

FUSE and STIS observations of
the sdO star ROB 162 in
NGC 6397

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Position of NGC 6397 with respect to the Sun

Hubble observes NGC 6397 in our Milky Way



NGC 6397

Antilhue Observatory, Chile (Daniel Verschate)



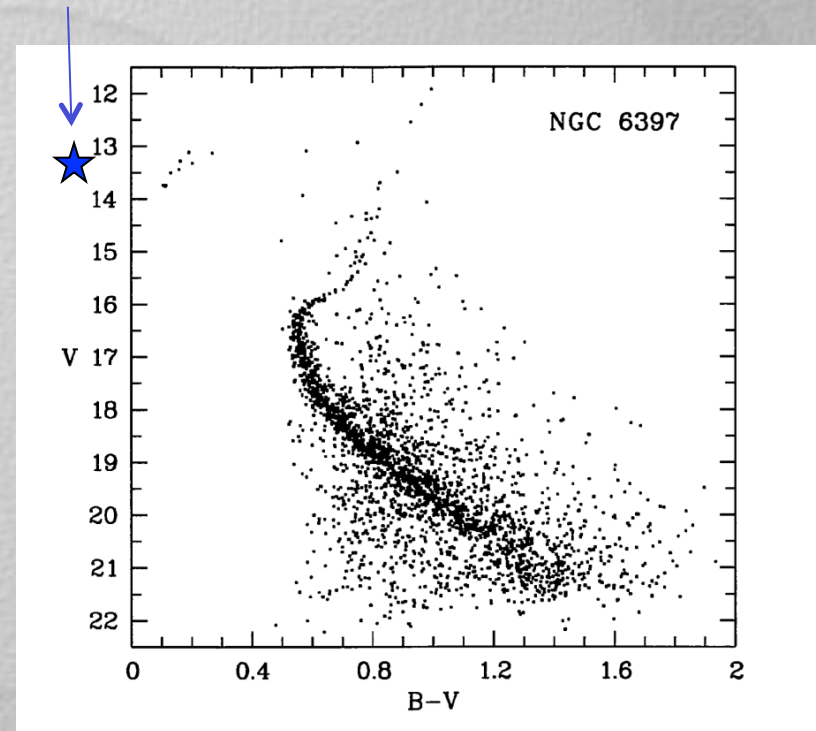
July 20-25, 2015, sdOB
Meeting, Oxford

37×25 arcminutes (14.5'' telescope)

NGC 6397

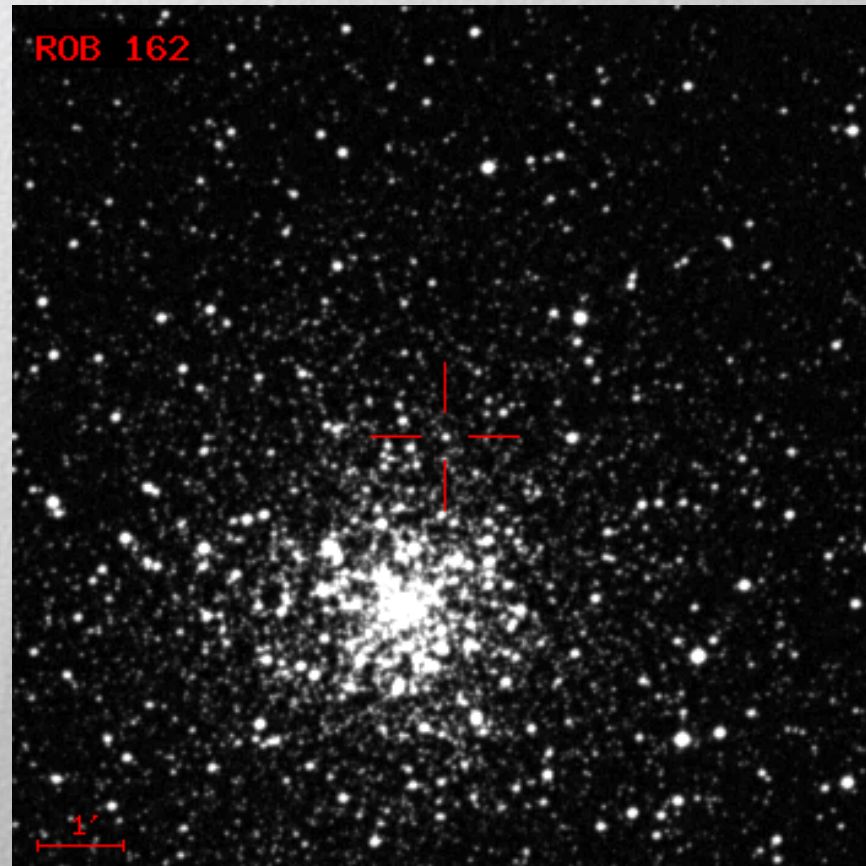
- $l = 338.17^\circ$
- $b = -11.96^\circ$
- $m-M=12.02$
- $d(\text{kpc}) = 2.54$
- $E(B-V) = 0.18$
- $[\text{Fe}/\text{H}] = -2.02$
- $V_R (\text{km s}^{-1}) = 18.8$
- Double main sequence
 - (see Milone et al. 2012, ApJ, 745, 27)

Position of ROB 162 in a color-magnitude diagram



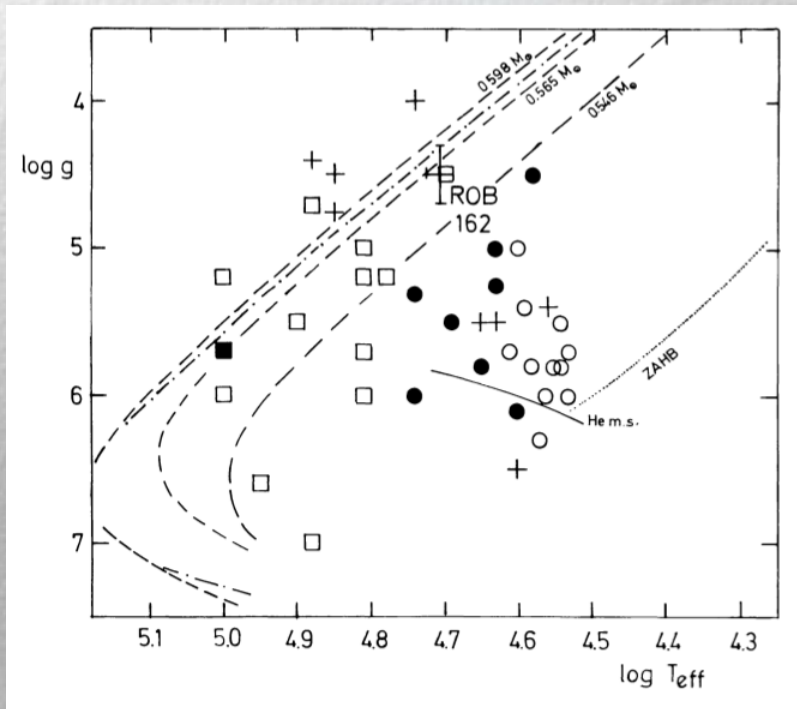
Alcaino et al. 1997 AJ, 114, 1067

ROB162: Finding chart



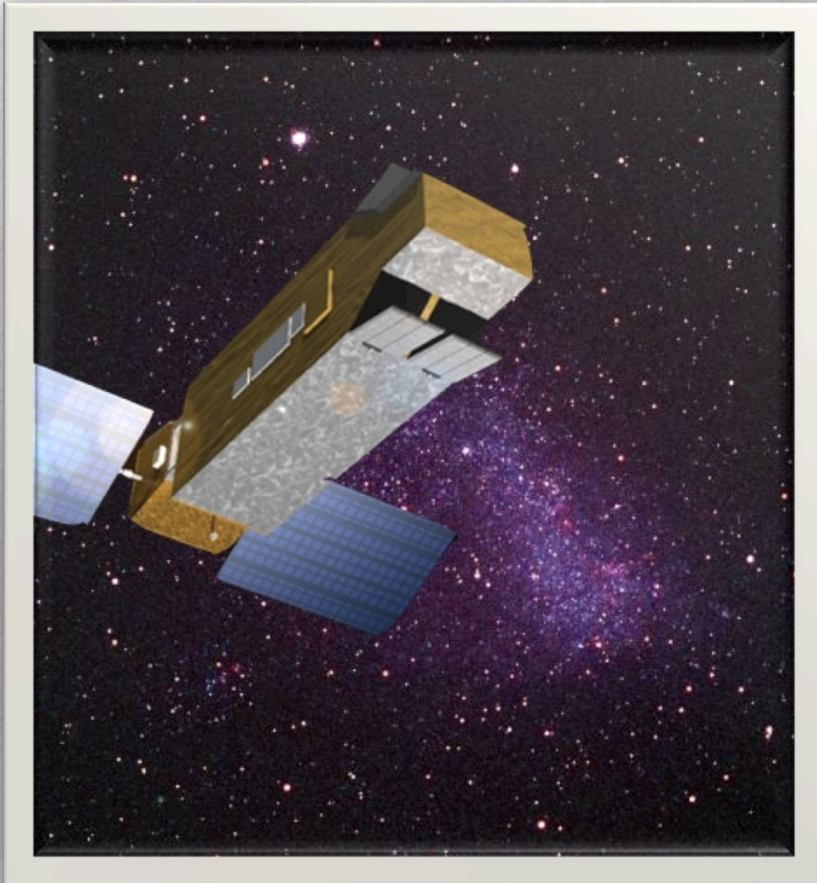
ROB 162

(Heber & Kudritzki 1986, A&A, 169, 244)



- $B = 13.06$
- $V = 13.23$
- $T_{\text{eff}} = 51,000 \pm 2,000 \text{K}$
- $\log g = 4.5 \pm 0.2$
- $n_{\text{He}}/n_{\text{H}} = 0.1(+0.02, -0.03)$
- $M = 0.56(+0.4, -0.2)$
- $\log L/L_{\odot} = 3.47 \pm 0.2$
- CSPN
- But no nebula observed

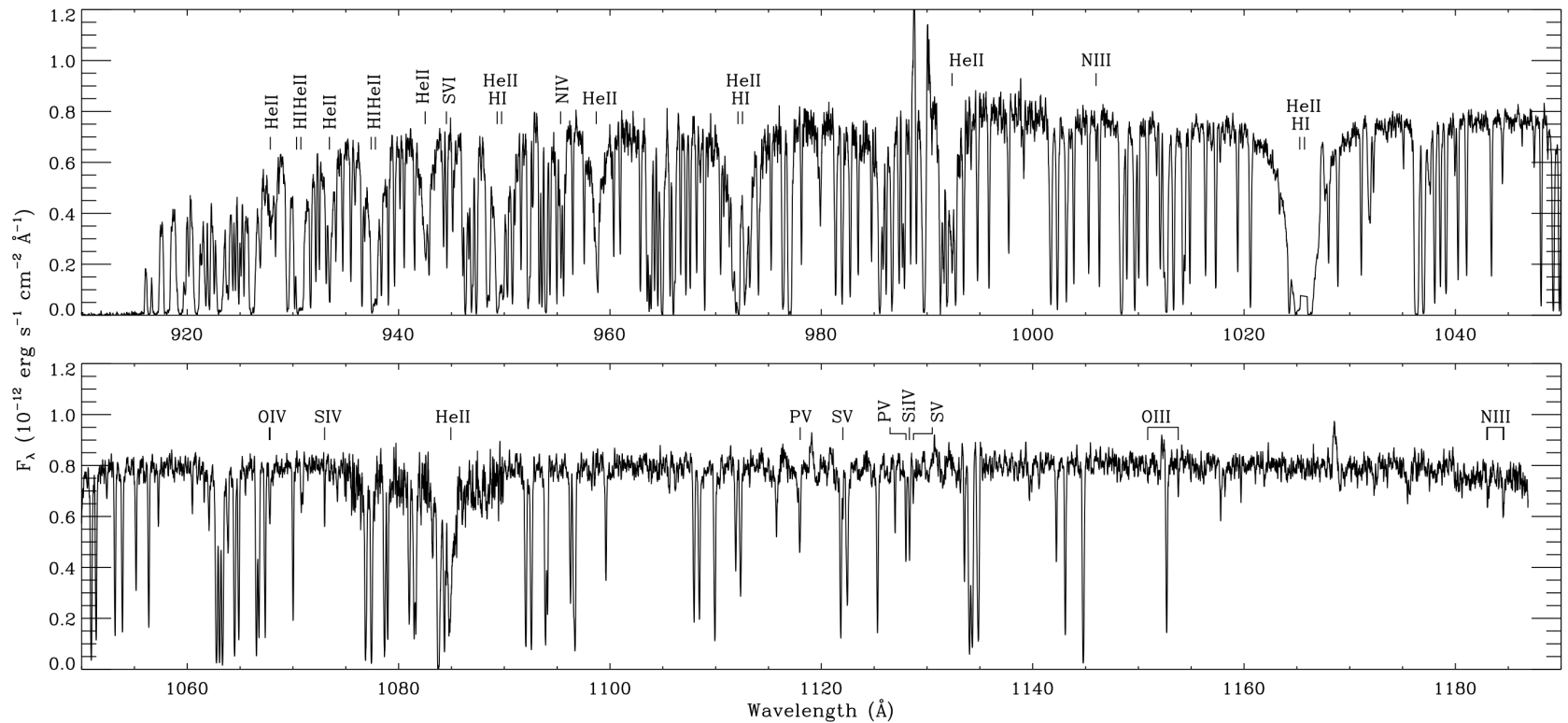
FUSE Observations



- Date: Apr 3 2000, Jul 7 2001
- PI: Uli Heber
- LWRS: 30'' × 30''
- $\Delta\lambda/\lambda \cong 20,000$
- Exptime = 17,983 s
- $905 \leq \lambda \leq 1187 \text{ \AA}$

FUSE Spectrum

Photospheric lines are identified. All the remaining lines are ISM lines, mainly H₂ lines.



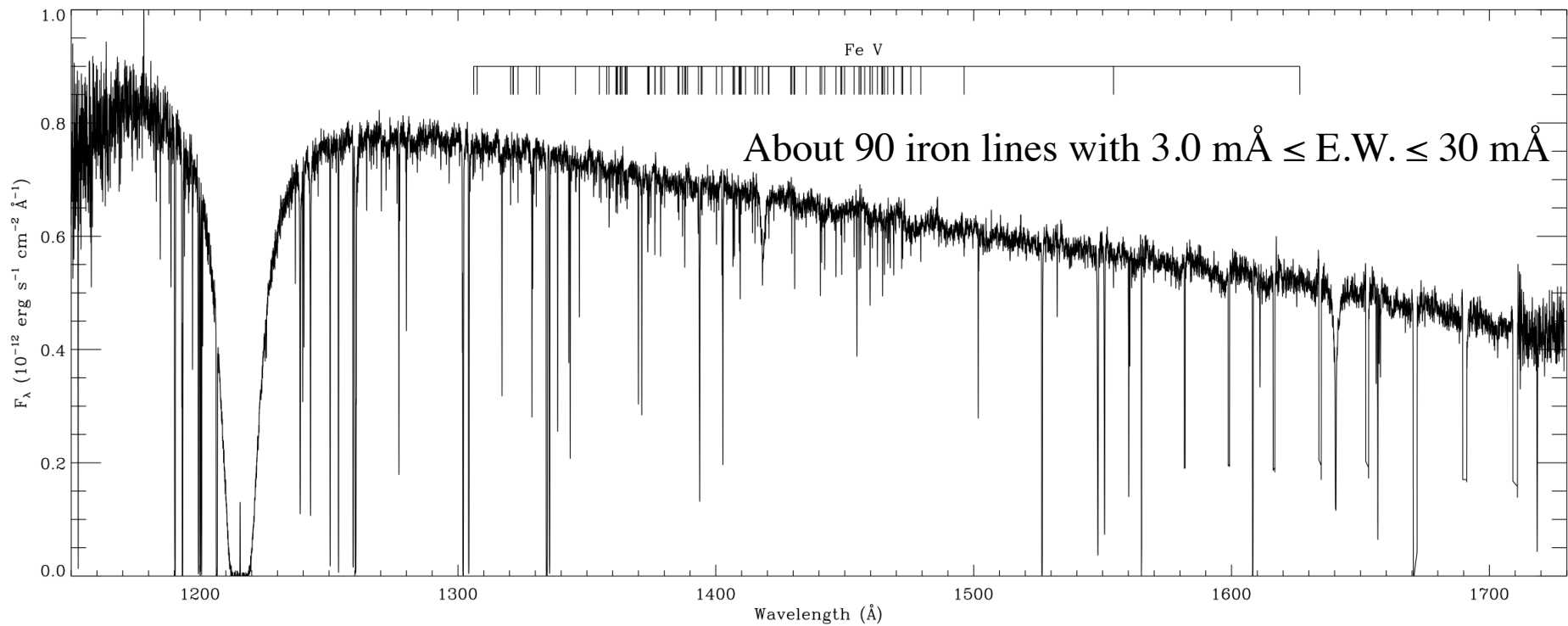
STIS Observations

- Date: Jul 6, 15 2003
- PI: Chris Howk
- Grating: E140M
- $\Delta\lambda/\lambda \approx 45,000$
- Exptime = 14,580 s
- $1150 \leq \lambda \leq 1730 \text{ \AA}$



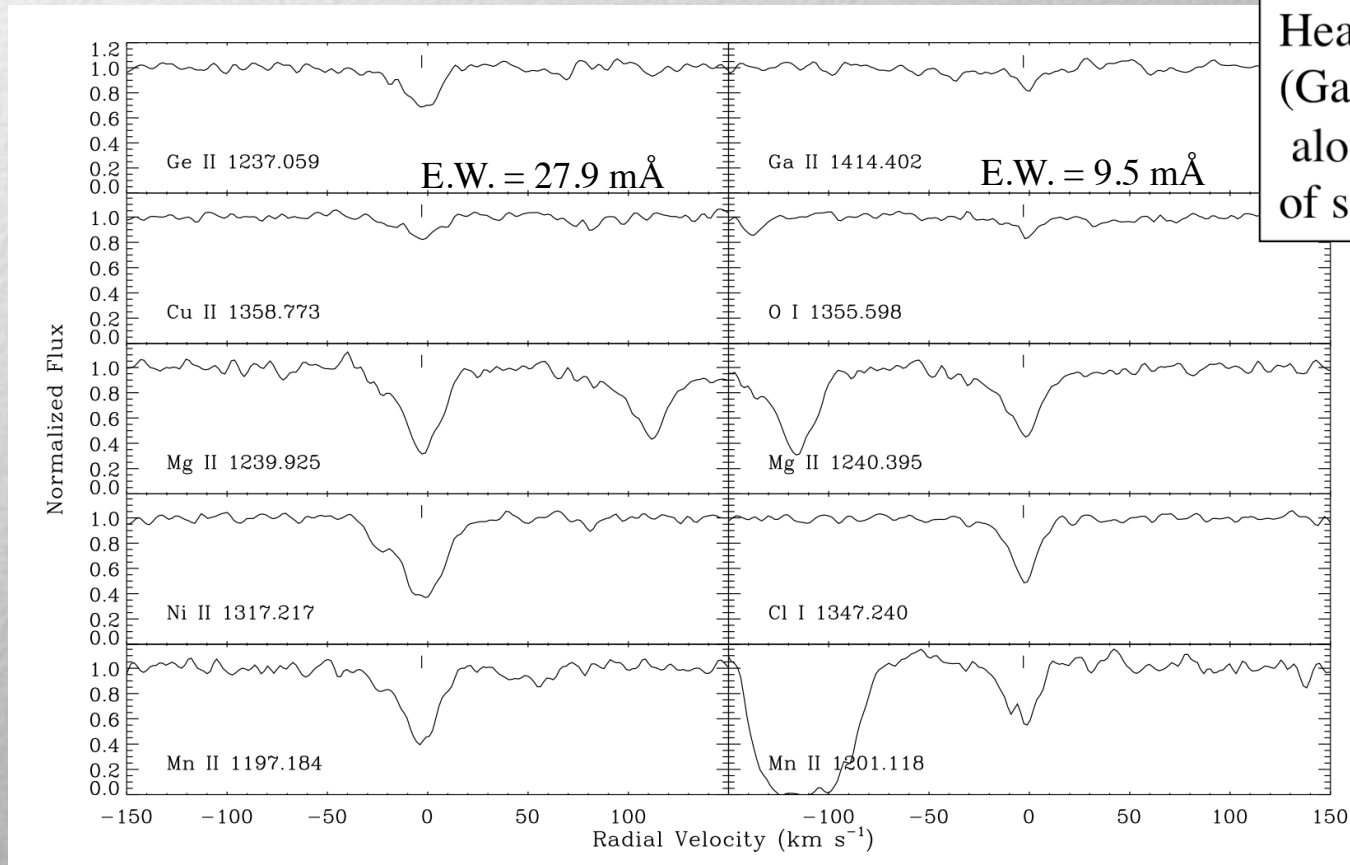
STIS Spectrum

Photospheric lines: C IV?, N III, N IV, O IV, O V, Si IV?, S V, Fe V, Fe VI, Ni V



Selected ISM lines in STIS spectrum

$$V_R(\text{ISM}) = -3.0 \text{ km s}^{-1}; V_R(\text{star}) = 29.1 \text{ km s}^{-1}$$



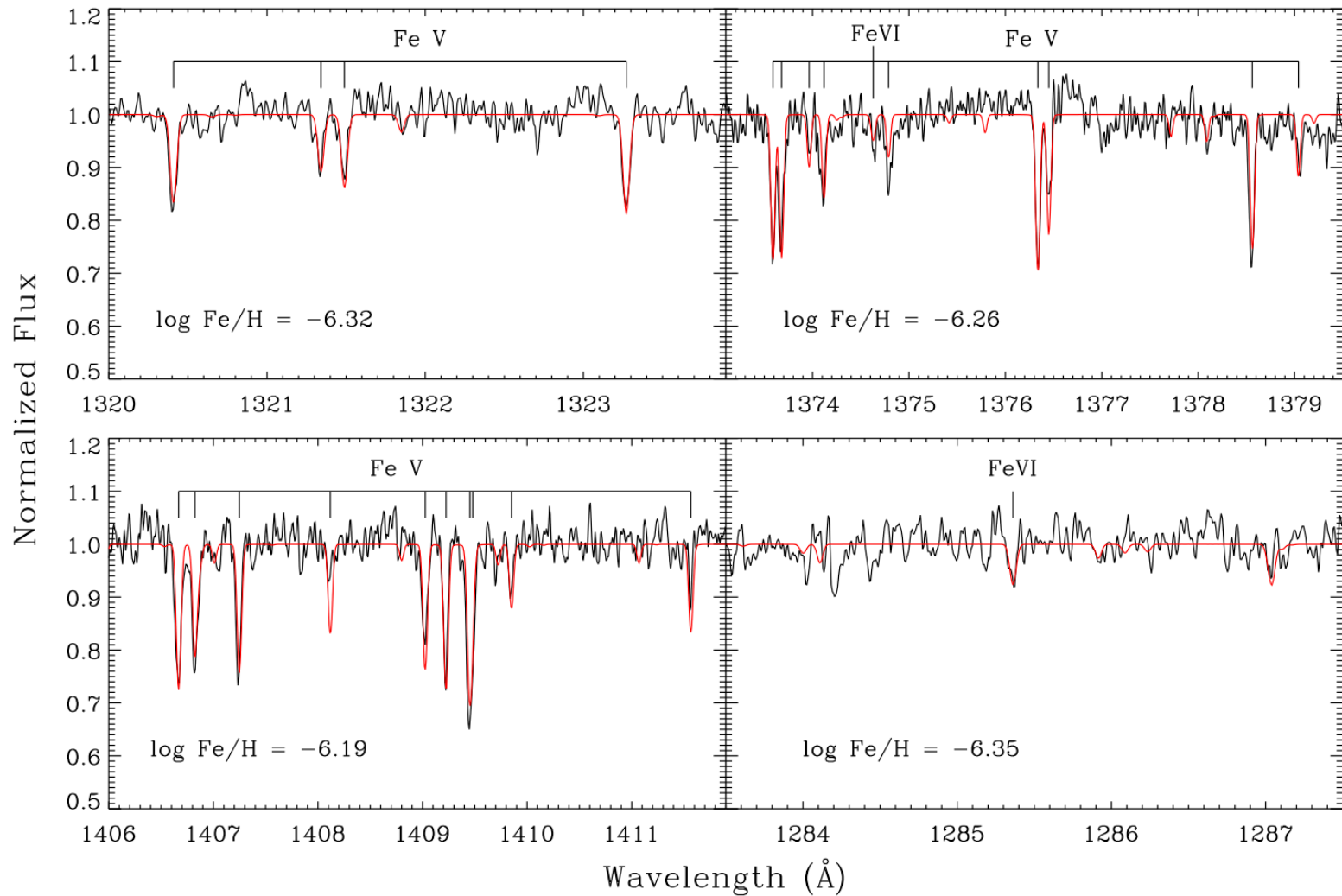
Heavy elements
(Ga, Ge, and Sn)
along the line
of sight.

Elements detected along the line of sight of ROB 162: H (HI, H₂), C, N, O, Mg, Si, P, S, Cl, Ar, Mn, Fe, Co, Ni, Cu, Ga, Ge, Sn

Spectral Synthesis Analysis

- TLUSTY: NLTE H+He+X where $X = \text{C, N, O, Si, P, S, Fe, and Ni}$ with abundances $-9.2 \leq \log N(X)/N(\text{H}) \leq -4.0$, in steps of 0.4 dex.
- SYNSPEC: Synthetic spectra.
- Abundances: Fit absorption lines by comparing models to observed spectra.

Iron in ROB 162



Results: Abundances in ROB 162 compared to HB and RGB stars in NGC6397

Elements	ROB 162 ¹		NGC 6397	References
log $N(X)/N(H)$				
He	-1.00(+0.08, -0.15)		-1.09±0.05	1
C	<-6.50		-5.81±0.23	2
N	-5.04±0.45		-5.40±0.11	2
O	-5.15±0.41		-4.81±0.19	3
Si	-6.07±0.12		-6.33±0.07	3
P	-7.85±0.05		...	
S	-6.19±0.24		-6.41±0.20	4
Fe	-6.28±0.07		-6.58±0.02	3
Ni	-7.91±0.09		-8.00±0.04	3

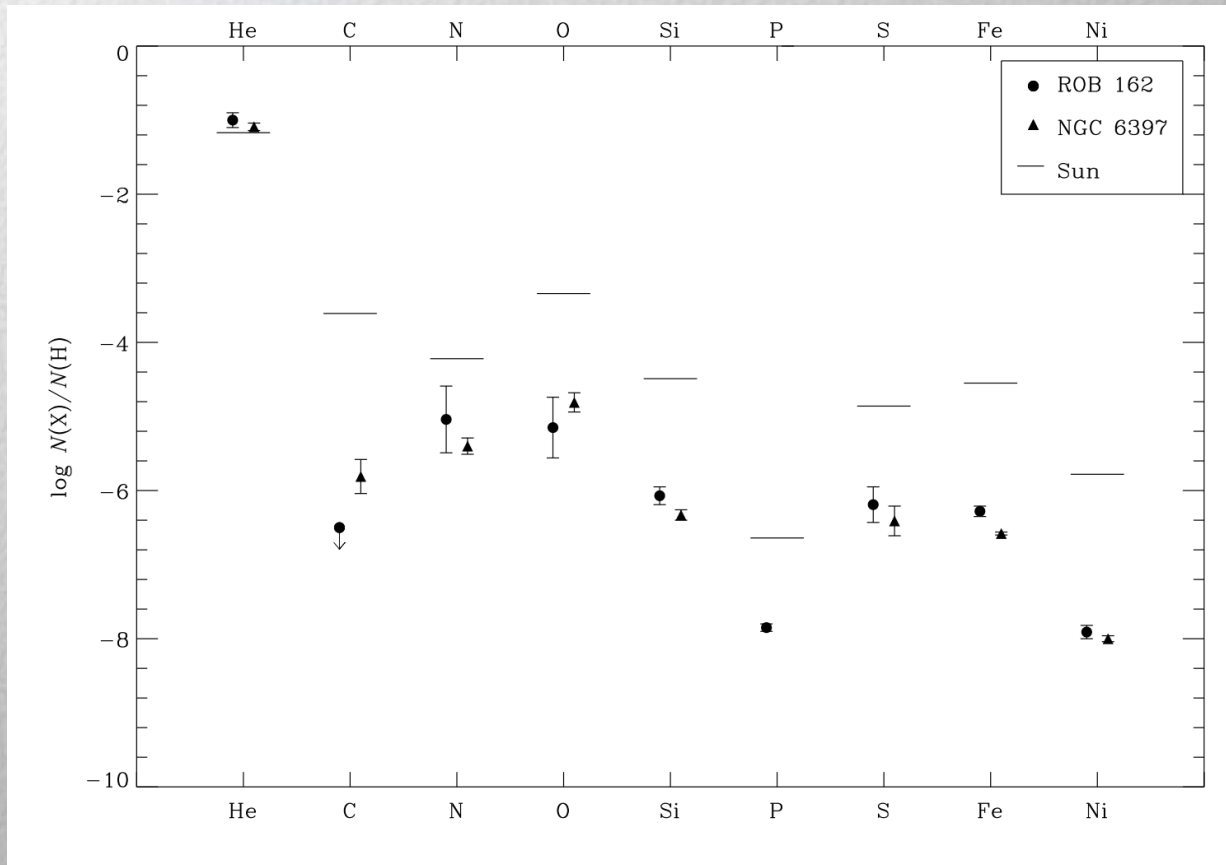
¹ Preliminary results.

Abundances in ROB 162 compared to HB and RGB stars in NGC6397

- References

- 1) Mucciarelli A. et al. 2014, ApJ, 786, 14.
- 2) Briley M. M. et al. 1990, ApJ, 359, 307.
- 3) Lind K. et al. 2011, A&A, 527, A148.
- 4) Koch A., Caffau E. 2011, A&A, 534, A52.

Abundances in ROB 162 compared to HB and RGB stars in NGC6397¹



Summary

- Observations of C, N, O, Si, P, S, Fe, and Ni.
- Neither heavy elements nor P Cygni profiles are observed.
- Abundances are consistent with those of RGB stars in NGC 6397 → surface chemistry did not change while on the AGB.
- Low C abundance → no 3rd dredge-up.
- Detection of ISM Ga, Ge, and Sn along the line of sight.