

# Spatial Analysis of the PAH and Ionic Features Southeast of the Orion Bar

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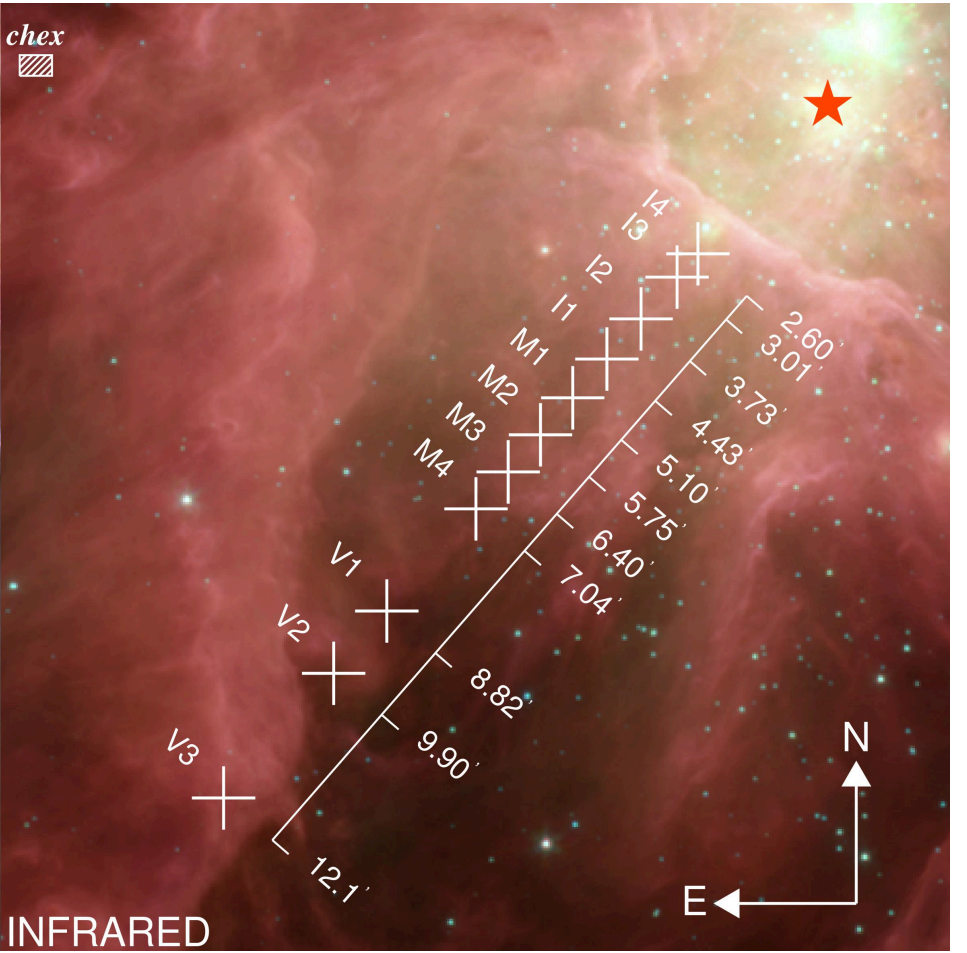
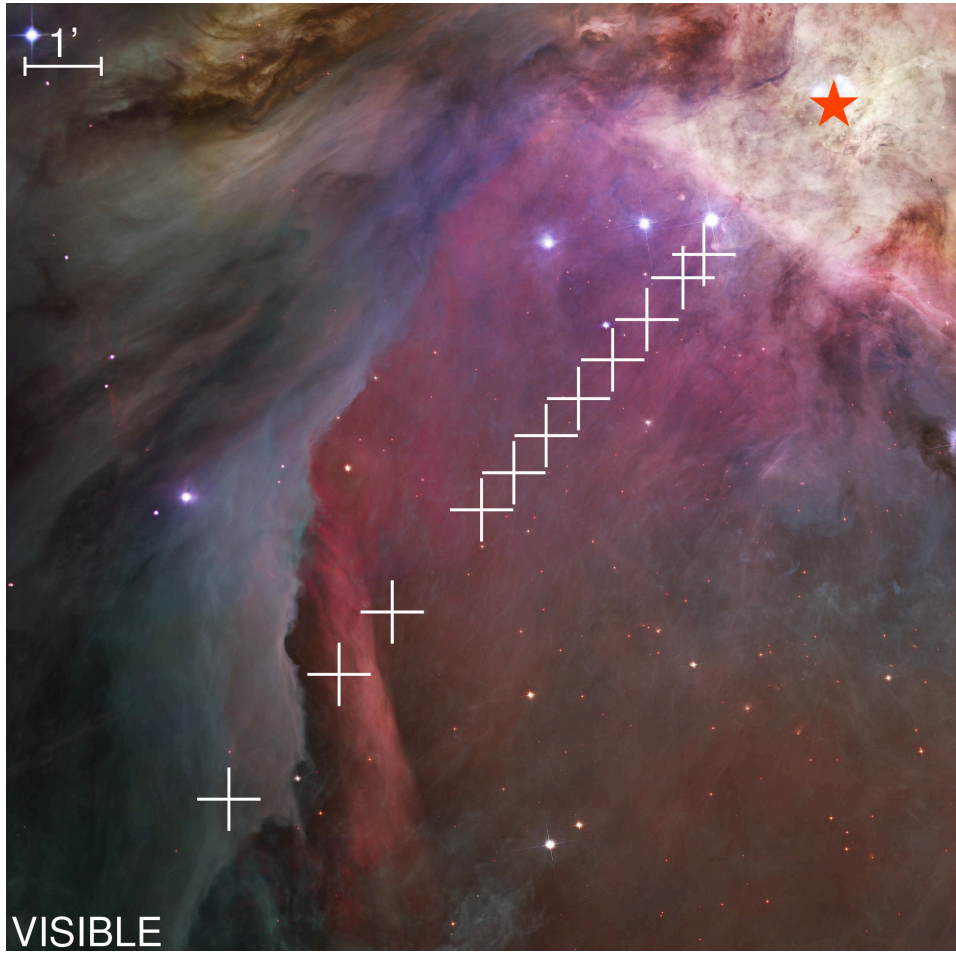
*Spitzer* is a Lean, Mean Neon and Sulfur  
Abundance Machine.

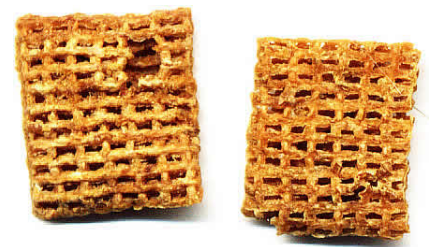
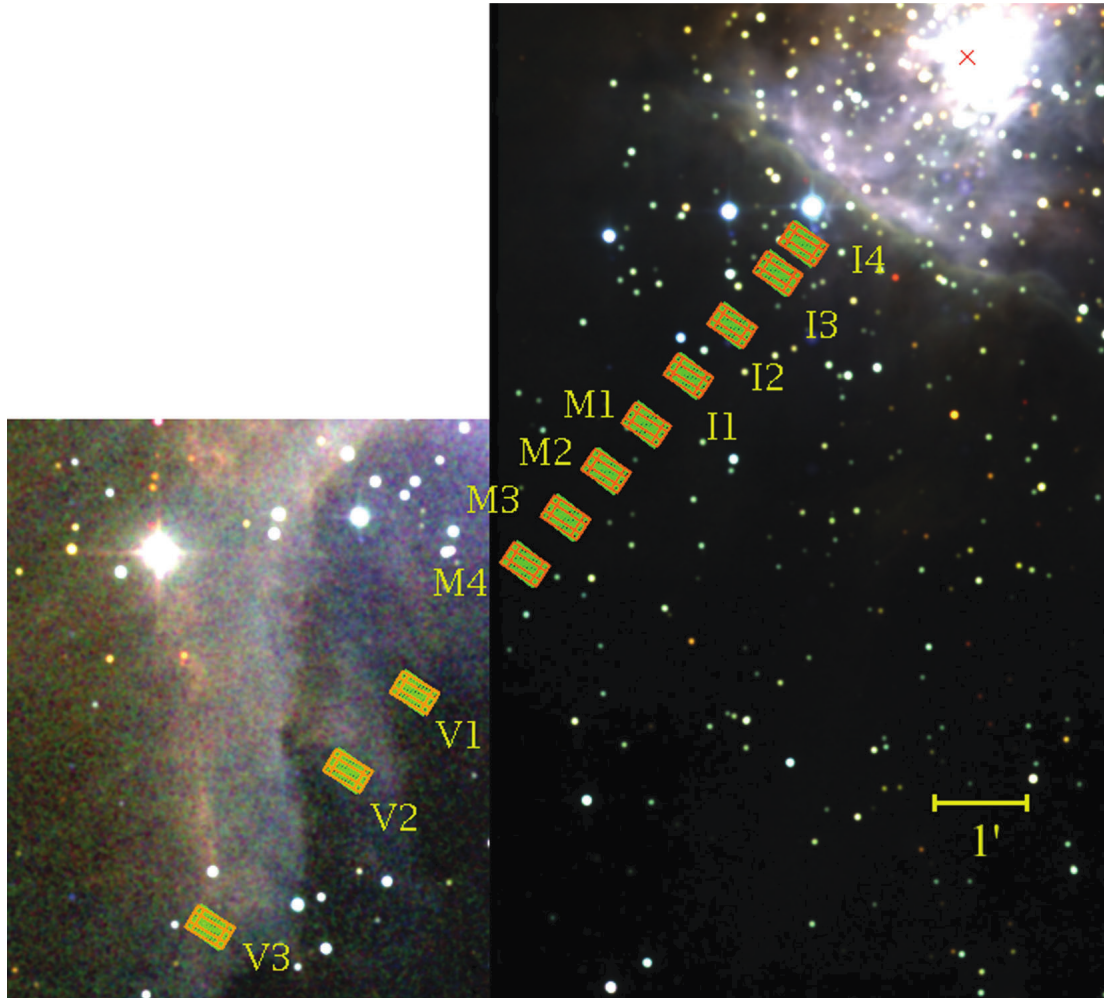
Paper I: *MNRAS*, 410, 132, 2011

Paper II: *ApJ*, 753, 168, 2012

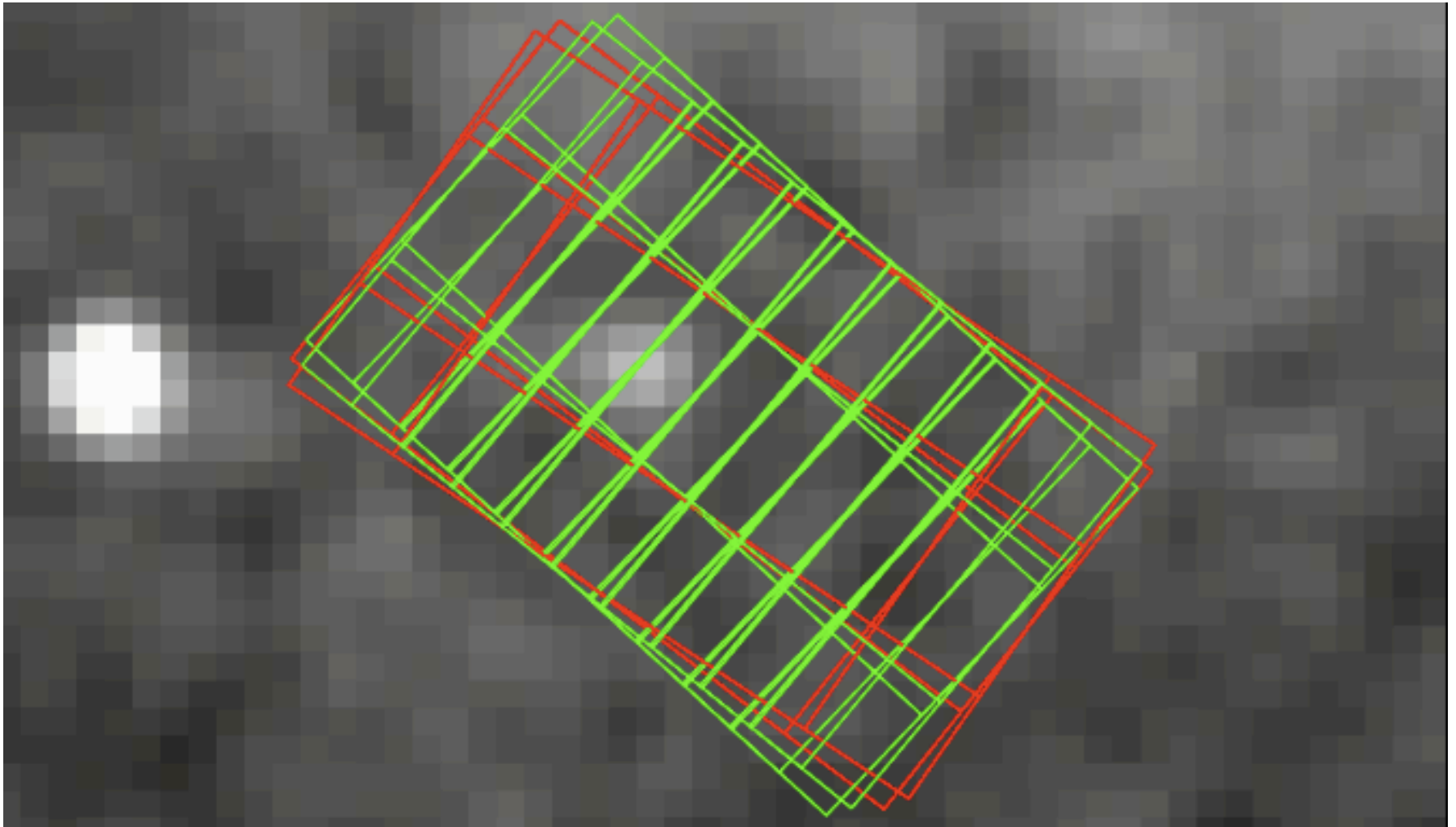
# Outline

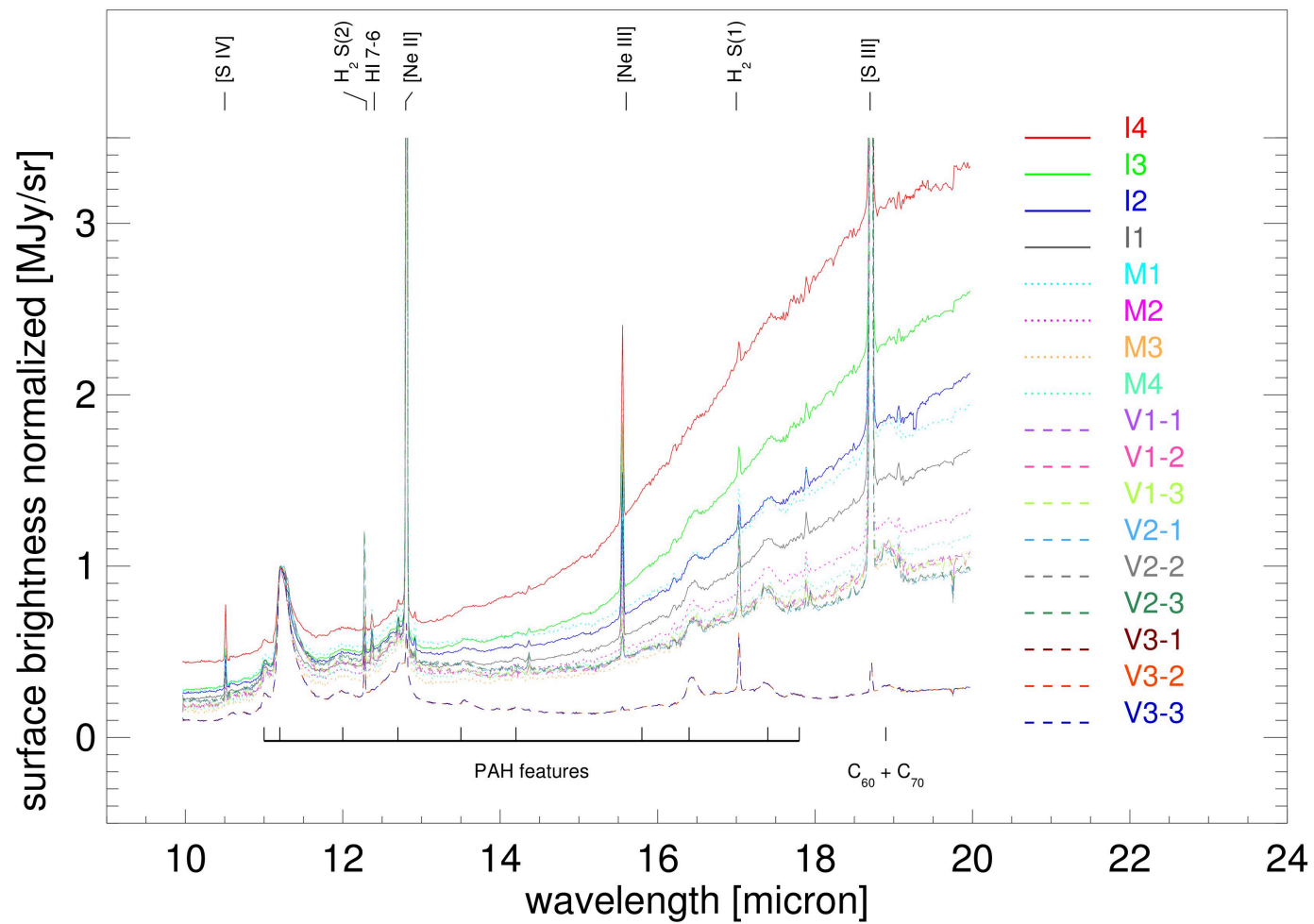
- .New observations with Spitzer & CTIO of outer Orion Nebula from SE of Bright Bar to optical boundary
- .Electron density distribution from optical & IR
- .Elemental abundance ratios
- .Variation in degree of ionization with distance from  $\theta^1$  Ori C
- .Characterization of the PAHs with distance
- .Evidence for high ionization to the optical boundary as well as an H II region/PDR interface at this outer Veil location

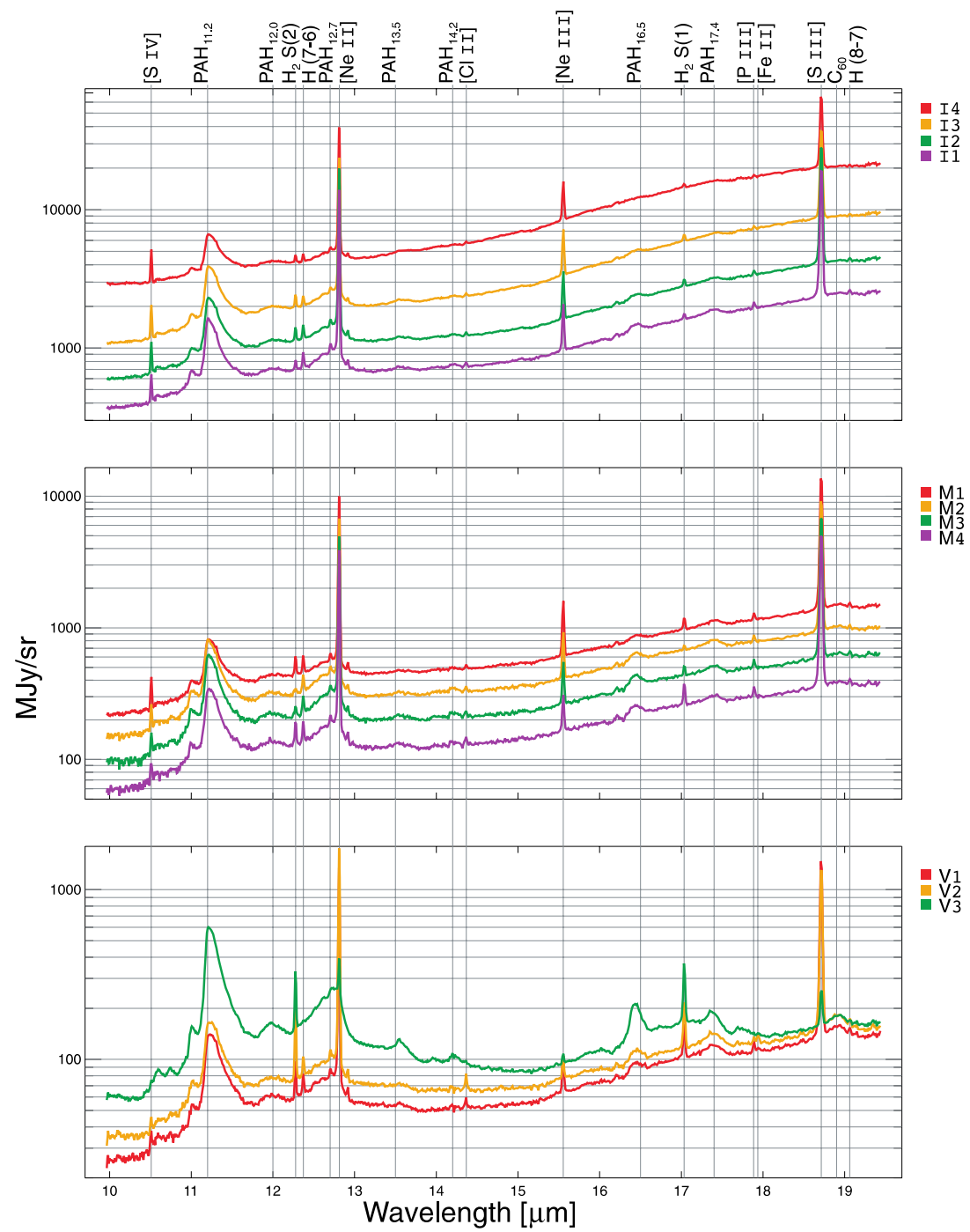




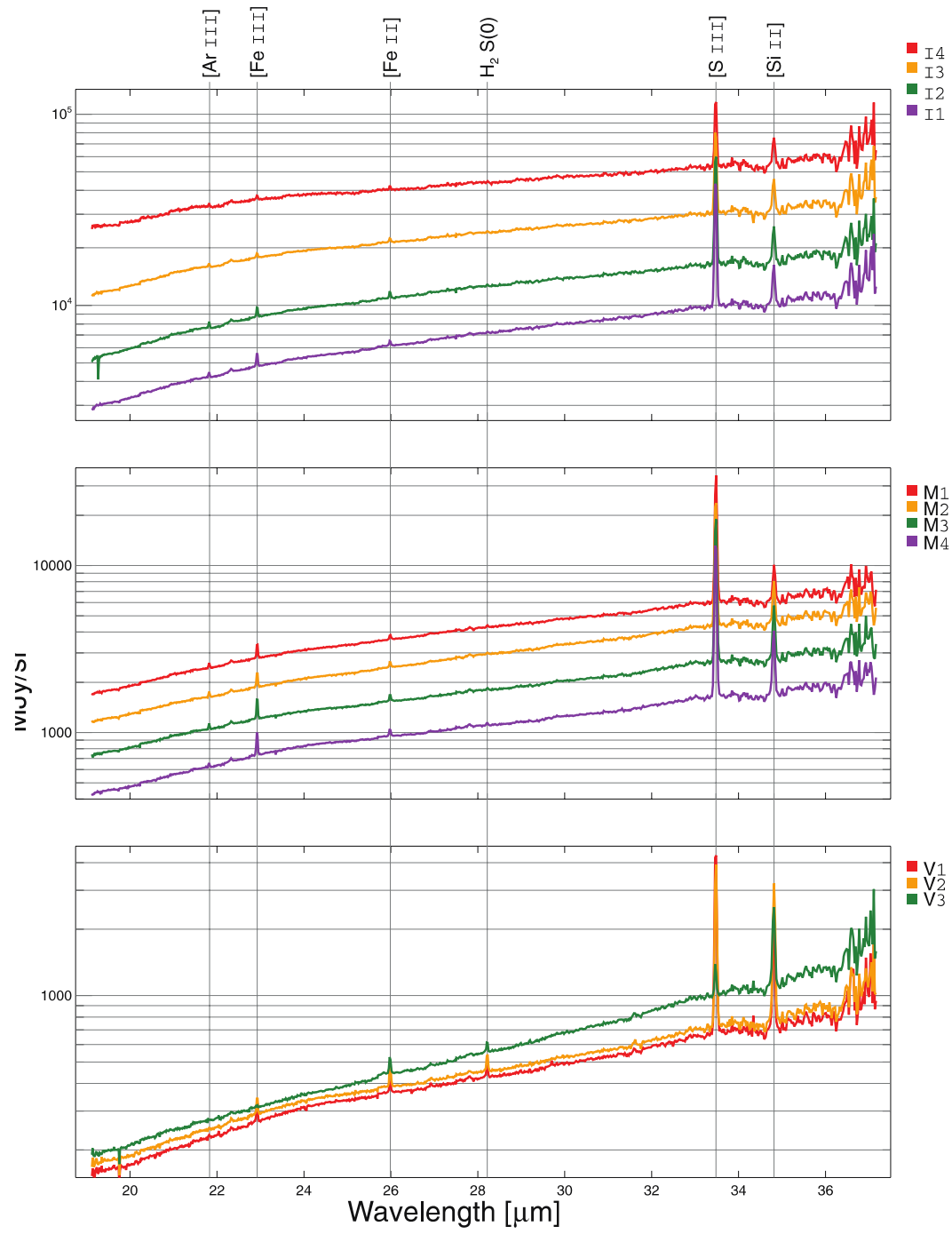
V3

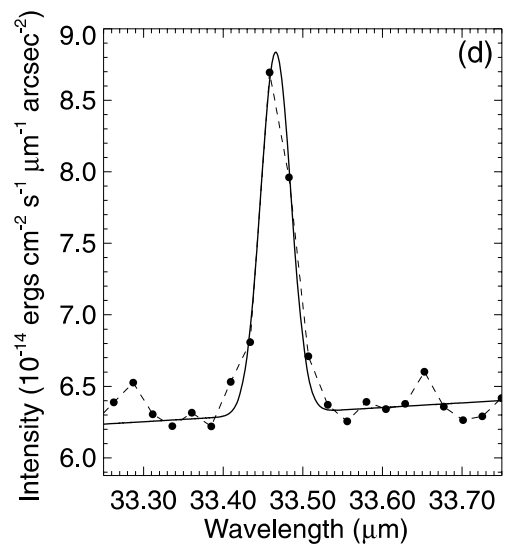
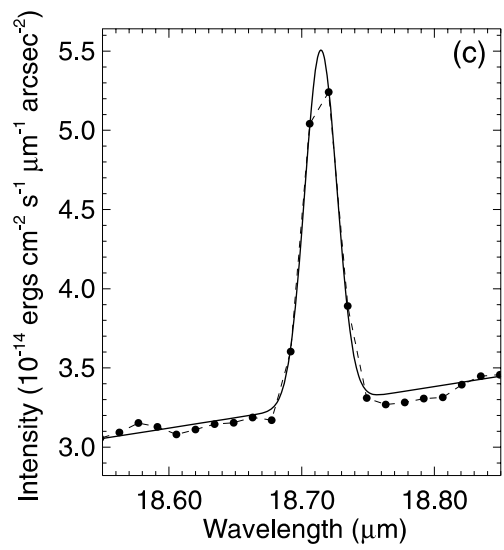
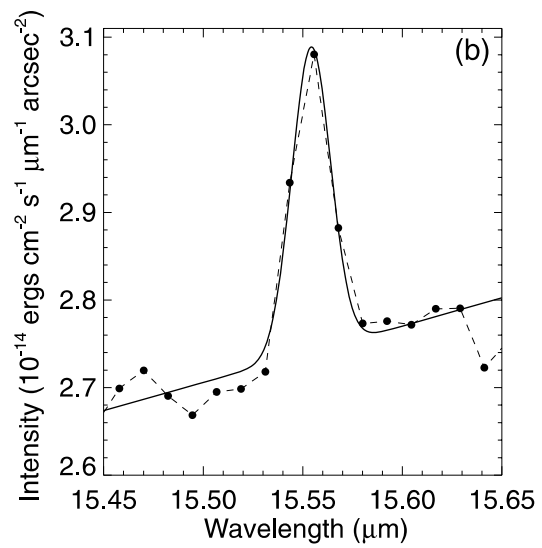
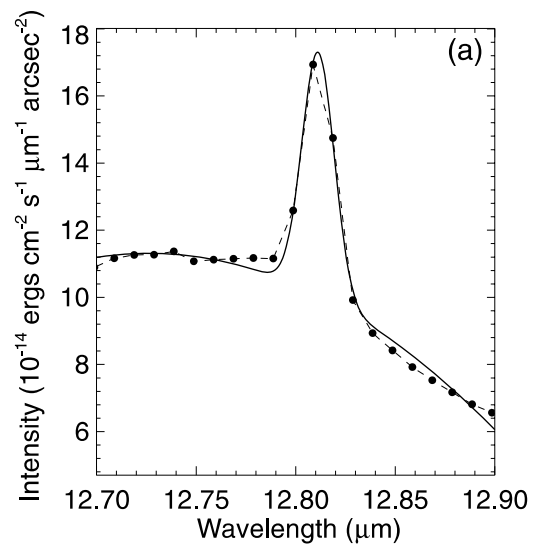


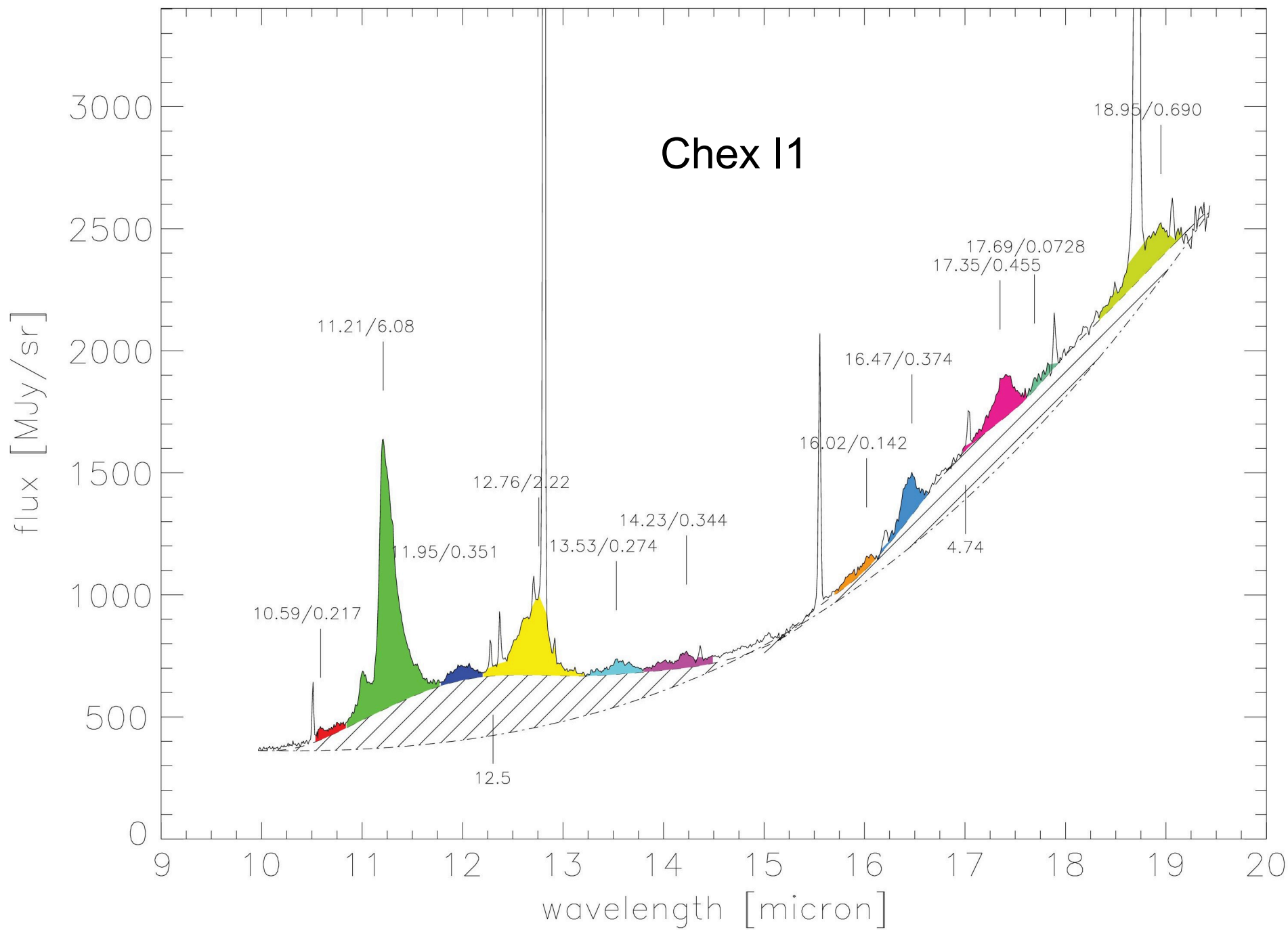


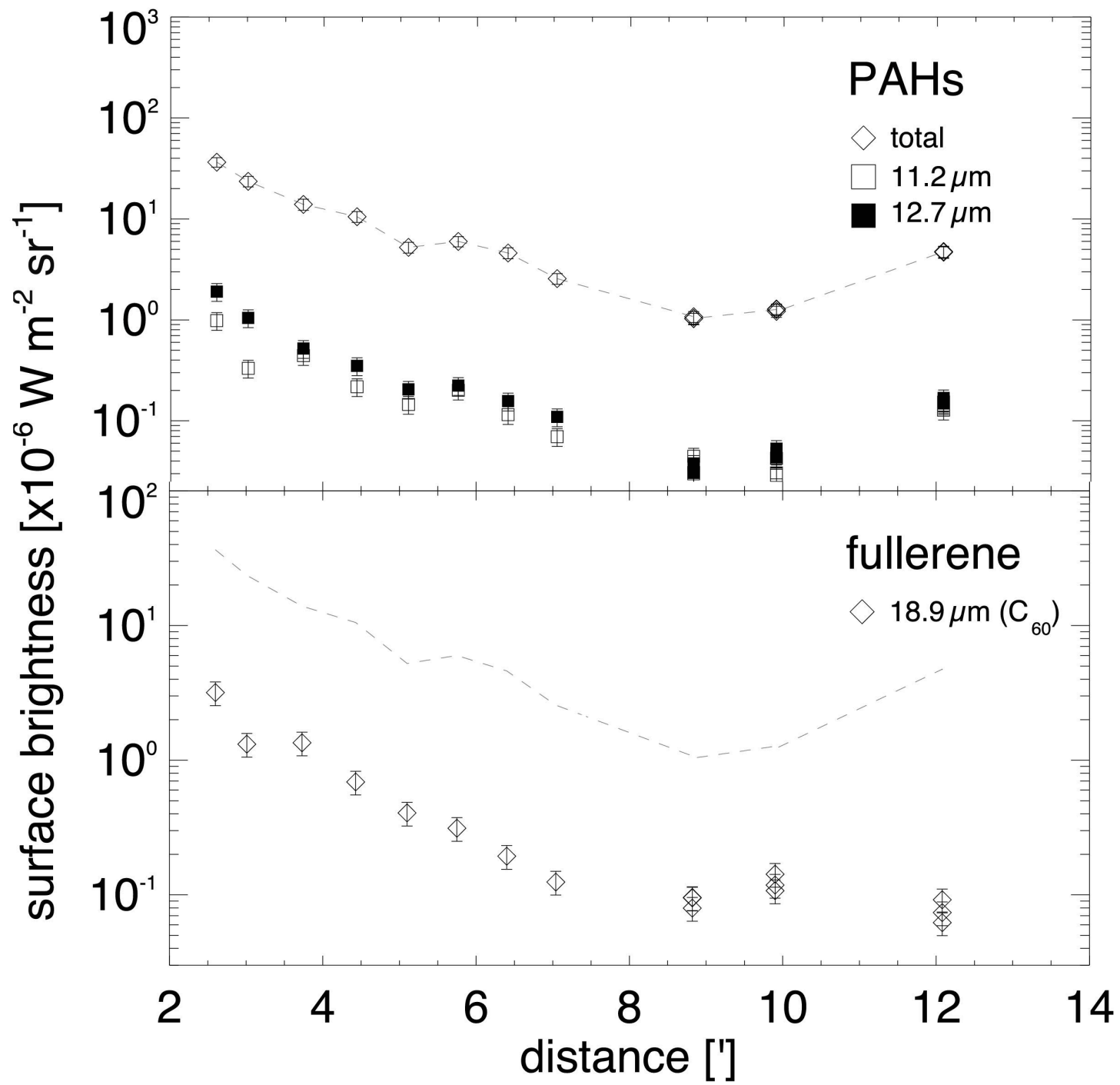


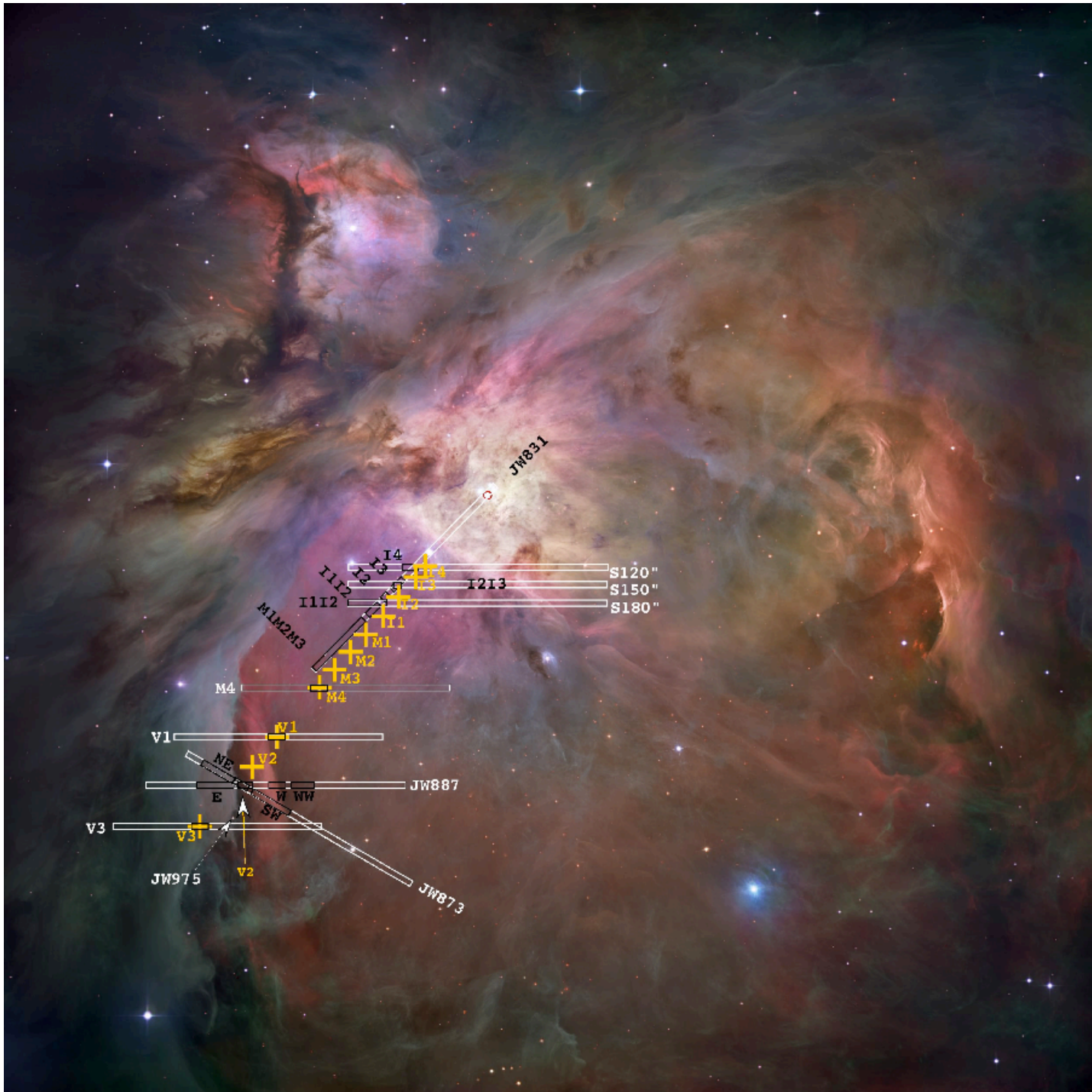




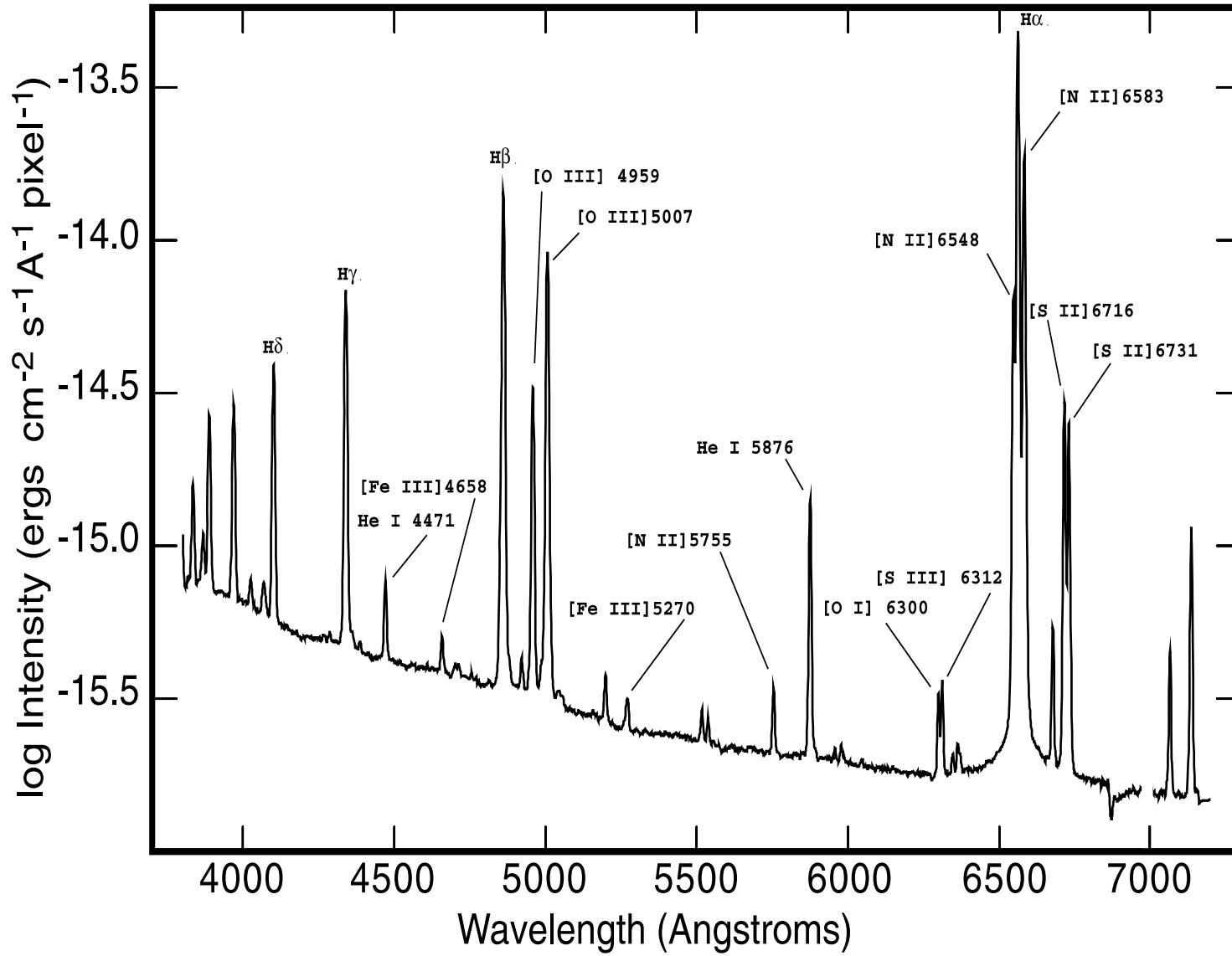


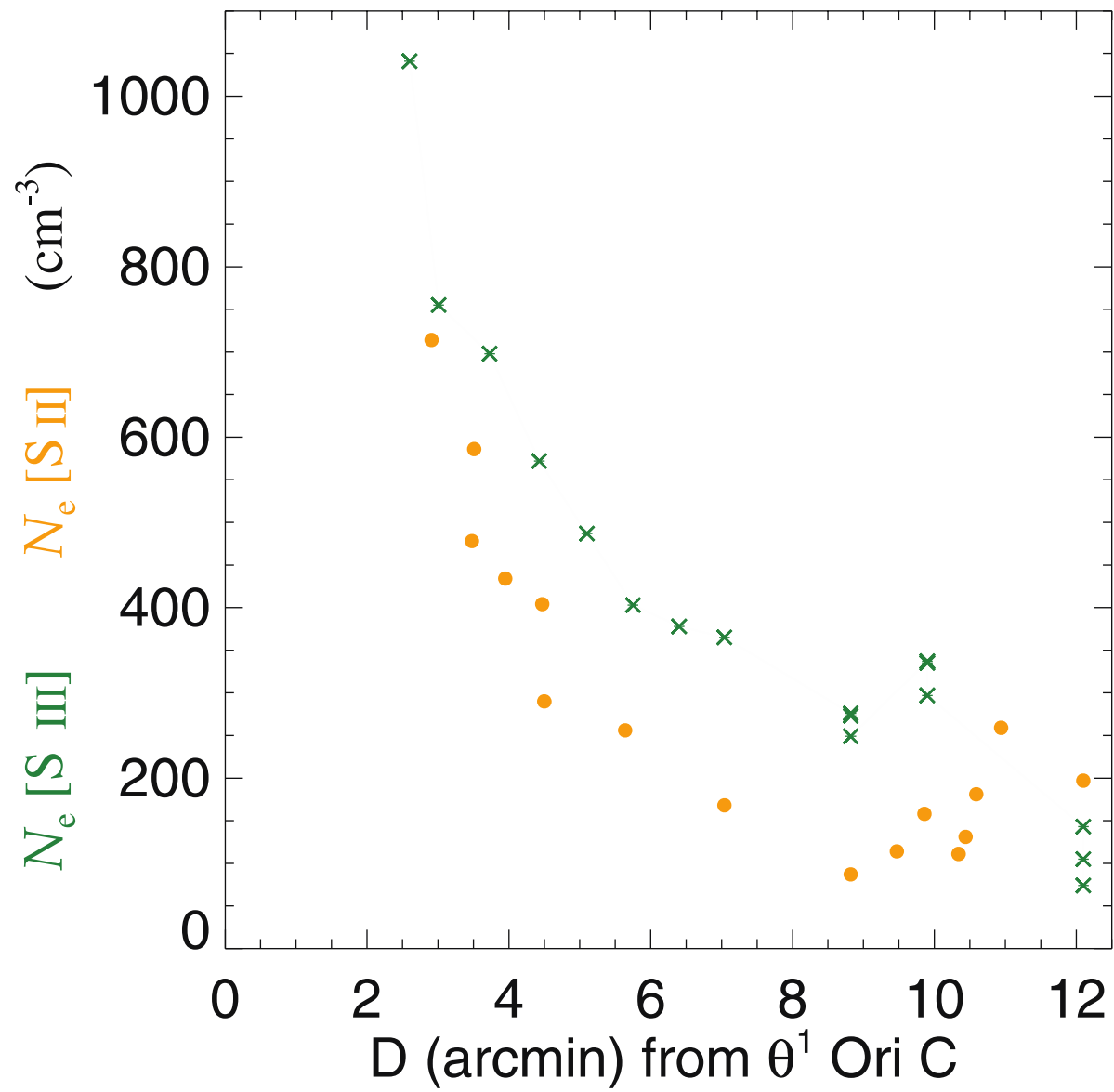


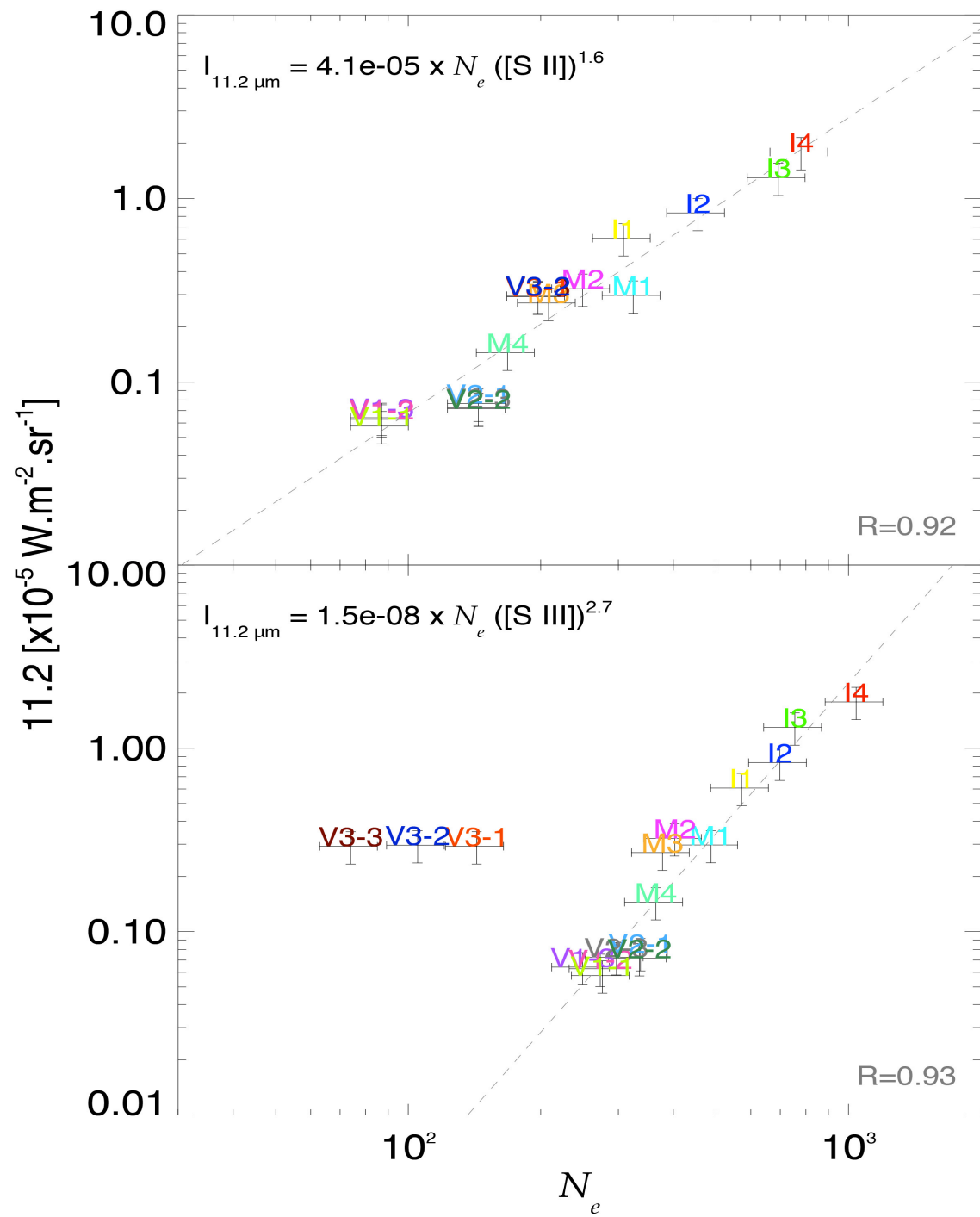




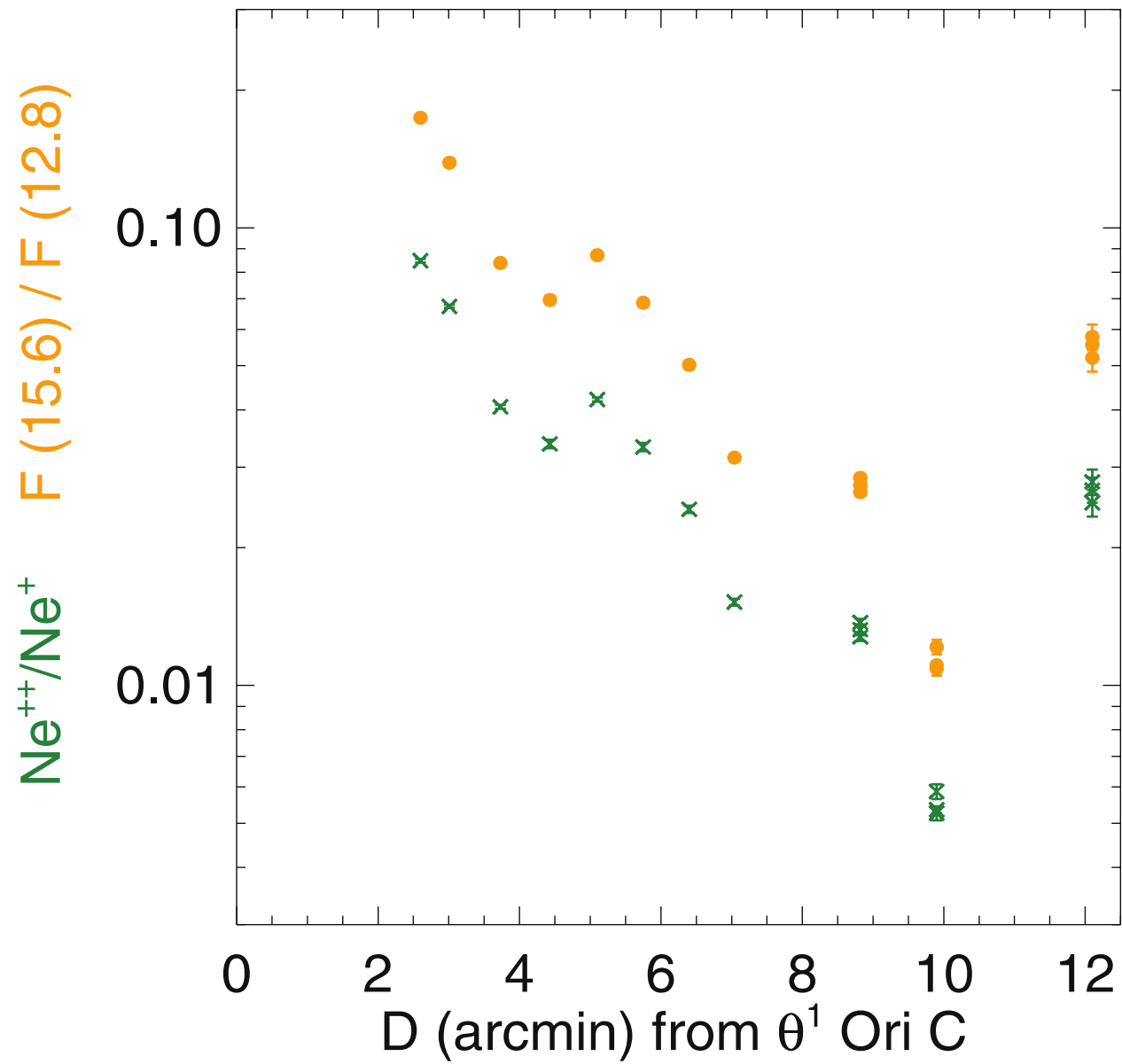
# Position M4



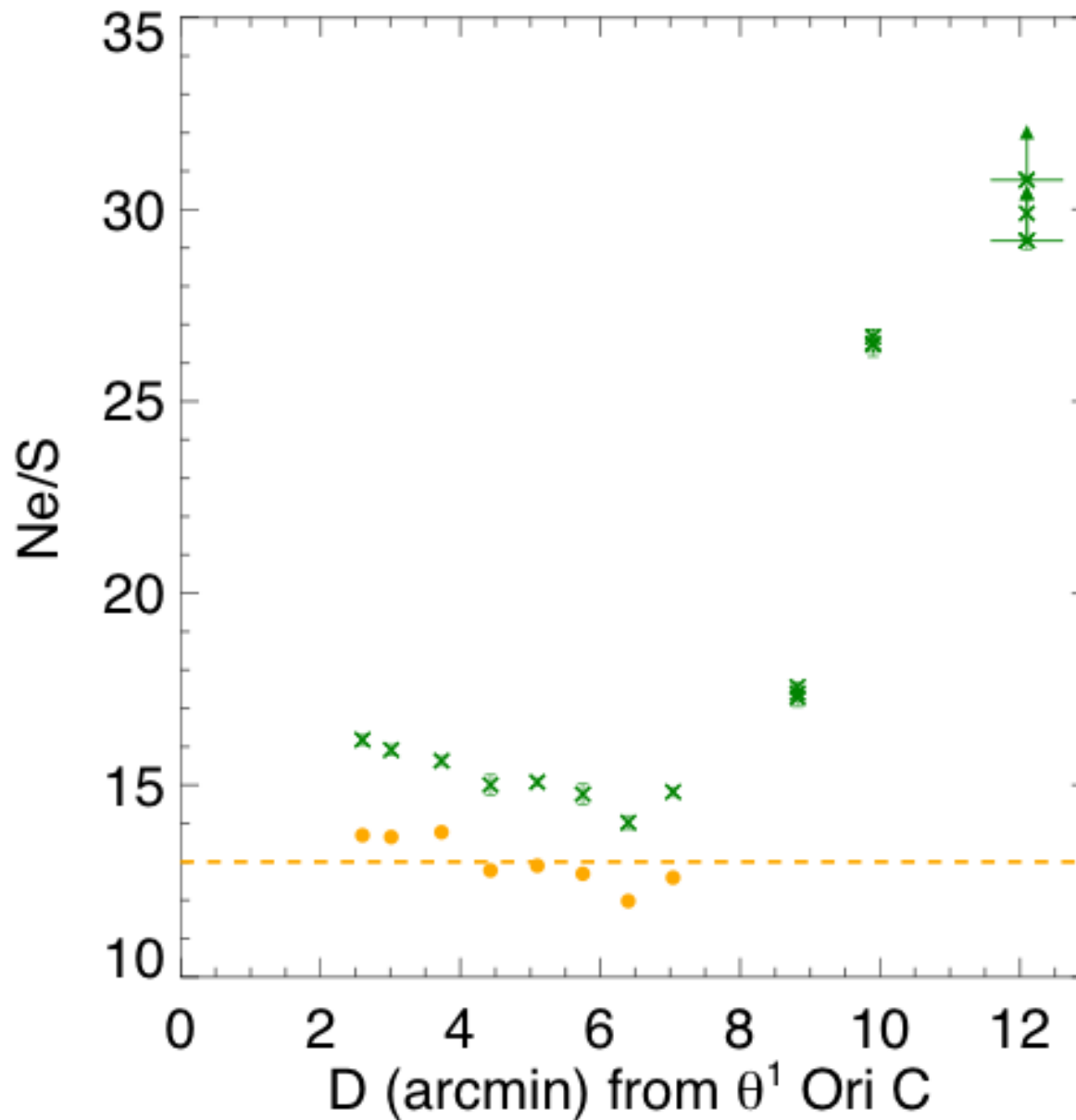






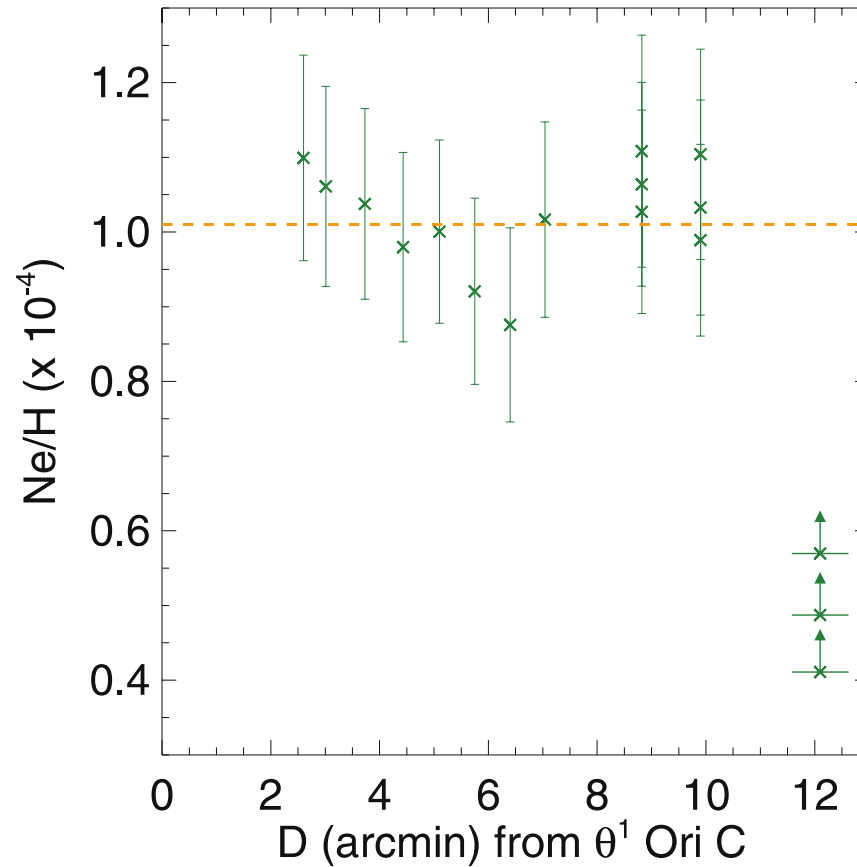


Ne/S



Median Value: 15.1 Mean Value: 15.2 (excluding all veils)

Mean Value adjusted for the optical  $S^+/S^{++}$  ratio: 13.0



**Figure 12.** Plot of Ne/H versus  $D$ . Except for chex V3 where the H(7–6) line was not detected, the ratios vary little. We include the six independent measurements at V1 and V2 and take the mean for the 10 innermost chex as the best value,  $\text{Ne}/\text{H} = (1.02 \pm 0.02) \times 10^{-4}$ . In terms of the conventional expression, this is  $12 + \log(\text{Ne}/\text{H}) = 8.01 \pm 0.01$ . This may well be the *gold standard* for a determination of metallicity in an H II region (see text).

**GOLD STANDARD**

$$12 + \log(\text{Ne}/\text{H}) = 8.01 \pm 0.01$$

# Results and Conclusions

- The Bright Bar is a localized, high-density feature - an H II region/PDR interface over a *very limited solid angle*.
- Tracking outbound from the Bright Bar, the outer Orion Nebula has high ionization with  $\text{Ne}^{++}$  existing to the outer Veil. This IR result is robust, whereas the optical conclusion suffers uncertainty because of the scattering of emission.
- The Veil seen in projection at position V3 is a prominent "new" H II region/PDR.
- $N_e$  [S III] is greater than  $N_e$  [S II] essentially at all D.
- Improved Ne/S, Ne/H abundances.
- PAHs provide details of 3-D structure

# PAH IR Spectral Database

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(e.g., C<sub>60</sub>H<sub>12</sub> N<sub>2</sub> neutral)

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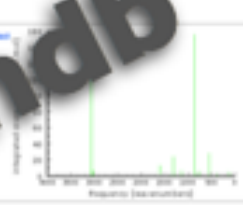
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Chemical structure: C<sub>10</sub>H<sub>8</sub>



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Vibrations

Wavenumber (cm <sup>-1</sup> )	Frequency (THz)	Assignment
3080.000000000000	92.43100000000000	CH stretch
3060.000000000000	91.35000000000000	CH stretch
3020.000000000000	89.27000000000000	CH stretch
2980.000000000000	87.19000000000000	CH stretch
2940.000000000000	85.11000000000000	CH stretch
2900.000000000000	83.03000000000000	CH stretch
2860.000000000000	80.95000000000000	CH stretch
2820.000000000000	78.87000000000000	CH stretch
2780.000000000000	76.79000000000000	CH stretch
2740.000000000000	74.71000000000000	CH stretch
2700.000000000000	72.63000000000000	CH stretch
2660.000000000000	70.55000000000000	CH stretch
2620.000000000000	68.47000000000000	CH stretch
2580.000000000000	66.39000000000000	CH stretch
2540.000000000000	64.31000000000000	CH stretch
2500.000000000000	62.23000000000000	CH stretch
2460.000000000000	60.15000000000000	CH stretch
2420.000000000000	58.07000000000000	CH stretch
2380.000000000000	56.00000000000000	CH stretch
2340.000000000000	53.92000000000000	CH stretch
2300.000000000000	51.84000000000000	CH stretch
2260.000000000000	49.76000000000000	CH stretch
2220.000000000000	47.68000000000000	CH stretch
2180.000000000000	45.60000000000000	CH stretch
2140.000000000000	43.52000000000000	CH stretch
2100.000000000000	41.44000000000000	CH stretch
2060.000000000000	39.36000000000000	CH stretch
2020.000000000000	37.28000000000000	CH stretch
1980.000000000000	35.20000000000000	CH stretch
1940.000000000000	33.12000000000000	CH stretch
1900.000000000000	31.04000000000000	CH stretch
1860.000000000000	28.96000000000000	CH stretch
1820.000000000000	26.88000000000000	CH stretch
1780.000000000000	24.80000000000000	CH stretch
1740.000000000000	22.72000000000000	CH stretch
1700.000000000000	20.64000000000000	CH stretch
1660.000000000000	18.56000000000000	CH stretch
1620.000000000000	16.48000000000000	CH stretch
1580.000000000000	14.40000000000000	CH stretch
1540.000000000000	12.32000000000000	CH stretch
1500.000000000000	10.24000000000000	CH stretch
1460.000000000000	8.160000000000000	CH stretch
1420.000000000000	6.080000000000000	CH stretch
1380.000000000000	3.999999999999999	CH stretch
1340.000000000000	1.919999999999999	CH stretch
1300.000000000000	0.839999999999999	CH stretch
1260.000000000000	0.759999999999999	CH stretch
1220.000000000000	0.679999999999999	CH stretch
1180.000000000000	0.599999999999999	CH stretch
1140.000000000000	0.519999999999999	CH stretch
1100.000000000000	0.439999999999999	CH stretch
1060.000000000000	0.359999999999999	CH stretch
1020.000000000000	0.279999999999999	CH stretch
980.0000000000000	0.199999999999999	CH stretch
940.0000000000000	0.119999999999999	CH stretch
900.0000000000000	0.039999999999999	CH stretch

Display options

Intensity:  log  linear

Wavenumber:  cm<sup>-1</sup>  THz

Scale factor:  1.000  10000

Axis labels:  none  auto  user-defined

893 species present in [table 1.20](#) of the theoretical database (Jan 13, 2011)

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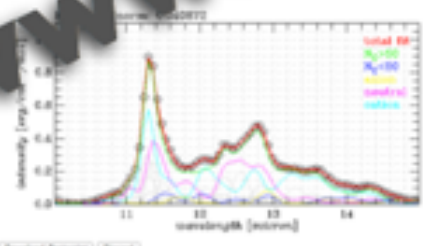
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Chemical structure: C<sub>10</sub>H<sub>8</sub>

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**#1. Spectral fit** [Collapse](#)

Spectral fit using the theoretical database. Theoretical emission profile with a full-width-at-half-maximum of 10 cm<sup>-1</sup> and a full-temperature profile. The PAH data has been shifted to the red by 10 cm<sup>-1</sup>.



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This site automatically updates by clicking on the images in the database.

Browsing theoretical database. Showing species 1 - 80 of 893

Wavenumber:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 ... 81 Next >

[C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  
 [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  [C<sub>10</sub>H<sub>8</sub>](#)  
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 ... 81 Next >

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Bouschlicher et al. 2010, ApJ

# The Orion Door

Google: “Orion Door Collection”

