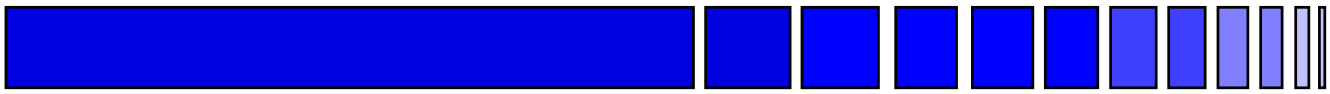


Preliminary Results from the APO Diffuse Interstellar Band Survey

Ben McCall — University of California at Berkeley

Julie Thorburn, Lew Hobbs, Dan Welty — University of Chicago

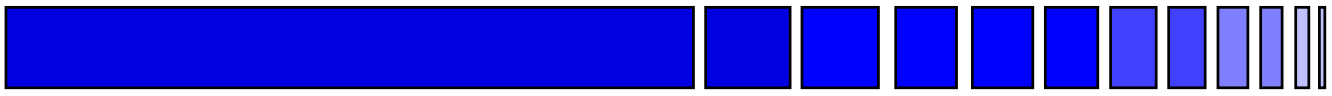
Ted Snow, Brian Rachford — University of Colorado at Boulder

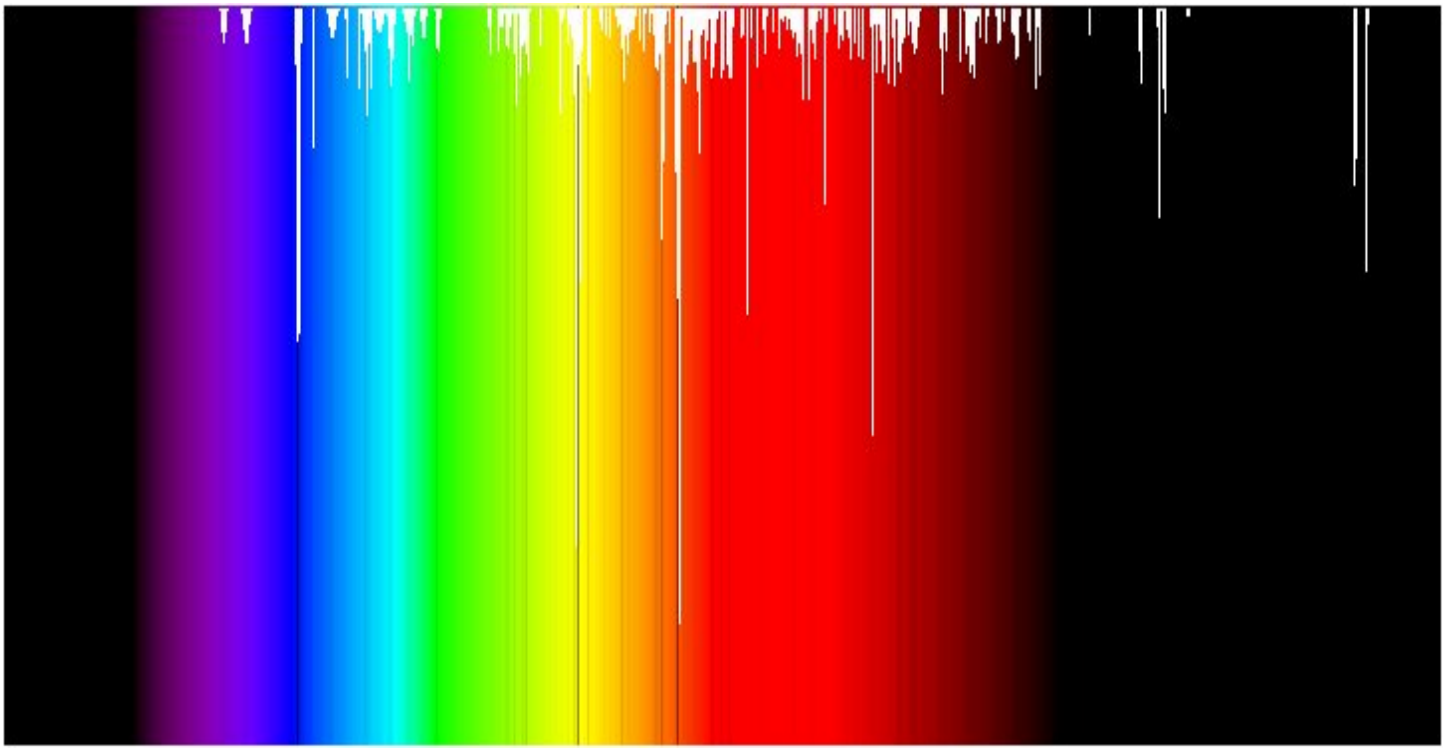
Paule Sonnentrucker, Scott Friedman — Johns Hopkins University

Takeshi Oka, Don York — University of Chicago

Ben McCall

Diffuse Interstellar Bands





★ Over 200 sharp and broad ("diffuse") bands

★ Seen in absorption against reddened stars

★ Range from ~4430 Å to >8000 Å

★ Associated with diffuse ($n \sim 10^2$ cm^{-3}) clouds

★ Not all correlated; roughly increase with E_{B-V}

★ Long-standing astrophysical mystery!
(also CH^+ and H_3^+)

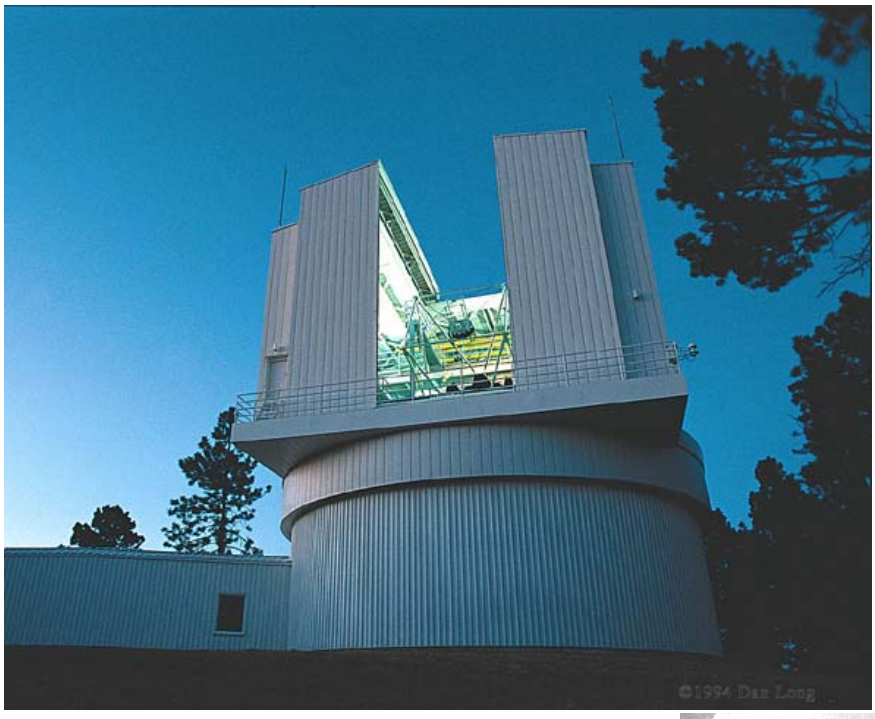
Ben McCall

The APO DIB Survey

- Current data inadequate for detailed comparisons
  - either “atlas” of a few stars
  - or “survey” of a small spectral region
- Goals of our survey:
  - large sample of stars (~150)
  - wide wavelength coverage
  - moderately high resolution
  - high signal-to-noise (~1000)

Ben McCall

Apache Point Observatory



3.5 meter telescope

near White Sands, New Mexico

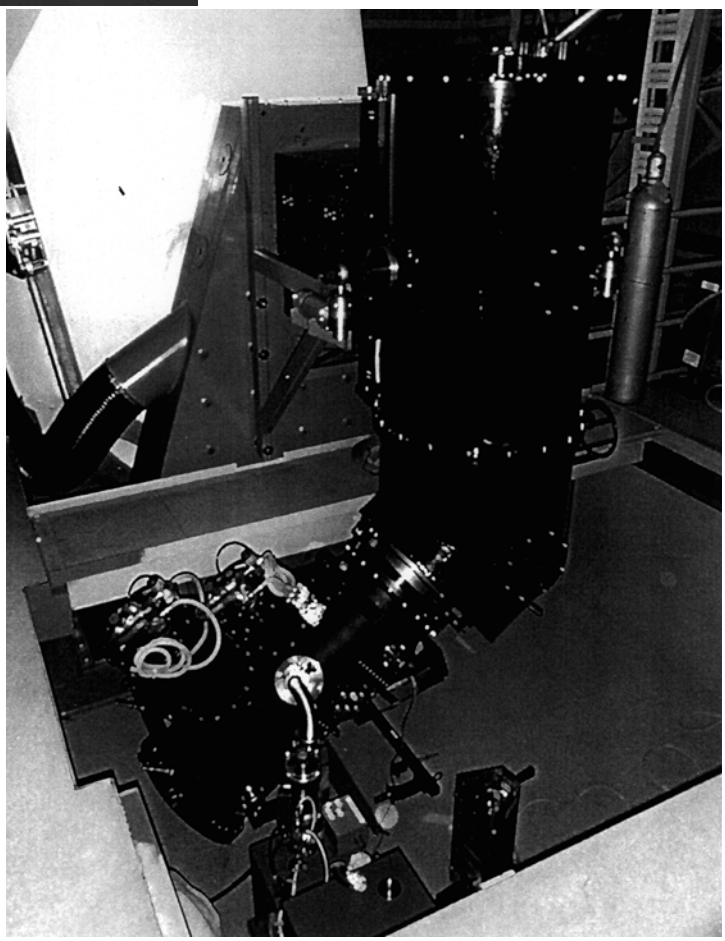
Astrophysical Research Consortium

Echelle Spectrometer:

Blazeless spectrum from 3600 — 10,200 Å in single exposure

High resolution ($\lambda / \Delta\lambda \sim 37{,}500$)

High sensitivity (S/N~1000)



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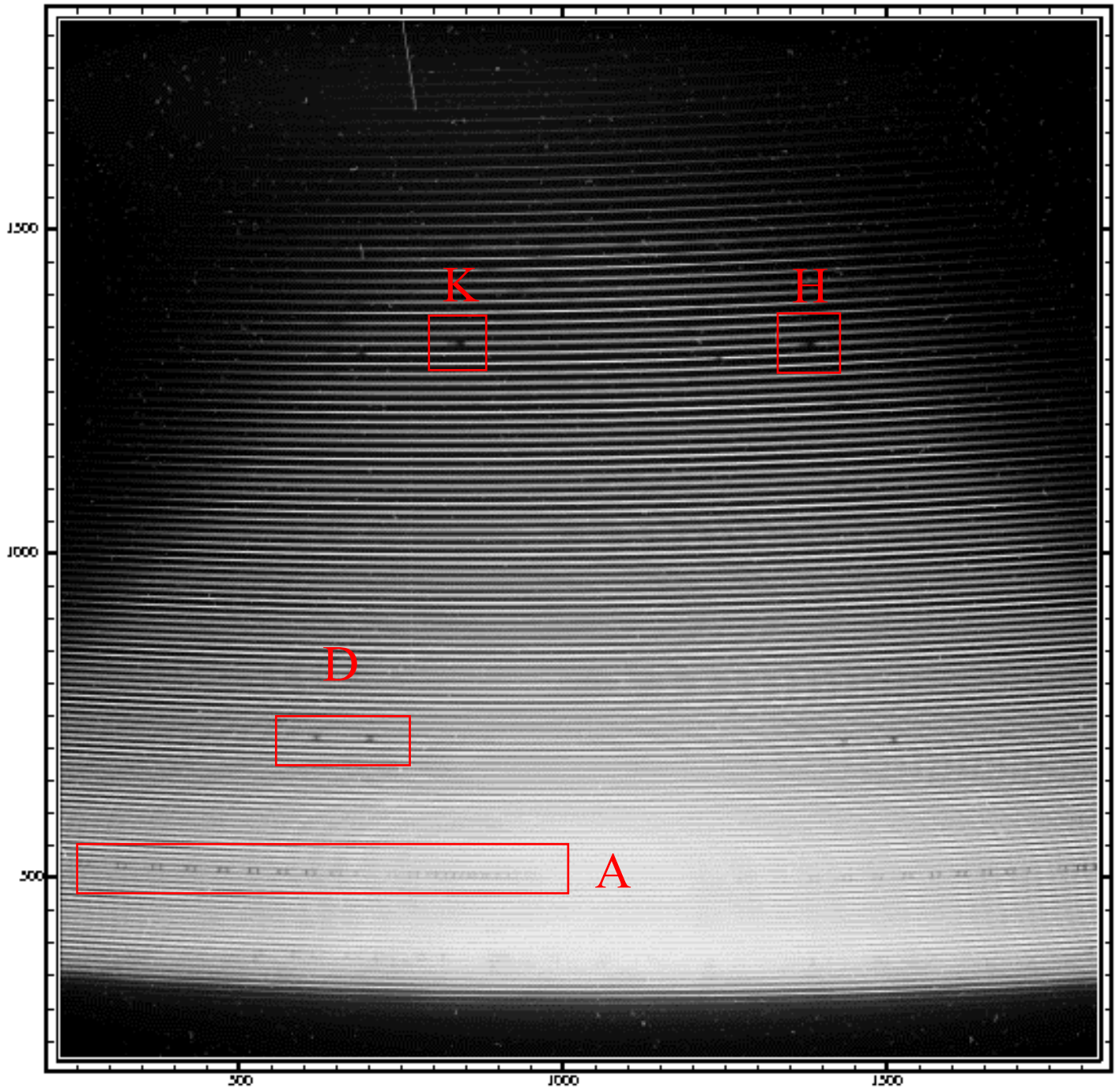
Echelle Image



Fraunhofer Lines

A: O_2 ~ 7650 Å D: Na I ~ 5890 Å

H: Ca II ~ 3968 Å K: Ca II ~ 3934 Å

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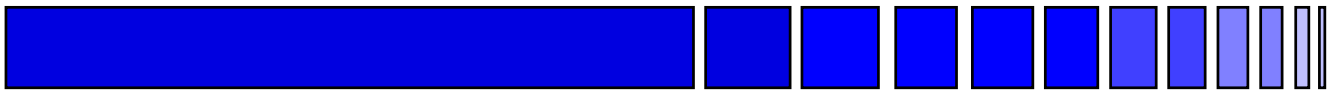
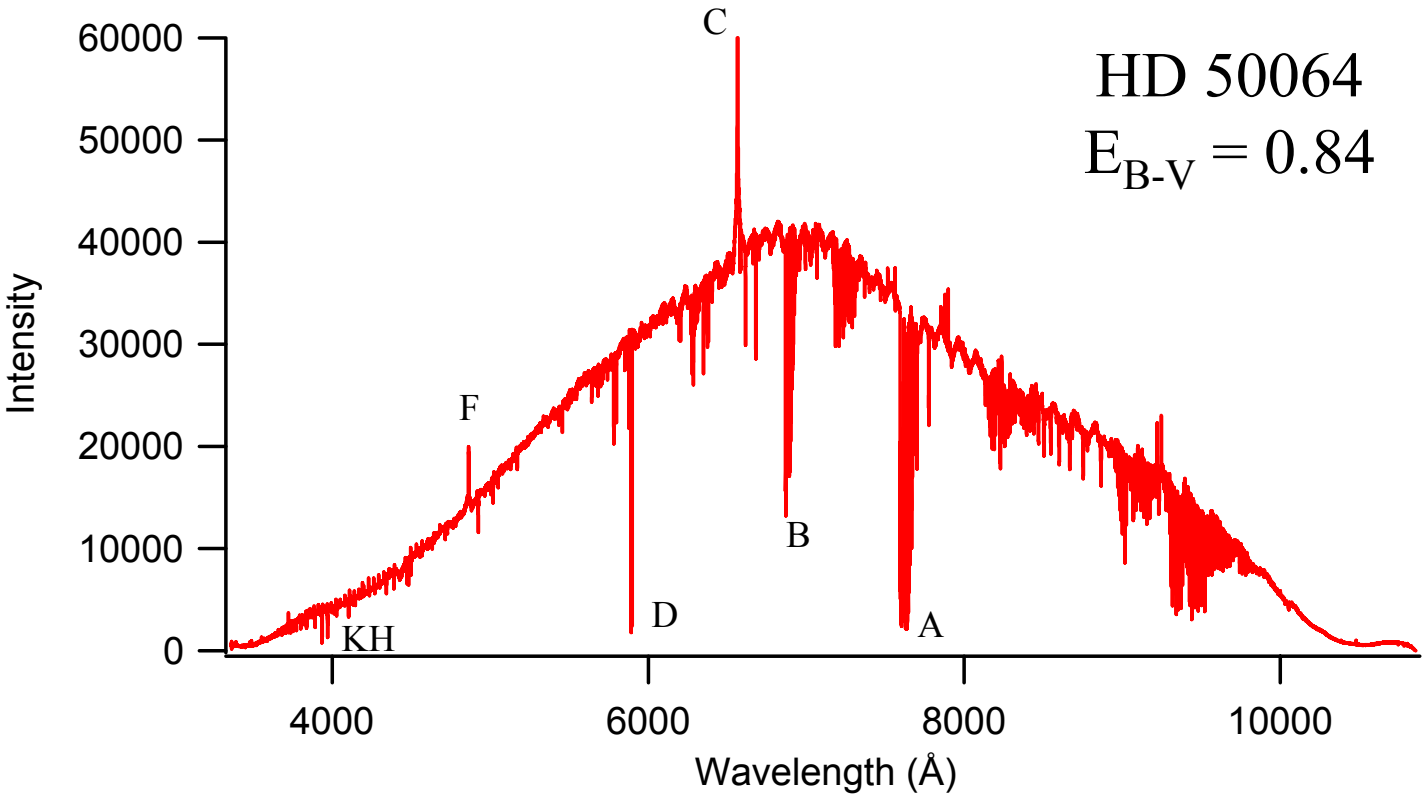
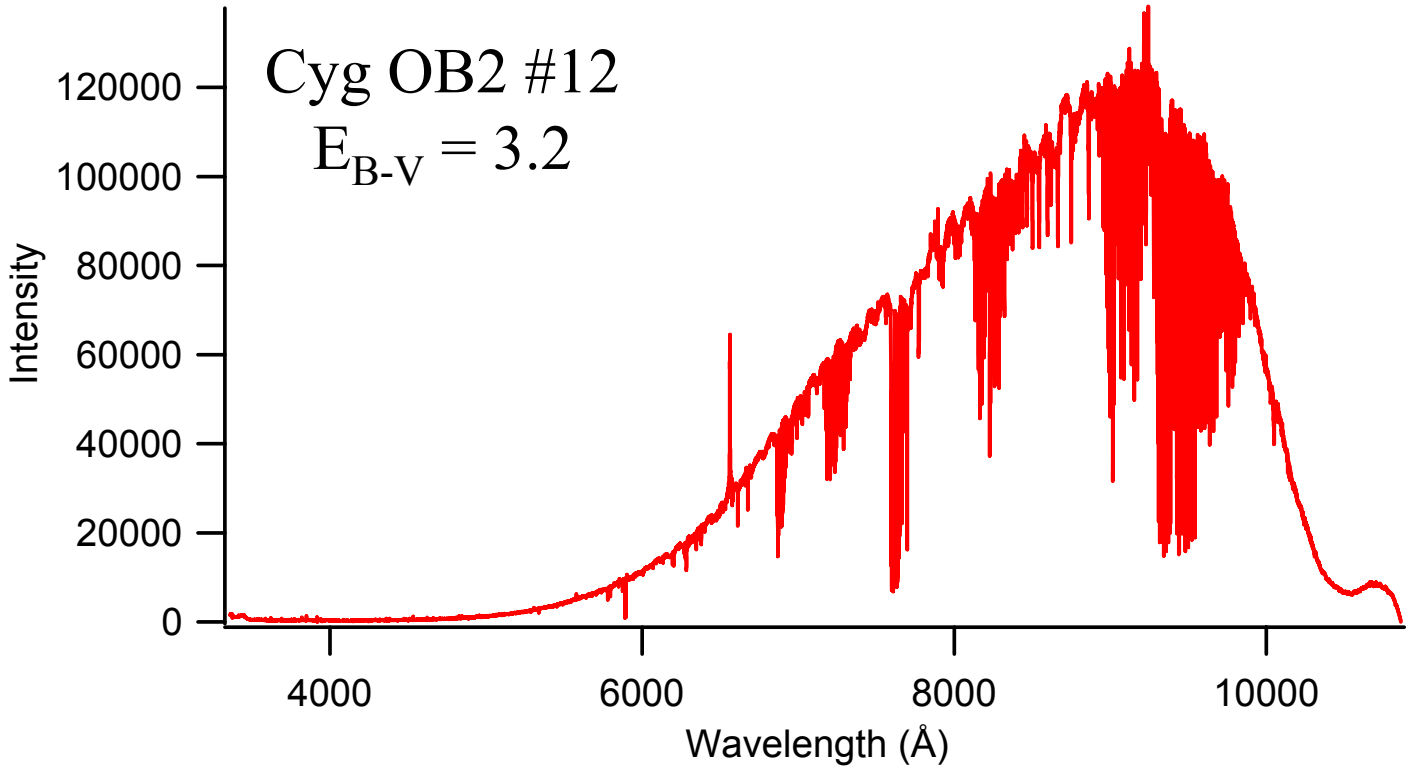
Stellar Spectra







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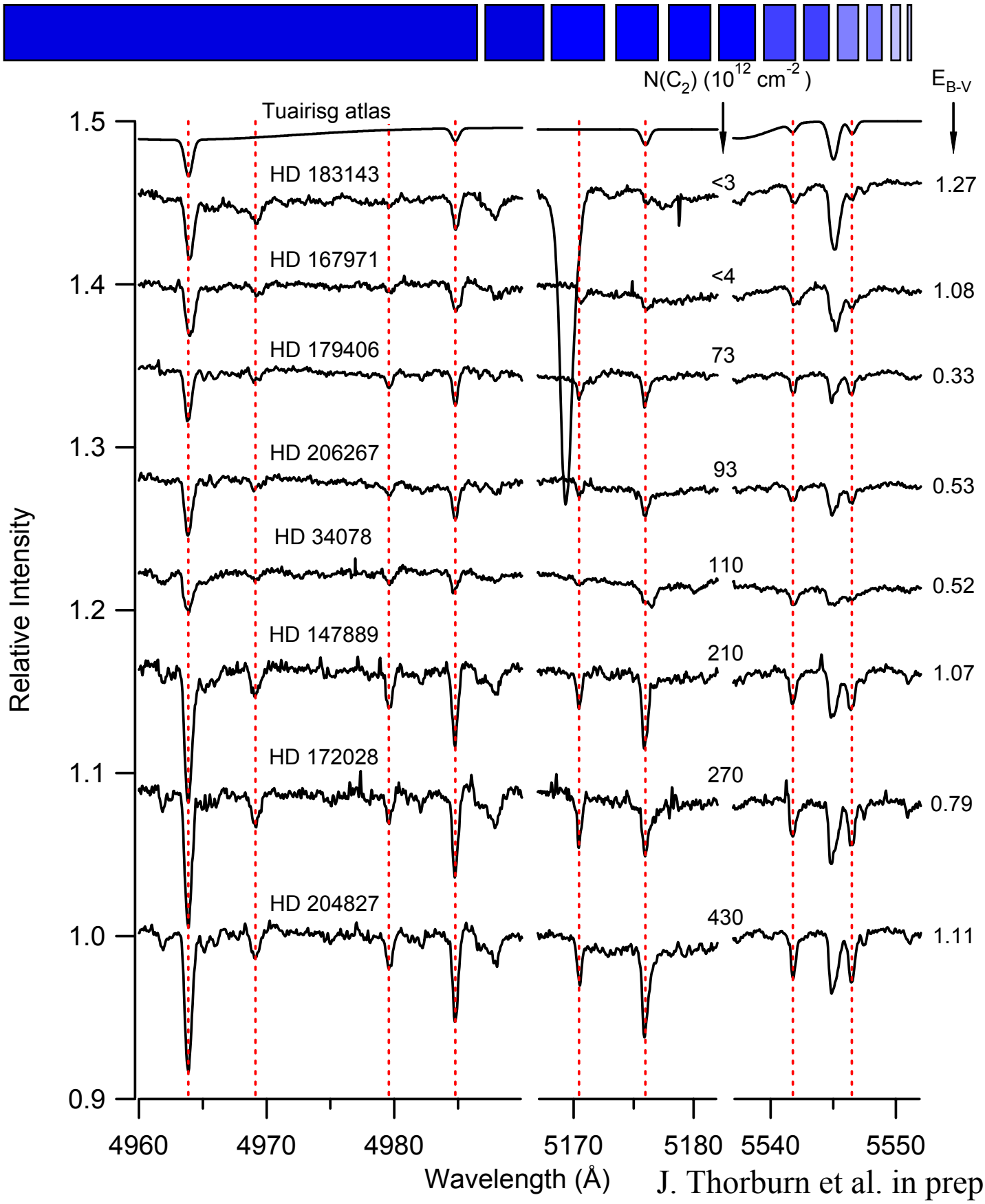
"C_2 DIBs"



J. Thorburn et al. in prep.

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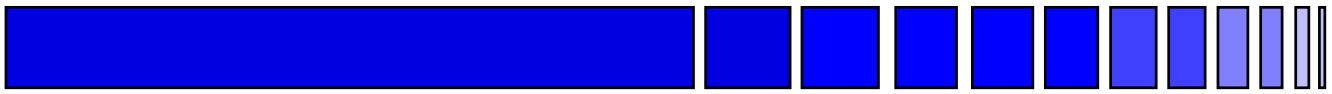
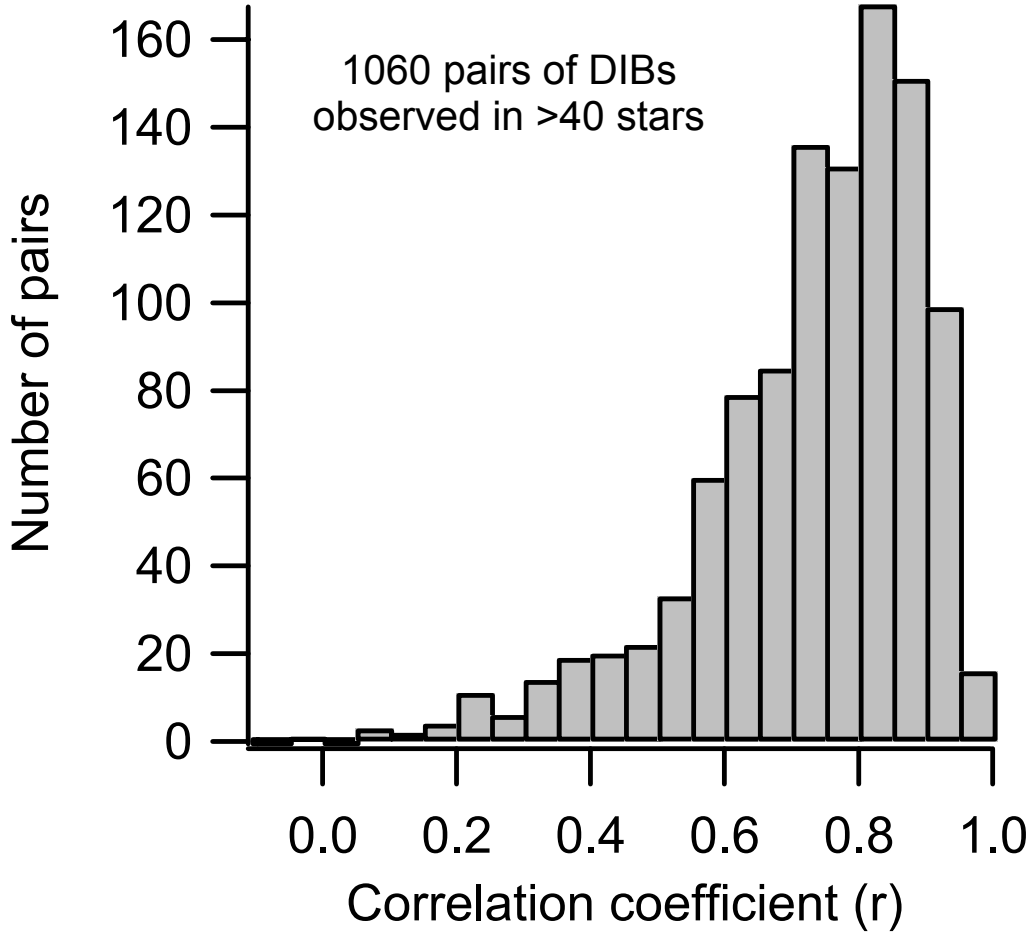
DIB Families?



- DIBs likely originate from the ground state

- Multiple (vibronic) bands from same molecule?
  - intensities T-independent
  - only Franck-Condon factors

- Search for DIBs whose intensities are correlated from star to star → common carriers



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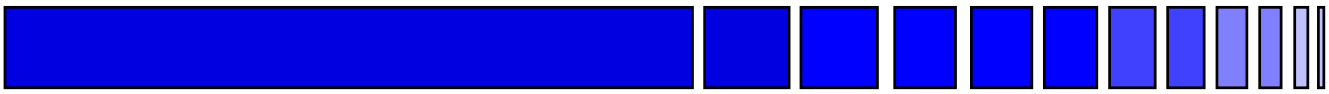
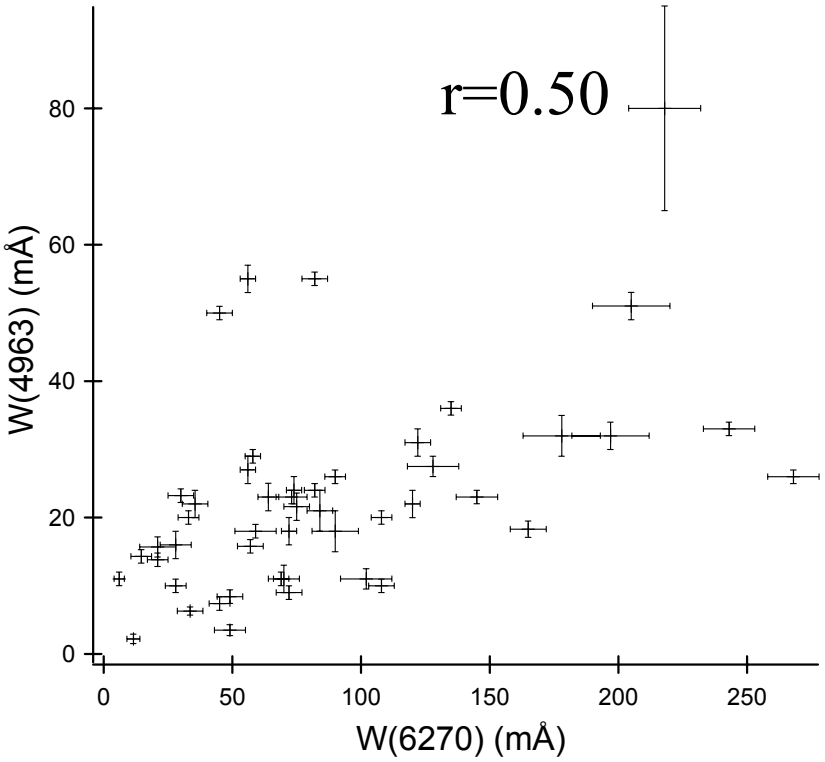
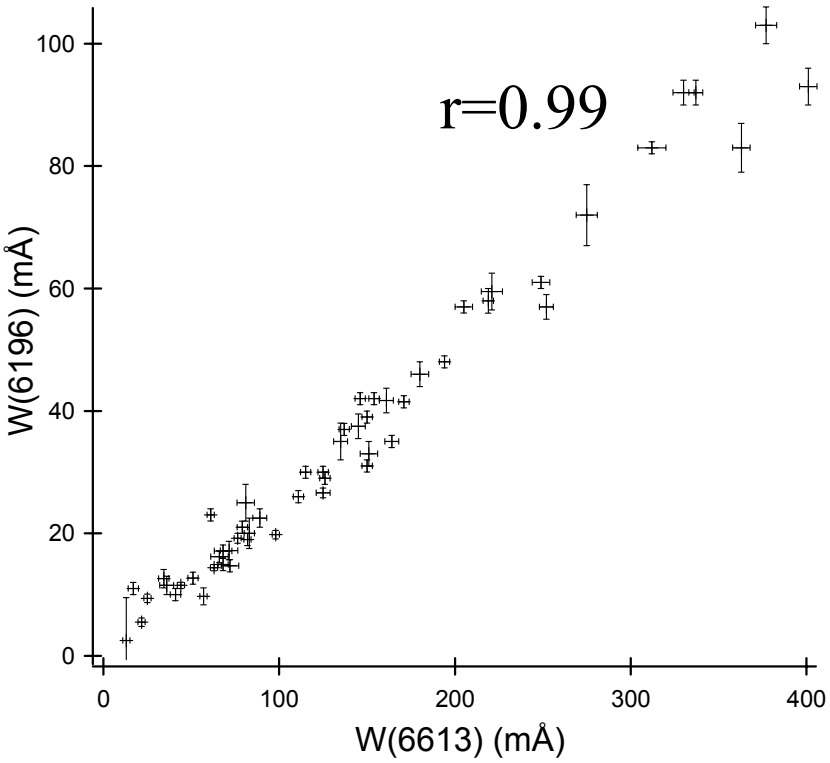
DIB Correlations





"C_7^- bands"



Two narrow DIBs with resolved structure

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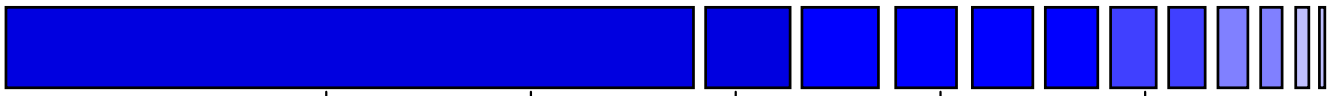
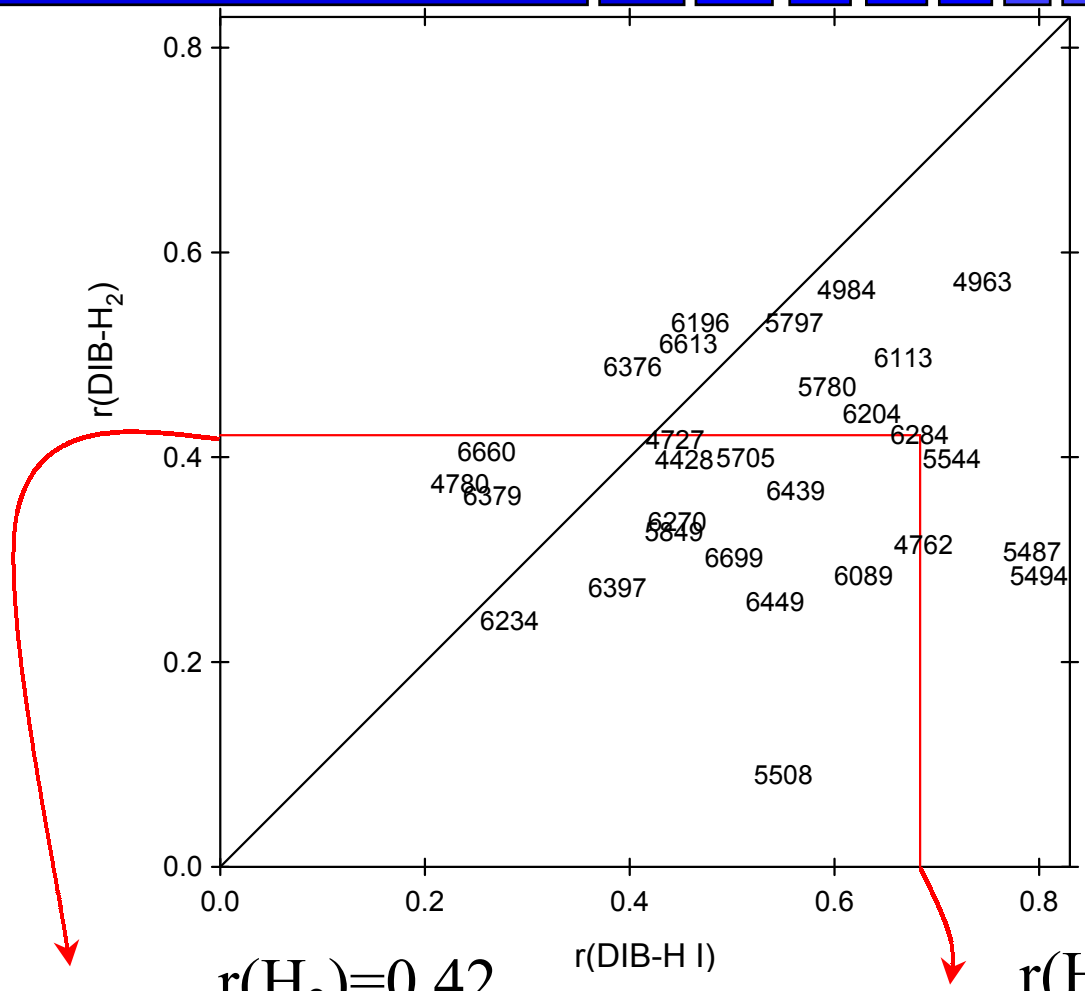
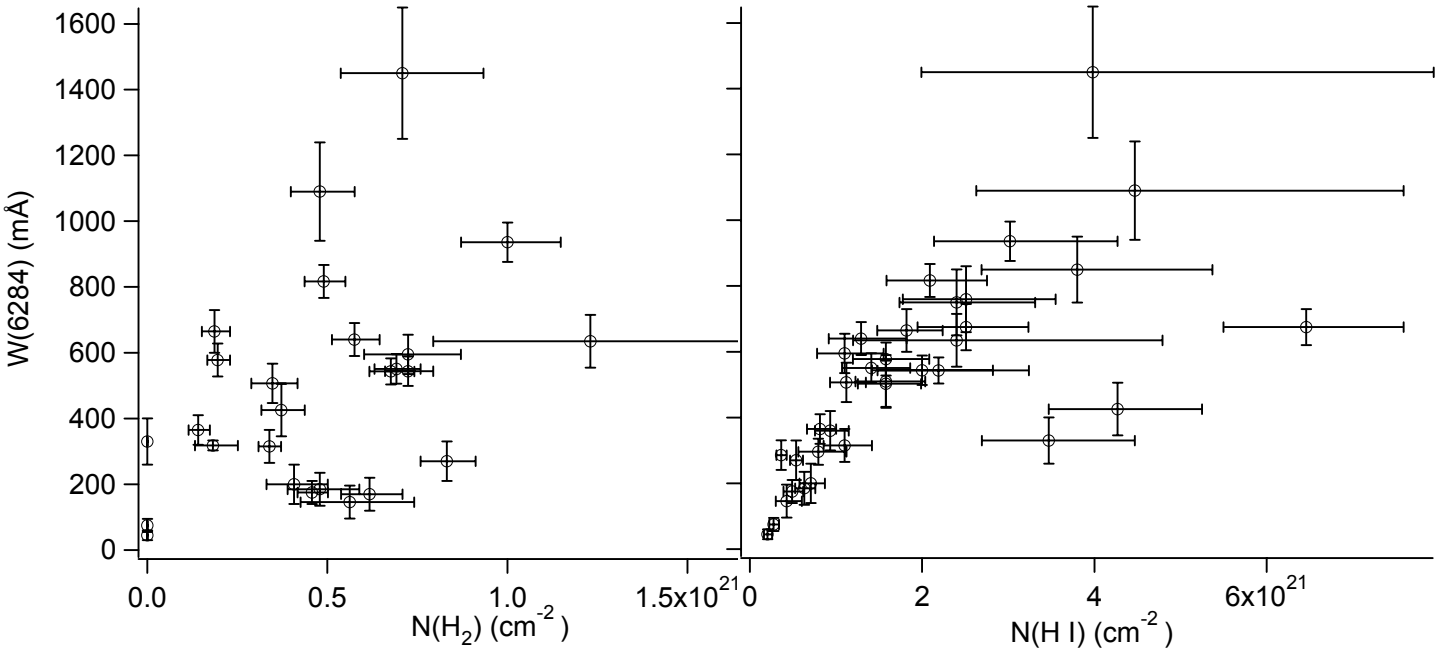
DIBs versus H & H_2





r(H_2)=0.42

r(H)=0.68



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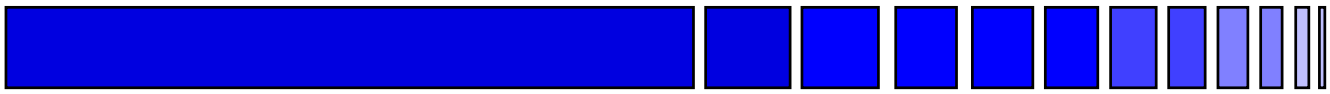
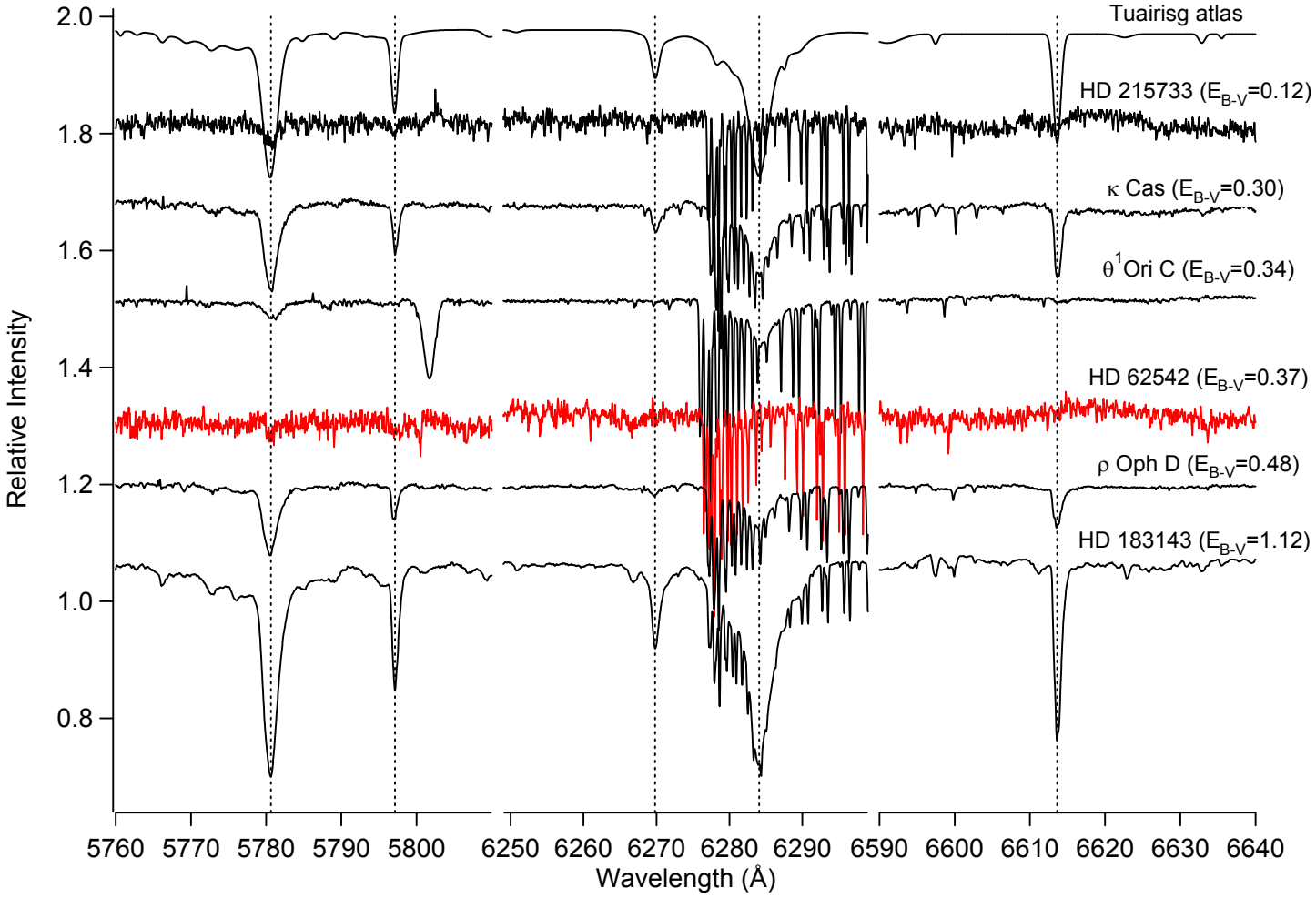
Weak DIBs in HD 62542





- UV extinction curve similar to dark clouds
- C_2 excitation suggests n ~ 1000 cm^{-3}
- CH, CN, C_2 abundant, but no CH^+ detected

- DIBs essentially absent!
  - perhaps this is a dense cloud whose more diffuse outer layers have been stripped away?

T.P. Snow et al., ApJ in press

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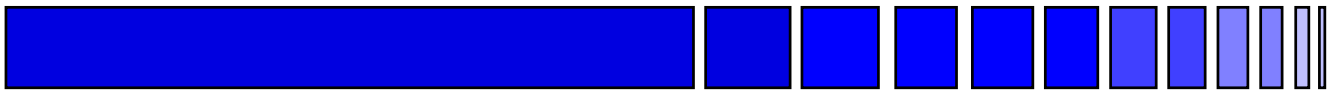
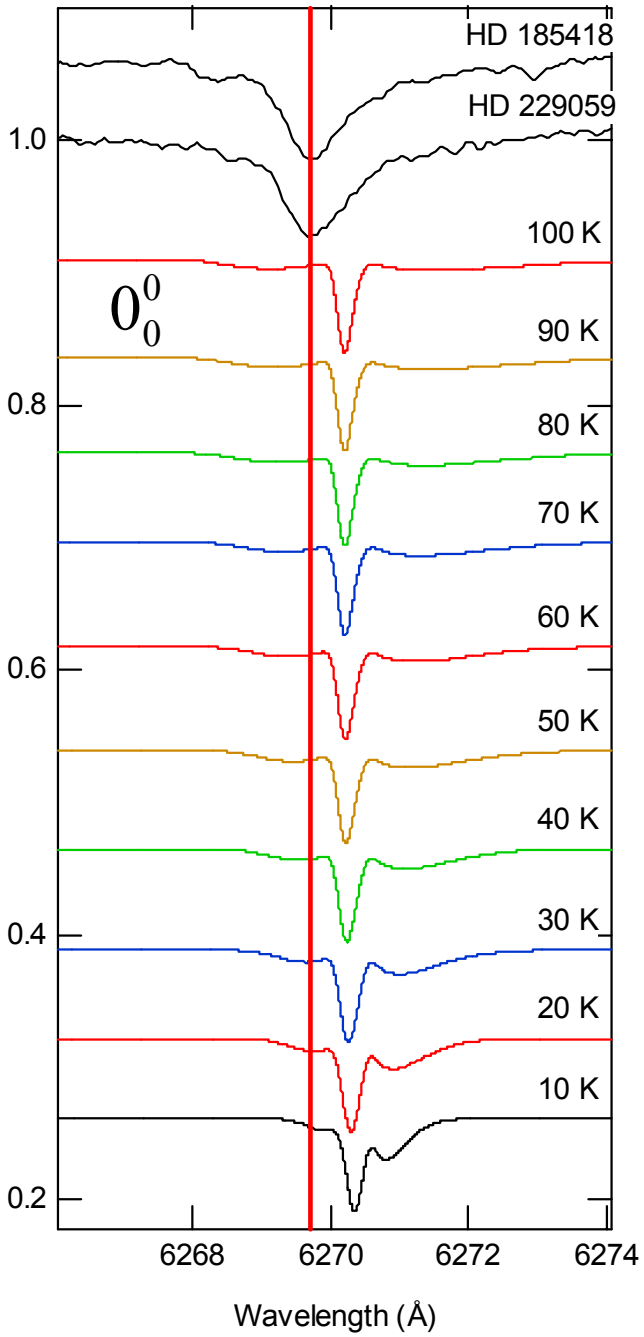
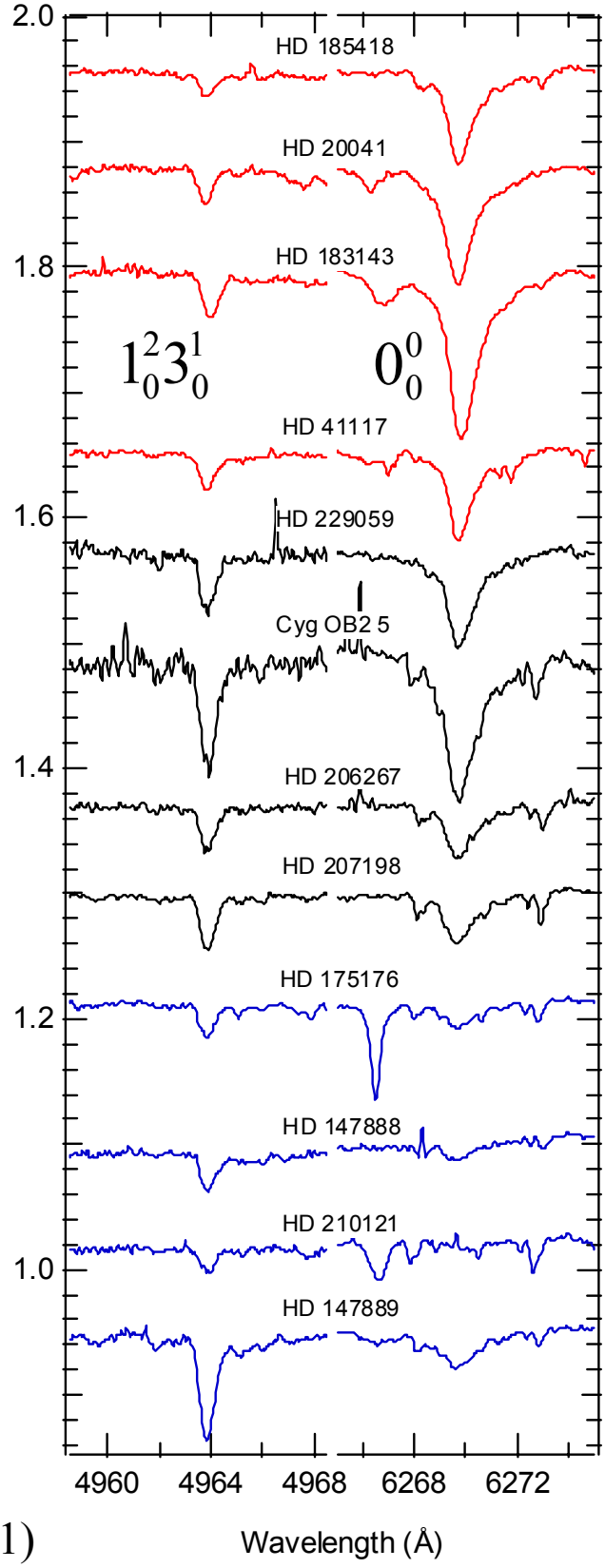
Comparison with C_7^-







B.J. McCall et al., ApJ 559, L49 (2001)

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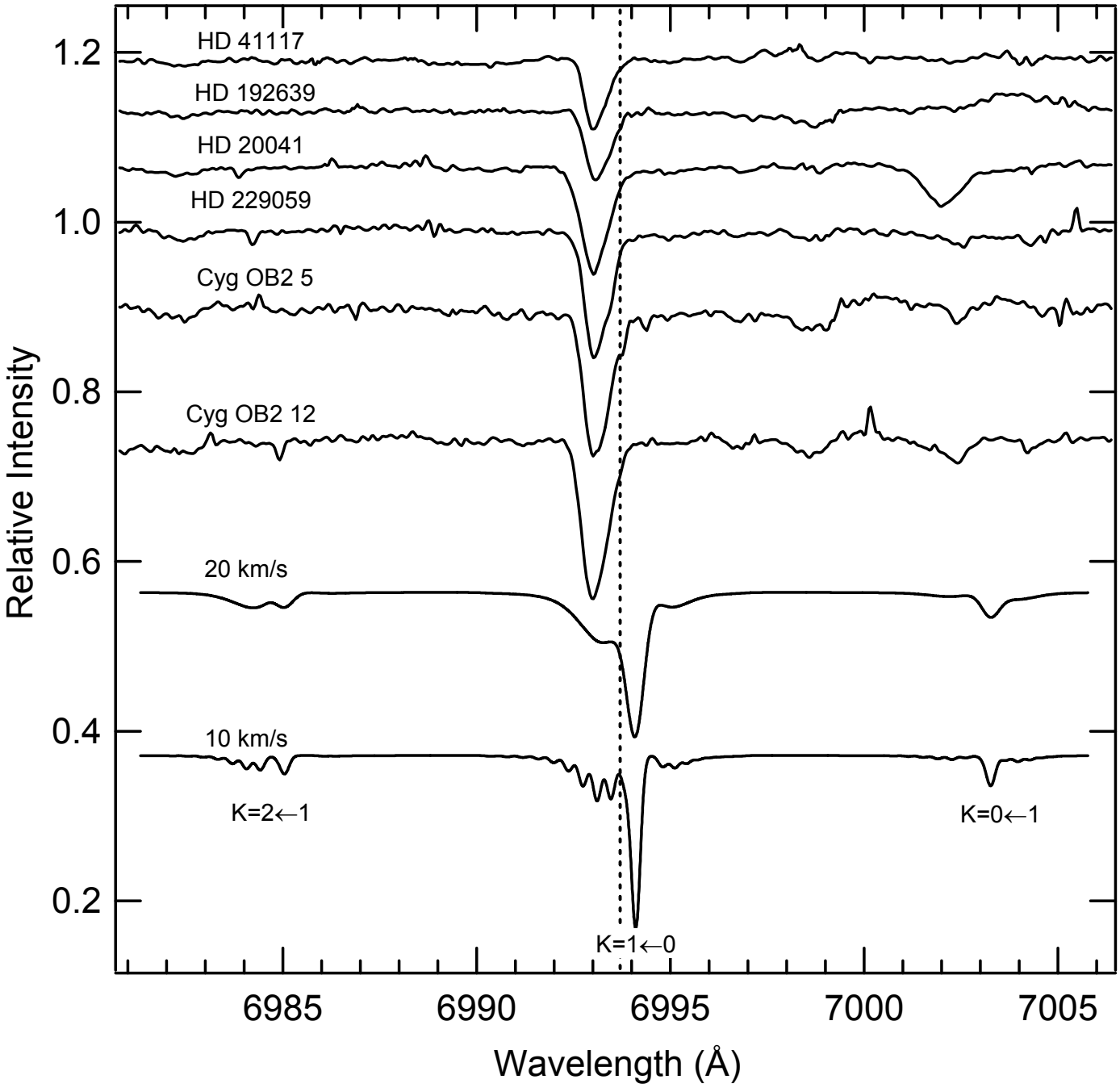
Comparison with l-$C_3H_2^-$

- Suggested by Güthe et al., ApJ 555, 466 (2001)
- Poor wavelength and profile match



B.J. McCall et al., ApJ 567, L145 (2002)

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Long-term Project Goals

★ Detailed catalog of DIBs
(weak and strong; narrow and broad)

★ Comprehensive search for "families"
(including weaker bands)

★ Comprehensive search for correlations with other species (H, H_2, CH, CH^+, C_2, CO, H_3^+...)

★ Reliable dataset for comparison with lab data

★ Complete online database of observations

★ Clues towards the origin of the DIBs (?)

Mary Lea Heger Shane
Lick Observatory in 1921
(1887-1983)

First two DIB observers

Paul Willard Merrill
Mt. Wilson Observatory in 1934
(1887-1961)