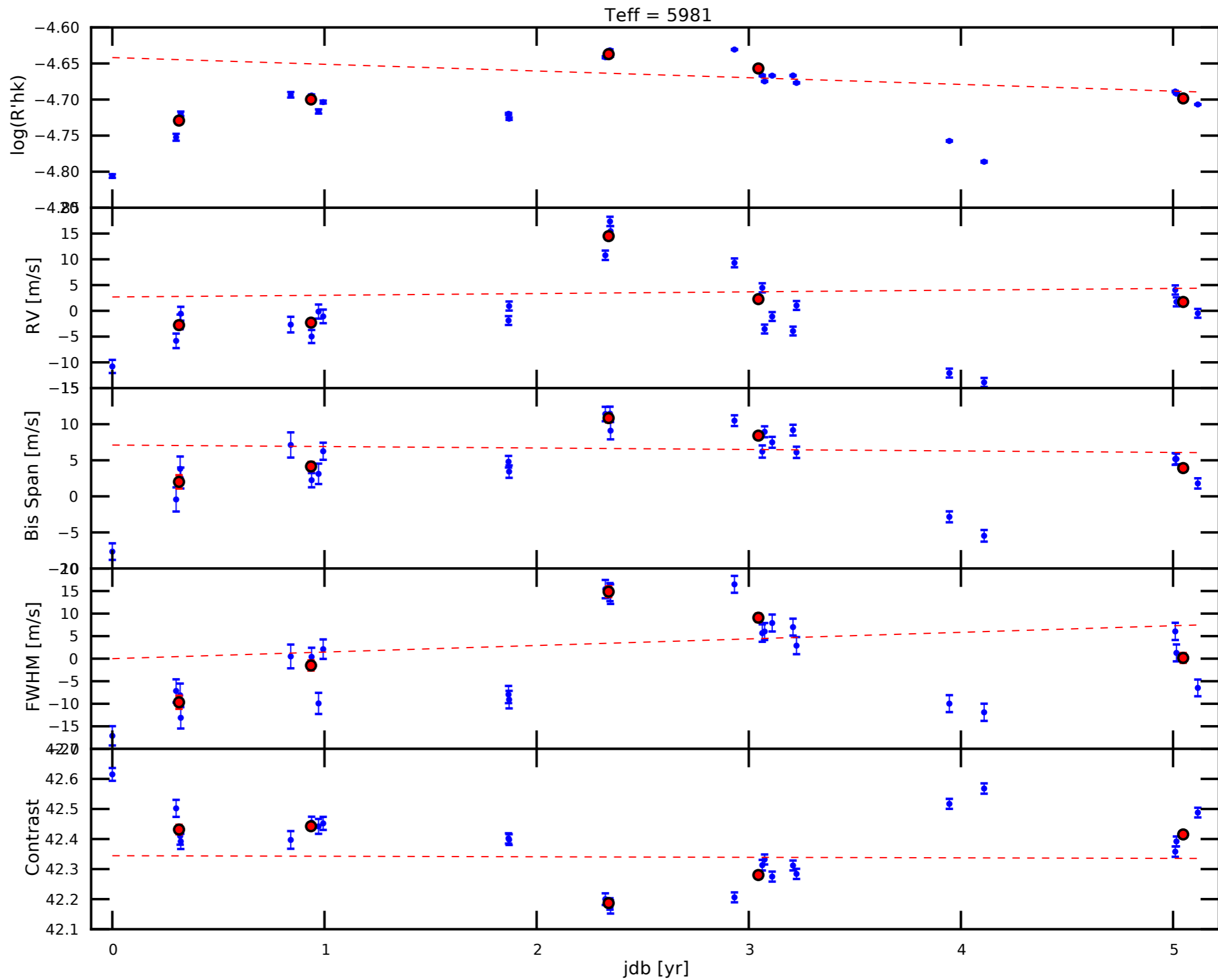


The effects of magnetic cycles

In our small sample of early-K dwarfs (Santos et al. 2010):

- Long term activity cycle variations are “observable” in all activity indexes used (CaII, H-alpha, and HeI)
- Also observable in CCFs BIS, FWHM and Contrast
 - If correlation exists, we will be able to diagnose it! (and maybe to correct it?)
- No clear hint of correlated RV variations
- But: small number of stars observed...

Extended study: FGK dwarfs in HARPS-GTO sample

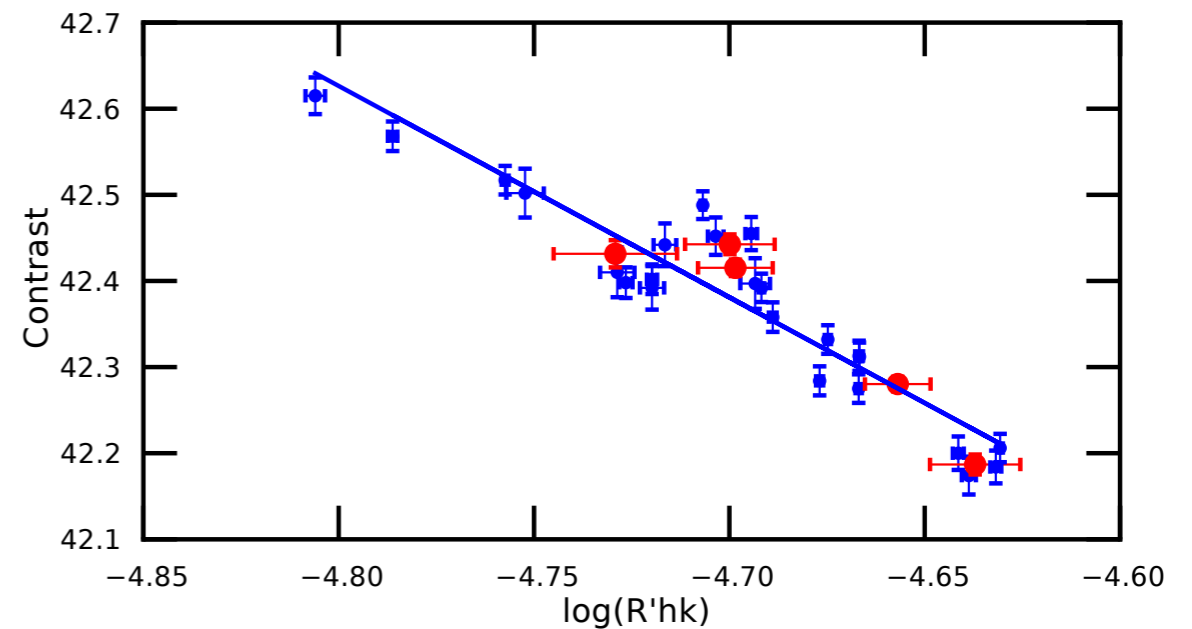
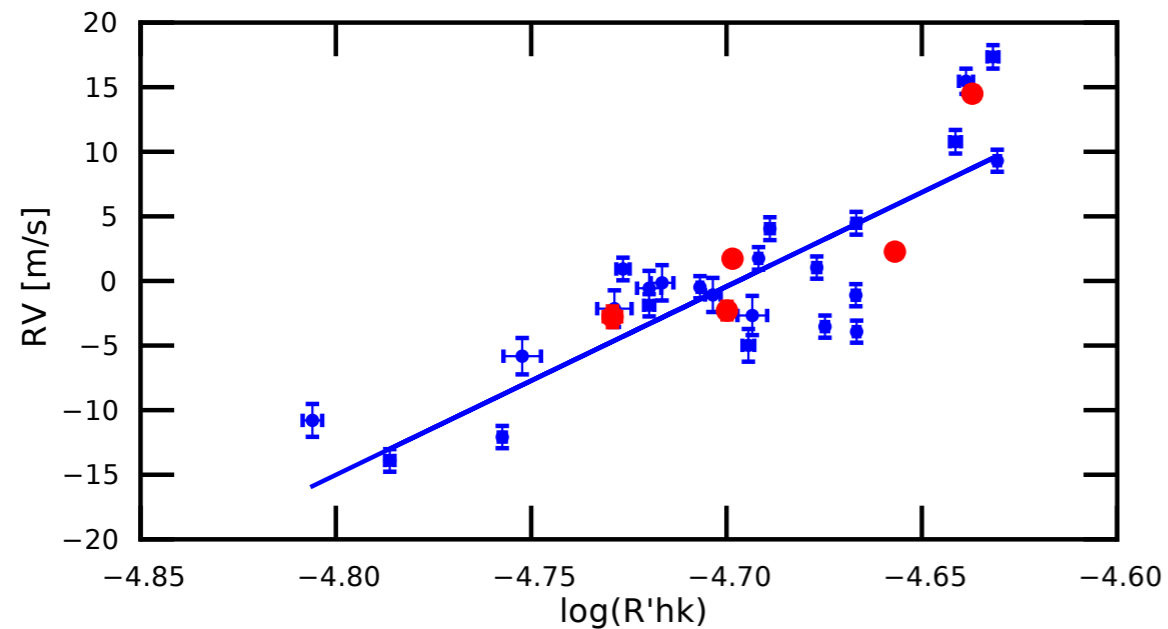
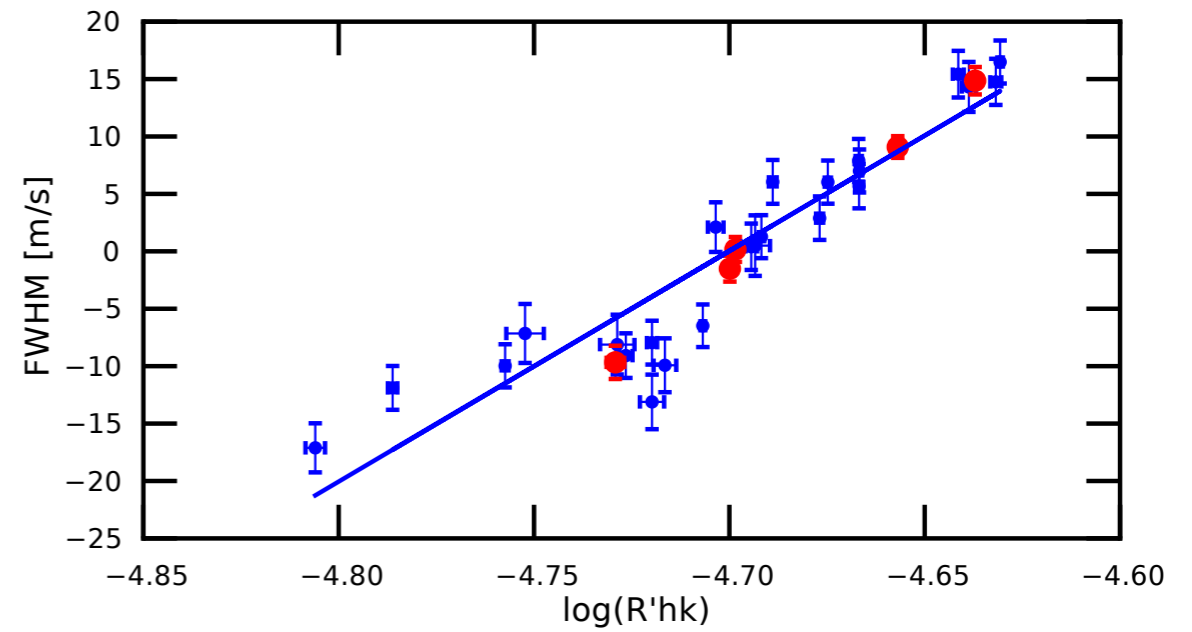
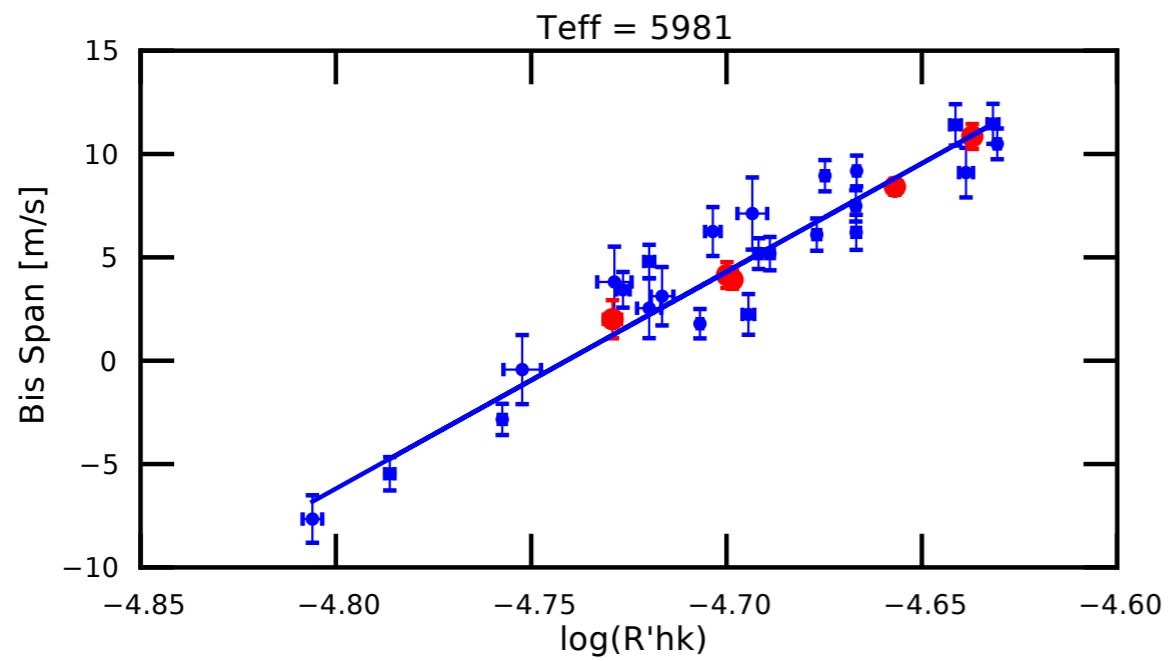


Lovis et al., in prep.

Dumusque et al., in prep.

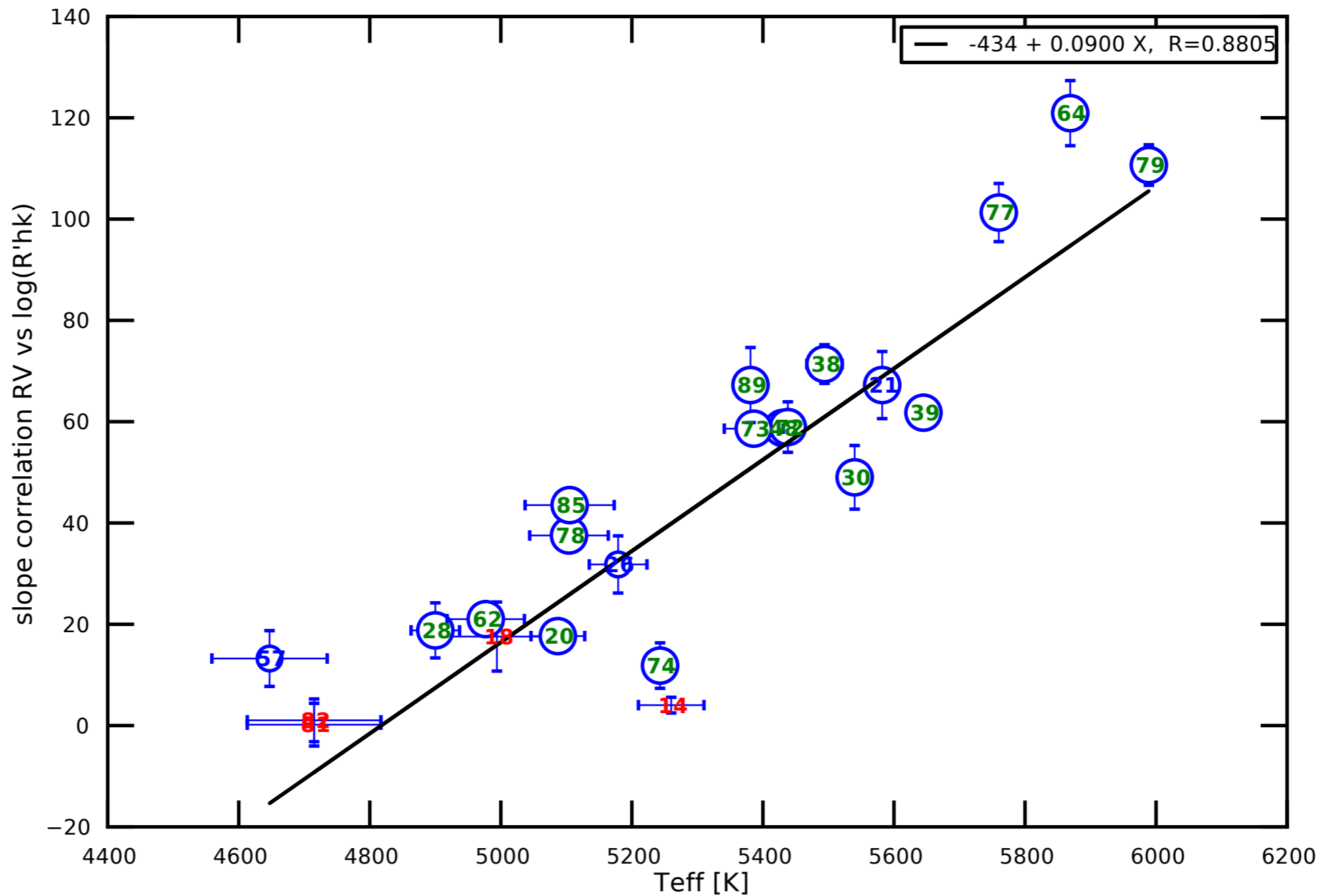
Extend study for FGK dwarfs of HARPS-GTO sample

Dumusque et al., in prep., Lovis et al., in prep.



A correlation with spectral type

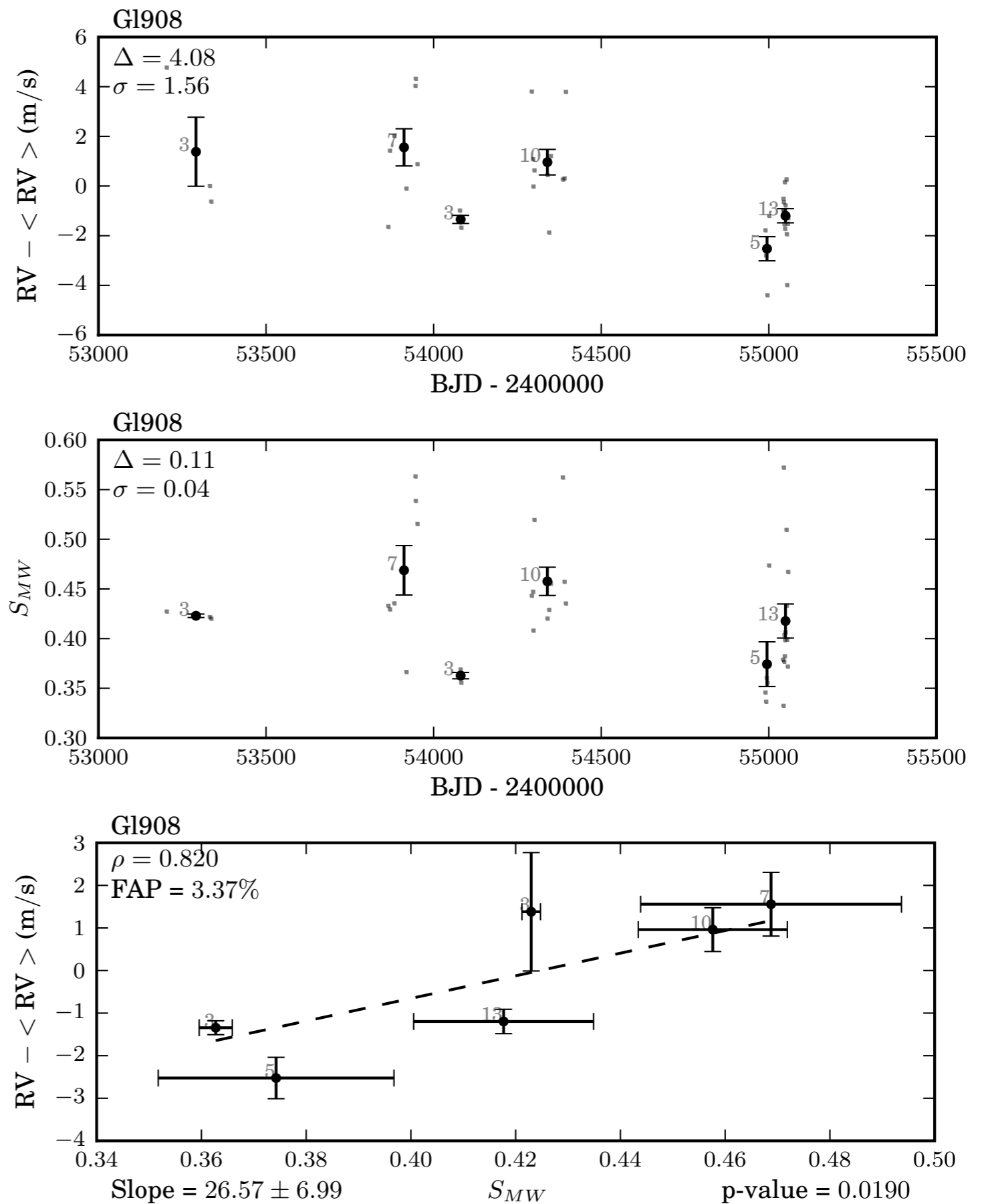
Dumusque et al., in prep., Lovis et al., in prep.



M-dwarfs from HARPS-GTO sample

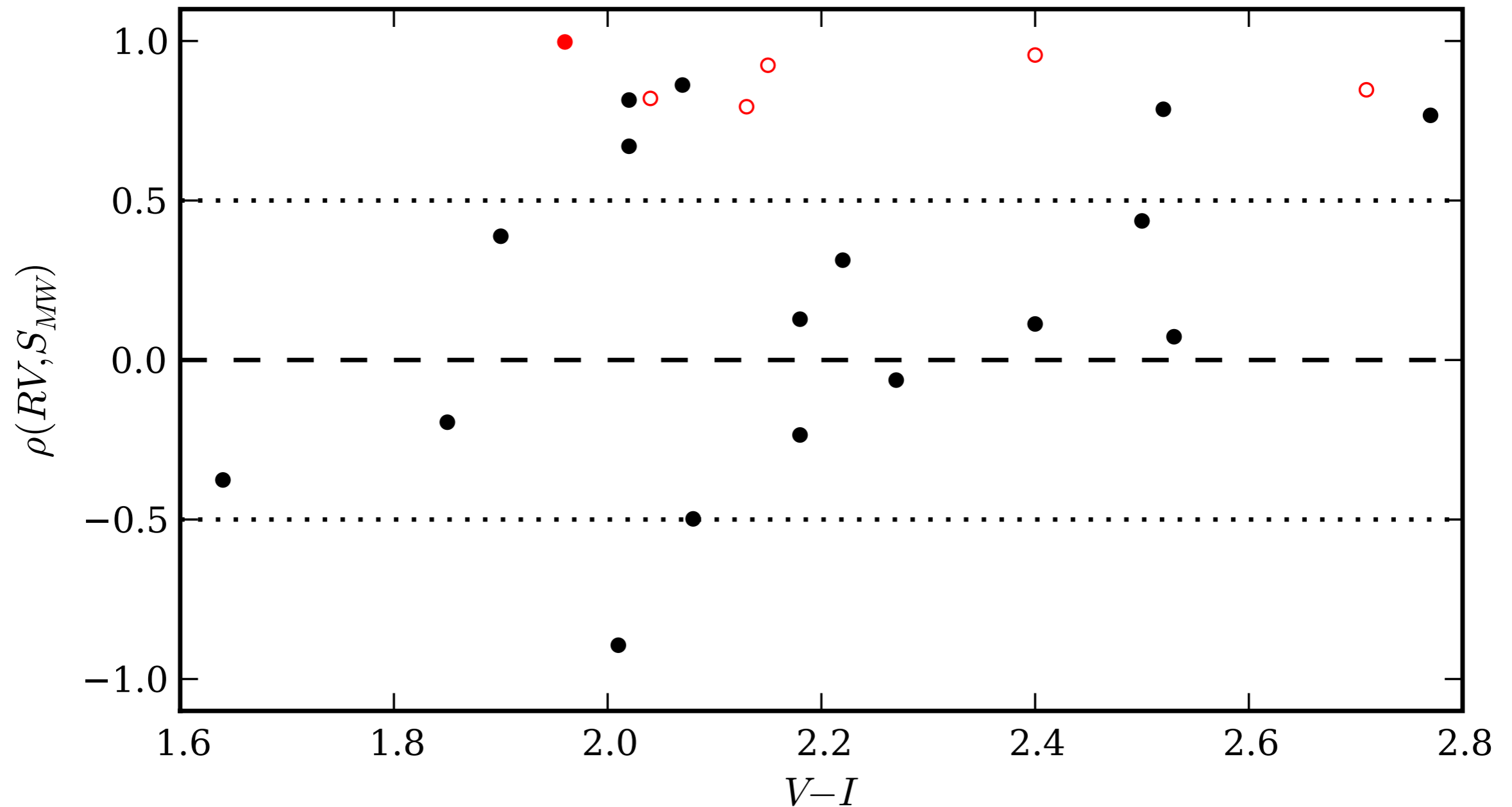
Da Silva et al., in prep.

Several examples of correlation seem to exist



M-dwarfs from HARPS-GTO sample

Da Silva et al., in prep.

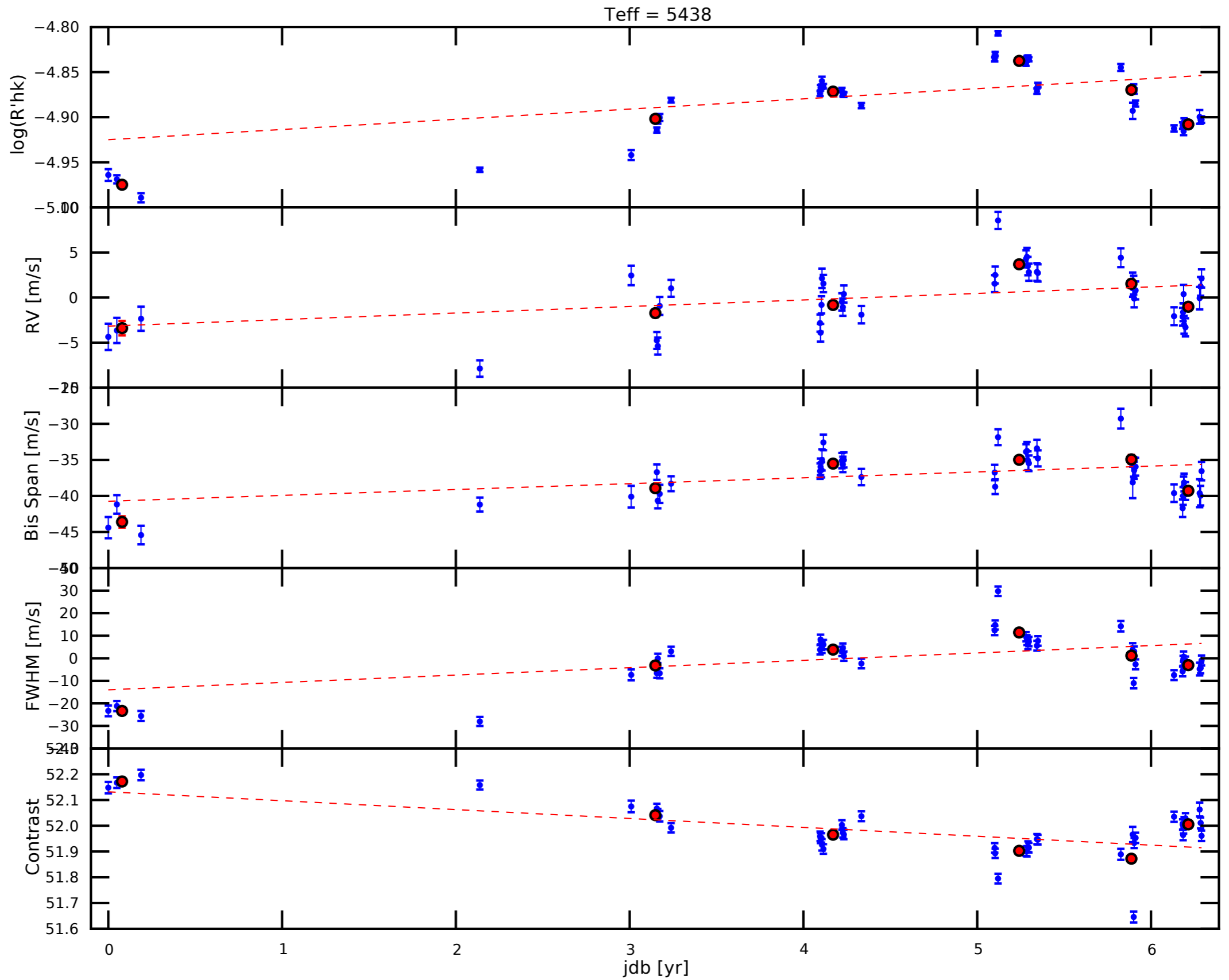


Conclusions

- Examples of long term activity induced signals exist
- Present for both FGK and M dwarfs
 - Stronger for earlier spectral types
- Good news: there are different ways to diagnose these signals (BIS, FWHM, Contrast, Call, Halpha, ...)
- Under investigation: correct for these signals
- Magnetic cycles are *probably* not a main threat to the detection of long period/low mass planets



Several examples of correlation exist!



Dumusque et al., in prep.