Radial and Rotational Velocities of Young BDs VLM stars in Upper Sco and ρ Oph

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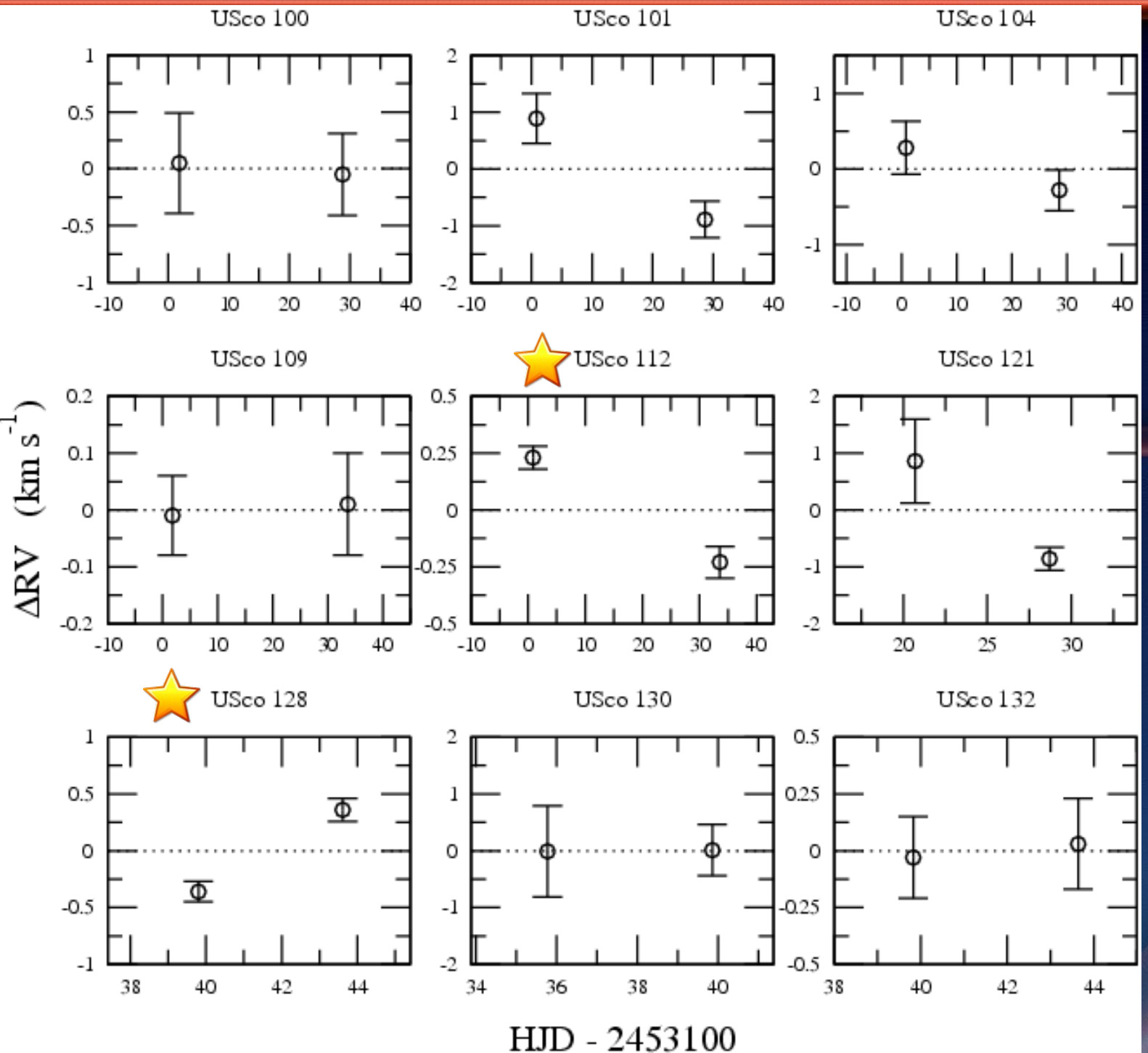
Based on: Kurosawa R., Harries T. J., Littlefair S.P. 2006, MNRAS, 372, 1879

Observations

- Small RV survey of BDs and VLM stars:
  - 14 in Upper Sco (d~145pc)
  - 3 in ρ Oph (d~150pc).
  - Sp. type M5-M8.5, Young (<~10Myr), *I*~14--16.
- UVES spectra (R~40,000, 6708--10,250 Å) at VLT
  - 2 different nights for each objects
  - Separated by 4 to 33 days in April and May 2004.
  - Mean time separation: 21.6 days
- Sensitive to binary separations < 0.1 A.U.
- RV obtained from x-corr of an object and a template spectra.

Sample of Two Epoch RV



- Data from Kurosawa et al. (2006)
- ★ -- Candidates

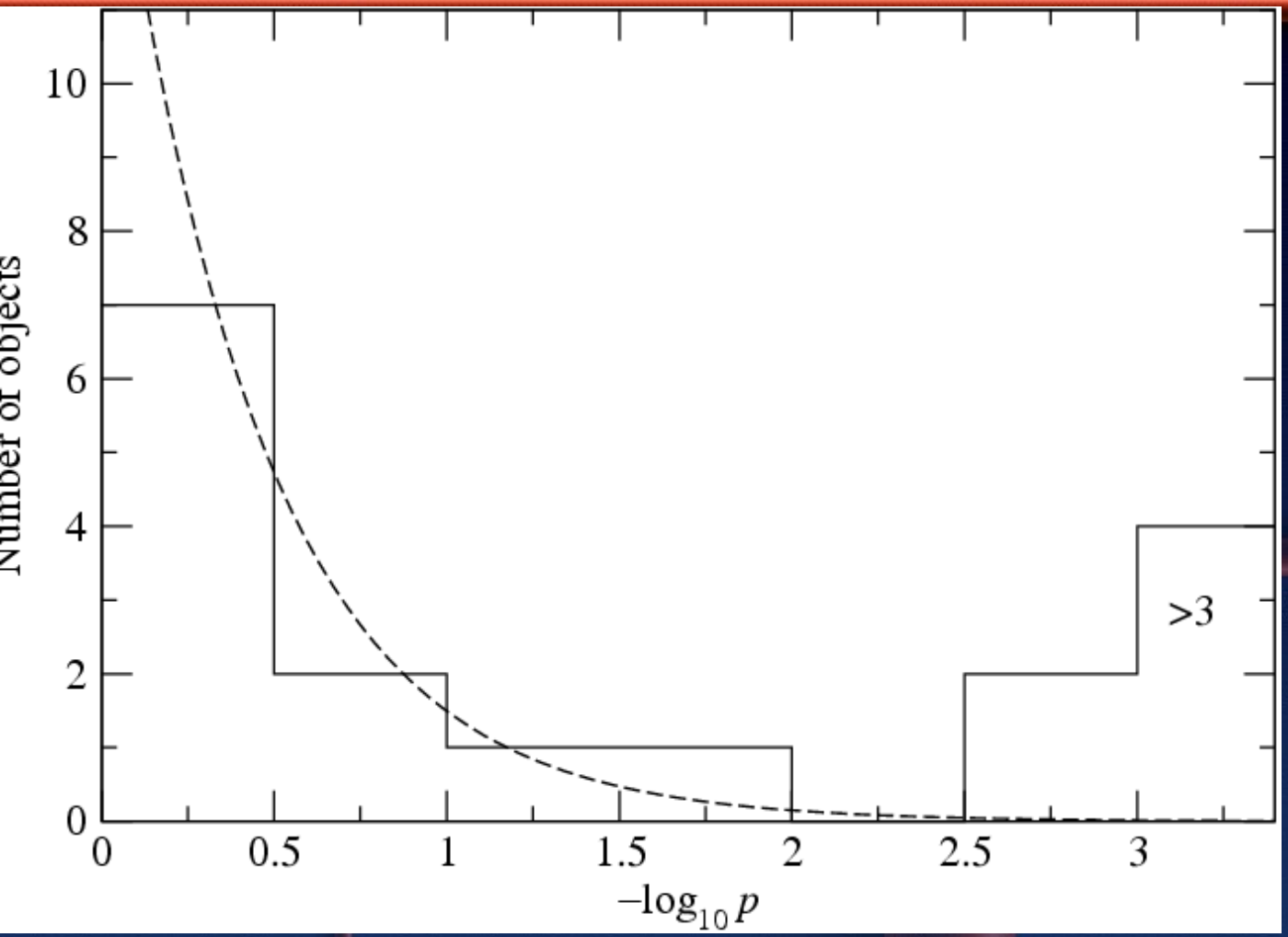
Similar to the plots in Joergens (2006)

Estimating Error in RV

Relative (w.r.t. a template star) RV errors, but not absolute (heliocentric) RV.

1. Add random Gaussian deviates to object spectra based on the S/N for each wavelength bin.
2. Compute the x-corr curve, and measure the position of the peak (V_i)
3. Repeat 1 and 2 for 100 times.
4. Compute the mean and s.d. of 100 trial V_i values. ==> Provides our measurement of RV and error.

Identifying Binary Candidates



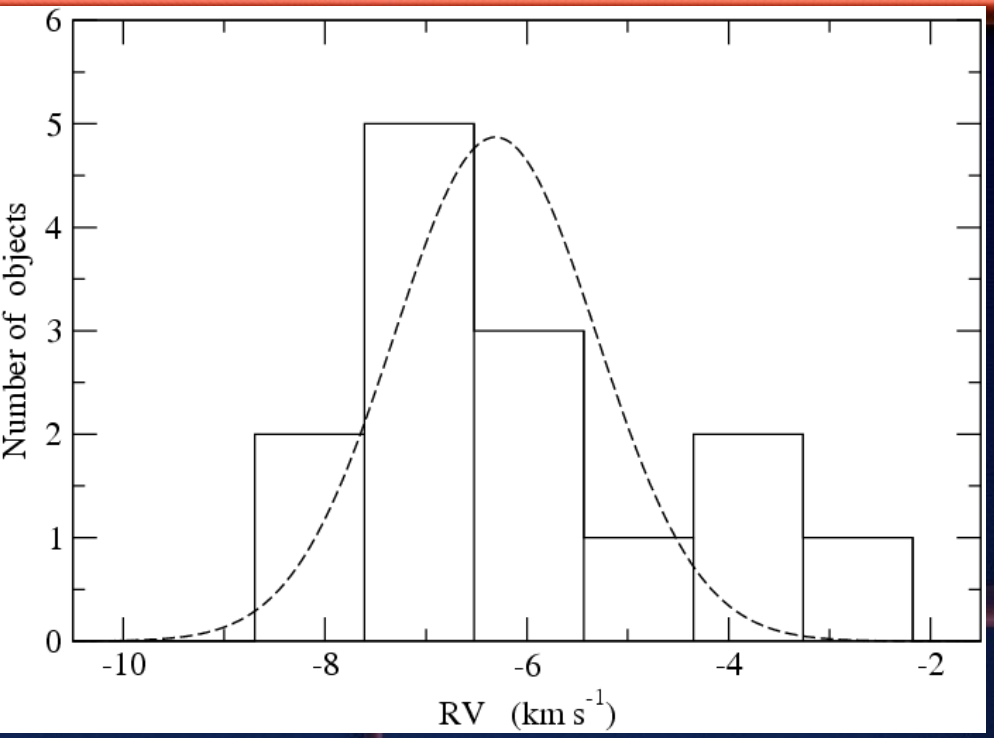
- Two distinct populations
- Objects with $p < 10^3$ are flagged as binary candidate (RED area)

⟶ 4 candidates out of 17.

- Match between the expected distribution and the data on left side is reasonable ==> error estimate is resonable.

- Histogram: χ^2 probability of fits of 2-epoch RV values with a straight line (horizontal, constant value). Same method as in Maxted & Jeffries (2005)
- Dashed Line: Expected # of object for a given *p* (when only have random errors)

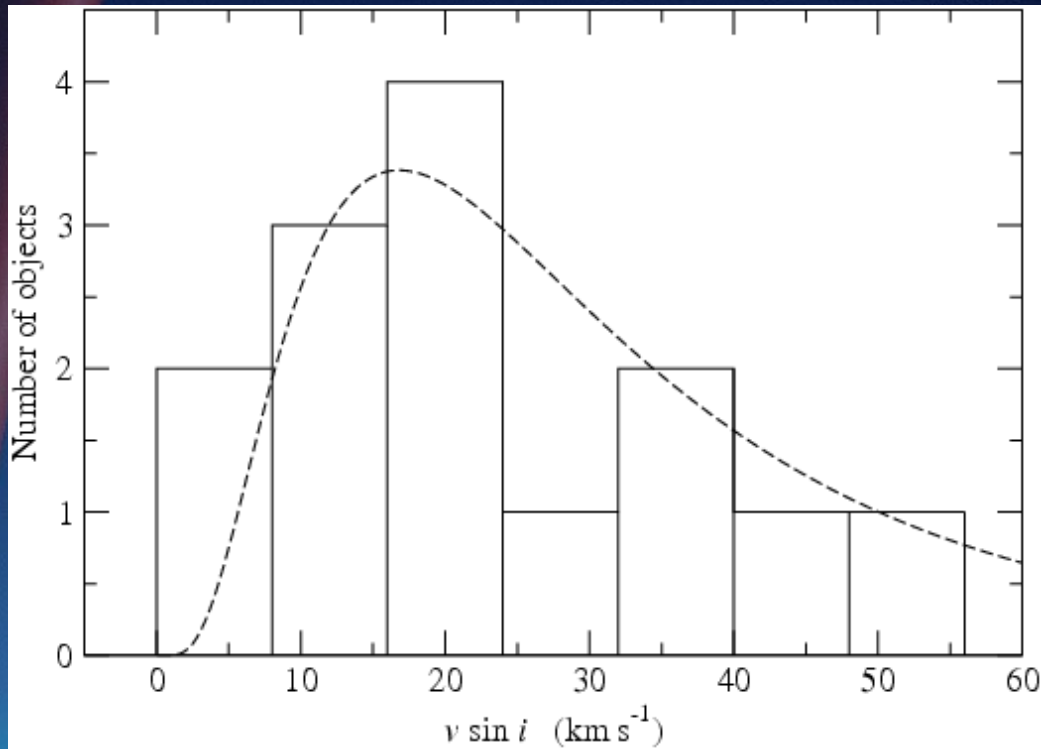
RV and V_{rot} Distributions for USco Objects



<== Histogram of average RV

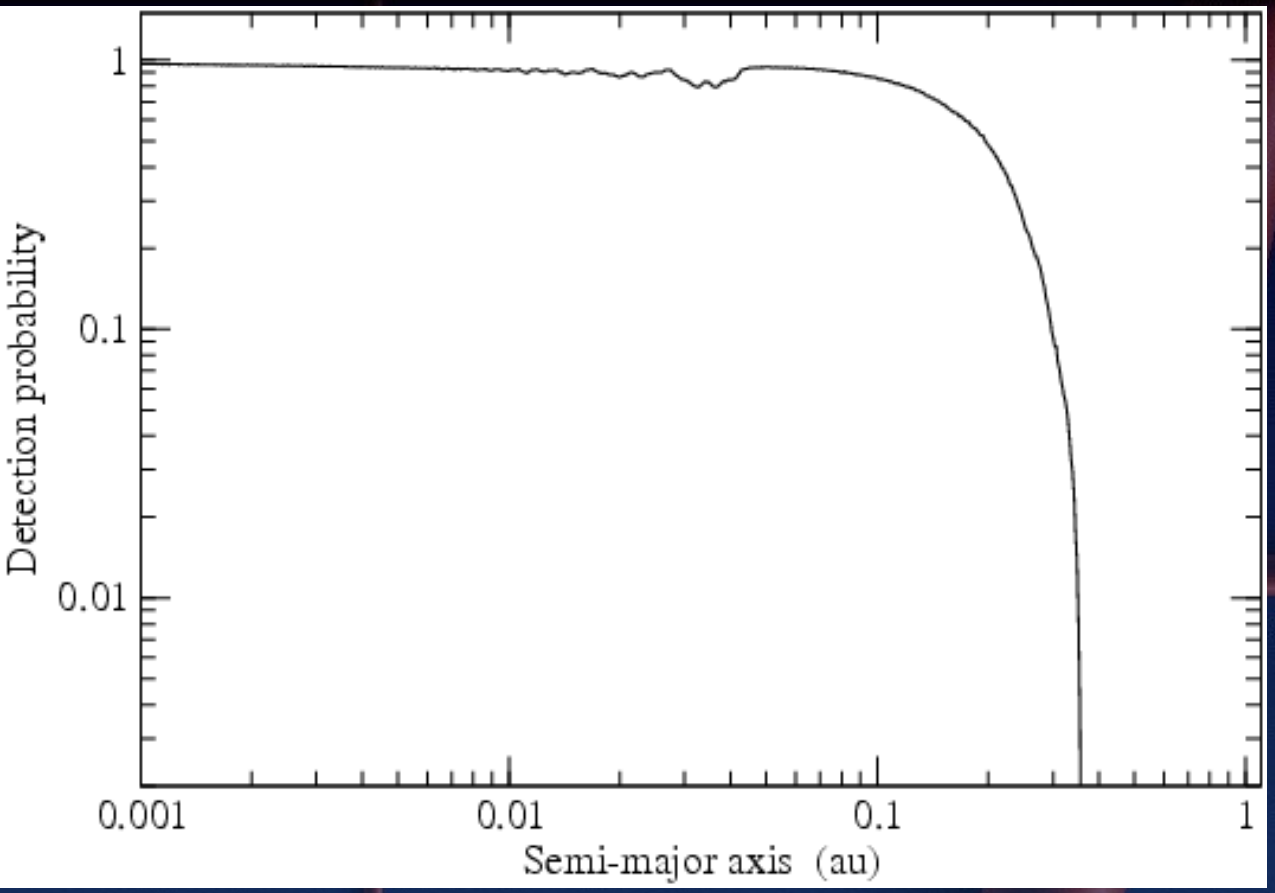
- Gaussian fit: peak @ -6.3 km/s, s.d.=1.0km/s
- c.f. 9 Cha I objects Joergens (2006a): s.d. = 0.9 km/s
- mean RV is more consistent with the lower stellar density model of Bate et al (2003).

Histogram of V_{rot} sin *i* ==>



- Range: 3.6—55.6km/s (similar range found in Mohanty et al 2006).
- Log normal fit: peak @ 16.9 km/s, s.d. = 27.8 km/s
- The peak is similar to that of Cha I objects in Joergens & Guenther (2001), but s.d. is much larger here.

Binary Fraction and Detection Probability



- Binary fraction:

  f = 24 (+16/-13) %

← 80% detect. prob. for a<0.1 AU.

- Method in Maxted & Jeffries (2005) and Bari & Reiners (2006) used here.

- Monte Carlo experiments: 10^5 pairs simulated RV measurements with ranges of mass ratio (q) assuming circular orbits for a fixed semi-major axis of a model binary. (Mass of primary, error in RV, time separation used from observation).
- Using the mean time-separation of our observations (21.6 d).

Summary

- Found four candidates (USco 112, USco 128, USco 40, USco 55 in order of likelihood) out of 17. Binary fraction f = 24 (+16/-13) %
- No double-line system found in the sample.
- RV dispersion of USco is similar to that Cha I (Joergens 2006)
- $V \sin i$ peaks at 16.9 km/s which is similar to the value in Cha I (Joegens & Guenther 2001)
- χ^2 probability method is arbitrary? (Which threshold p)? A better statistical method required?