Draft version January 8, 2021
Typeset using LaTeX **twocolumn** style in AASTeX63

Facilities: VLT:Yepun (MUSE); VLA

Extinction and scattering of nebular emission in Orion

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Abstract

I compare several different methods for estimating the dust extinction of diffuse emission from H II regions. Using archival data for the Orion Nebula, I show that apparent discrepancies between the different methods are powerful diagnostics of (1) emission line scattering from dusty PDRs; (2) the presence of dust layers sandwiched between two emitting gas layers; and (3) the presence of deeply embedded ionized gas that is invisible at optical and near-infrared wavelengths.

Keywords: Atomic physics; Radiative transfer; Photodissociation regions

1. INTRODUCTION

Do separate versions of this graph for different spatial regions selected from the map

2. THE ORION S REGION

This has a slightly elevated r/ir anomaly, but nothing i v/ir, or maybe even slightly negative.

Also do the map of 21cm absorption from Orion S, using data from van der Werf et al. (2013). This should coincide pretty exactly.

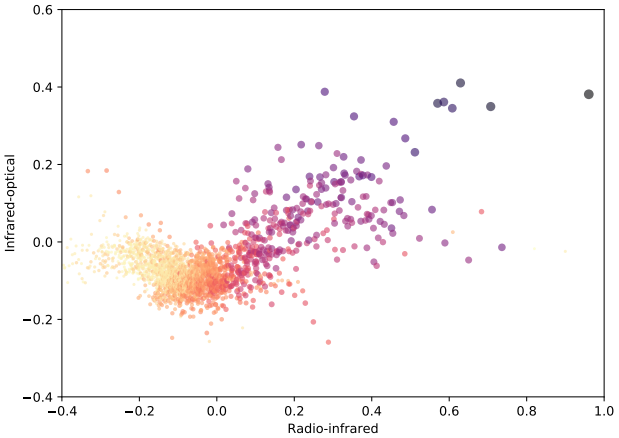

Figure 1. Scatter plot of the infrared/optical extinction anomaly versus the radio/infrared extinction anomaly. Plot symbol color and size indicate the optical–radio extinction (larger values are darker and larger).

Is it an overhang, like in the Bob paper, or is it a separate HII region in the background? It certainly looks like the latter.

3. OTHER MEASURES OF EXTINCTION

3.1. *Diffuse interstellar bands*

5781 Å is the cleanest. There is also 6283 Å, which is stronger, but it is affected by the telluric O_2 absorption.

3.2. *Forbidden metal doublets*

We can use two lines that share an upper level. Small wavelength range, but high S/N and rock-solid intrinsic ratio.

[O III] 4959 and 5007 Å is a 1% change in wavelength. We see about a 1% variation in the ratio.

[Ar III] 7751 and 7136 Å is a 9% change in wavelength. We see about a 15% variation in the ratio. We also see scattering in the Bar PDR (reduction in reddening).

These give the gradient, $dA_\lambda/d\lambda$

Possibly affected by intermediate-scale structure (ISS) in the extinction curve (Massa et al. 2020). The 3 main features are at 4370, 4870, and 6300 Å. The first two are positively correlated with the 2175 Å bump, which is weak in Orion, but the last one is not. Inverse wavelength is 1.997 to 2.016 μm^{-1} for [O III] and 1.29 to 1.40 for [Ar III]. These are both regions where ISS is increasing with inverse wavelength, which would tend to steepen the extinction curve slightly.

3.3. *Continuum colors*

Broad band colors of the pure continuum can be a diagnostic of scattered light.

We should try and subtract off the atomic continuum.

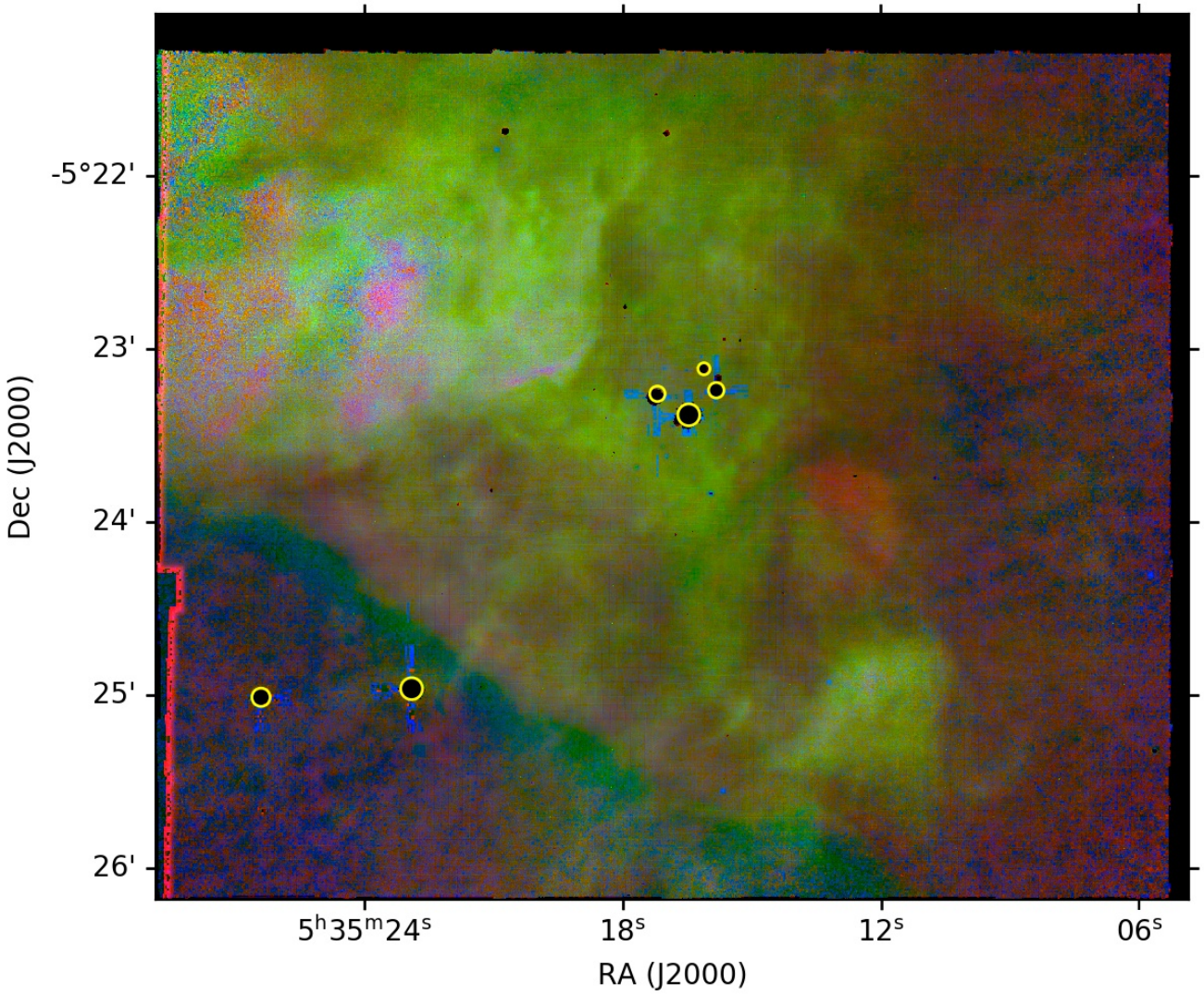

Figure 2. Three-color image of extinction in the inner Orion Nebula. Extinction derived from the optical band reddening of the Balmer decrement (4886 Å to 6563 Å) is shown in green. The infrared/optical extinction anomaly is shown in blue and the radio/infrared extinction anomaly is shown in red.

REFERENCES

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