X36b

近傍 LIRG IIZw096 の 近赤外線域水素再結合線を用いたダスト減光分布

Spatially Resolved Dust Attenuation in a Local LIRG IIZw096 Measured with Near-Infrared Hydrogen Recombination Lines

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Abstract

銀河の真の性質を調査するには、銀河内のダストによる吸収と散乱に起因するダスト減光による補正が必要となる。ダスト減光を補正する手段としてバルマー逓減率が広く使用されているが、大量のダストによって深く隠された領域ではダストの奥までを見通せていない可能性がある。本研究では、JWST/NIRSpec を用いて観測された近赤外線域にある複数の水素再結合線を利用し、近傍高光度赤外線銀河（LIRG）II Zw 096 について、空間分解されたダスト減光を推定した。本ポスターでは、パッシェン線（Paα、Paβ）とブラケット線（Brα、Brβ）の水素再結合線の HI 逓減率から作成したダスト減光分布を示す。Brα/Brβ と Paα/Paβ の輝線強度比を用いてCase B を仮定して得られた赤化 E(B – V) の空間分布から、それぞれ異なる減光量を示す領域があることが分かった。これは、単一の HI 逓減率だけを用いた手法がこれらの領域のダスト減光を正確に推定するには不十分である可能性を示唆している。また、今回の赤化の推定には Calzetti et al. 2020 の減光曲線を外挿した。そのため、これらの領域固有の減光がこの曲線から外れている可能性も考えられる。

1. Background

- Dust attenuates light emitted by celestial objects including galaxies.
- Correction for the dust attenuation is necessary to investigate galaxy properties.
- The Balmer decrement has been used to estimate the dust attenuation.
- However, it is unclear if these optical H lines reflect the total attenuation, especially for thick dust clouds.

2. The Aim of this research

- Create spatially resolved dust attenuation maps of the local **L**uminous **I**nfra**R**ed **G**alaxy (LIRG) II Zw 096 by estimating reddening from two different HI decrements at NIR.

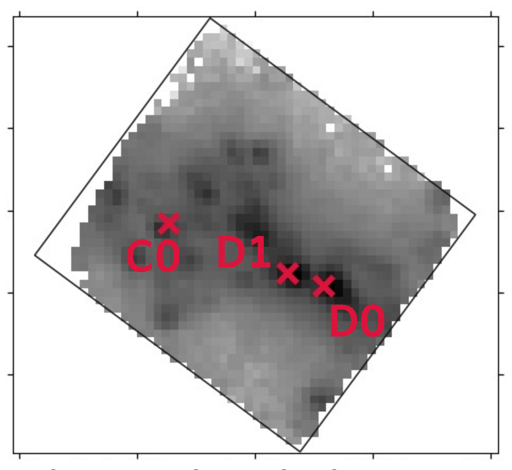
3. Data and the Target

- Integral Field Unit (IFU) data of II Zw 096 taken with:
  - JWST/NIRSpec
    Field of view: 3" × 3", Resolution: ~ 2,700

Disperser-filter combination	G140H/F100LP	G235H/F170LP	G395H/F290LP
Wavelength (μm)	0.97–1.89	1.66–3.17	2.87–5.27
H lines (Rest frame wavelength)	Paβ (1.28 μm)	Paα (1.88 μm) Brβ (2.63 μm)	Brα (4.05 μm)

- II Zw 096

A JWST false color image with the NIRSpec FoV overlaid. (PI: Armus & Evans)

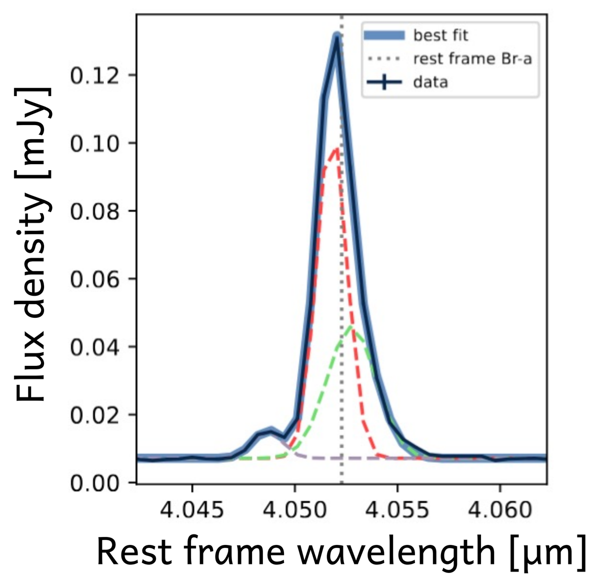


The wavelength slice at ~4.05 μm (Brα).

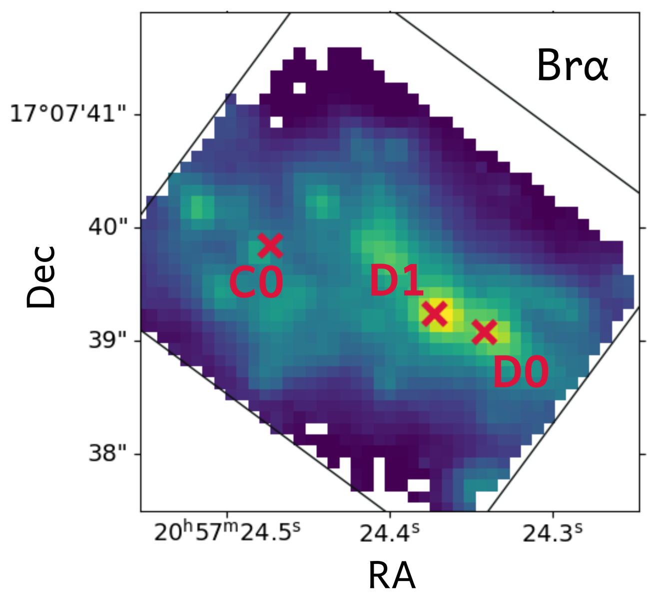
- A local merging LIRG:[1]
  - z = 0.0361
  - $L_{\rm IR} = 8.7\times10^{11} L_\odot$
- Up to ~70% of its total IR emission comes from source D1 in the overlap region.
- D1 is a highly obscured starburst or AGN.
  ($A_V \geq 19$ mag.[2], $A_K > 1-2$ mag.[3])

4. Method

1. Fit H lines with Gaussian functions for each spaxel.



2. Create a flux map for this line.



3. Calculate attenuation differences between two lines.

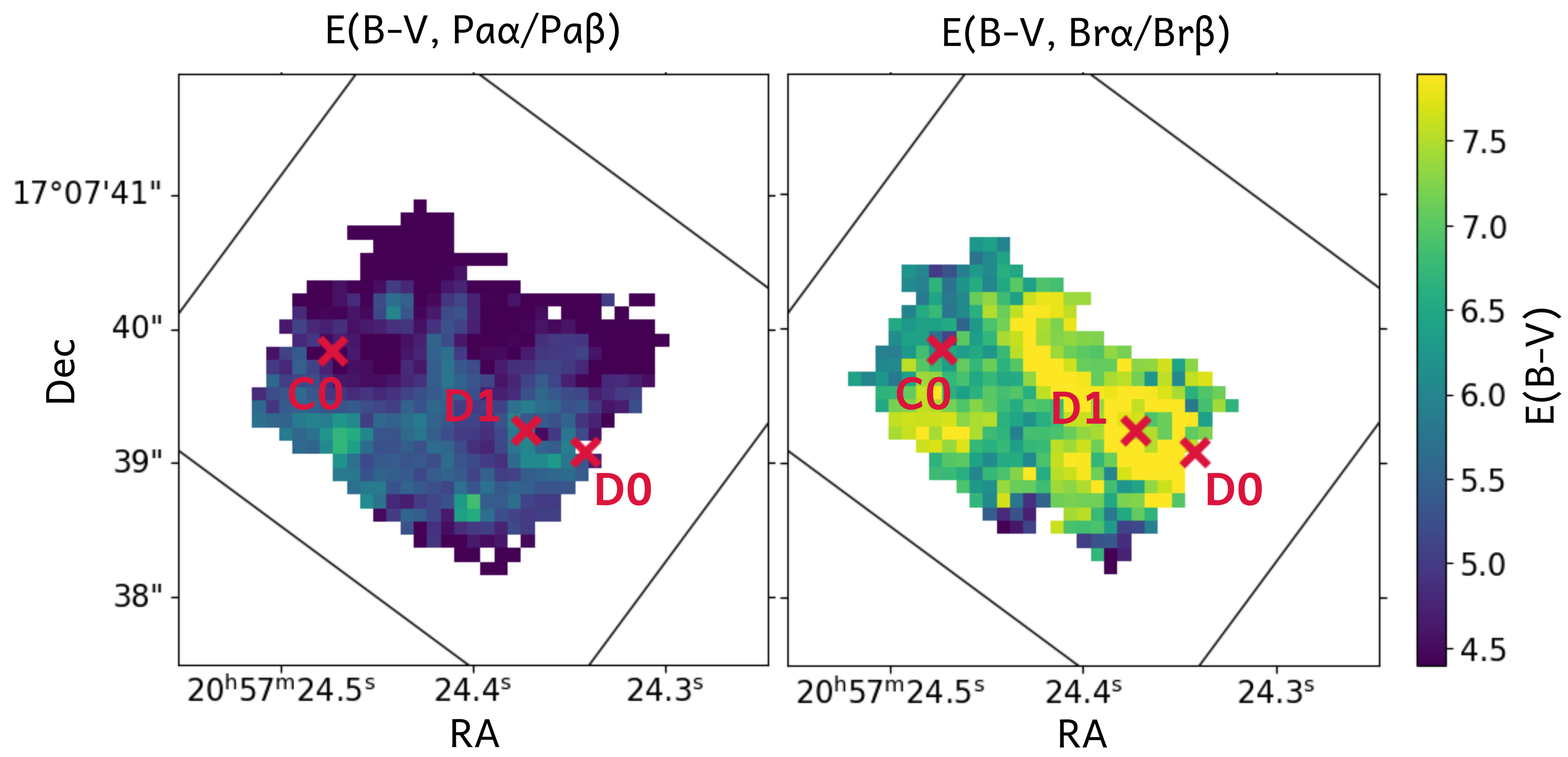
$$A(\lambda_2) - A(\lambda_1) = 2.5\left[\log_{10}\left(\frac{f(\lambda_1)}{f(\lambda_2)}\right) - \log_{10}\left(\frac{f_0(\lambda_1)}{f_0(\lambda_2)}\right)\right] \quad [4]$$

Observed ratio — Case B: theoretical ratio

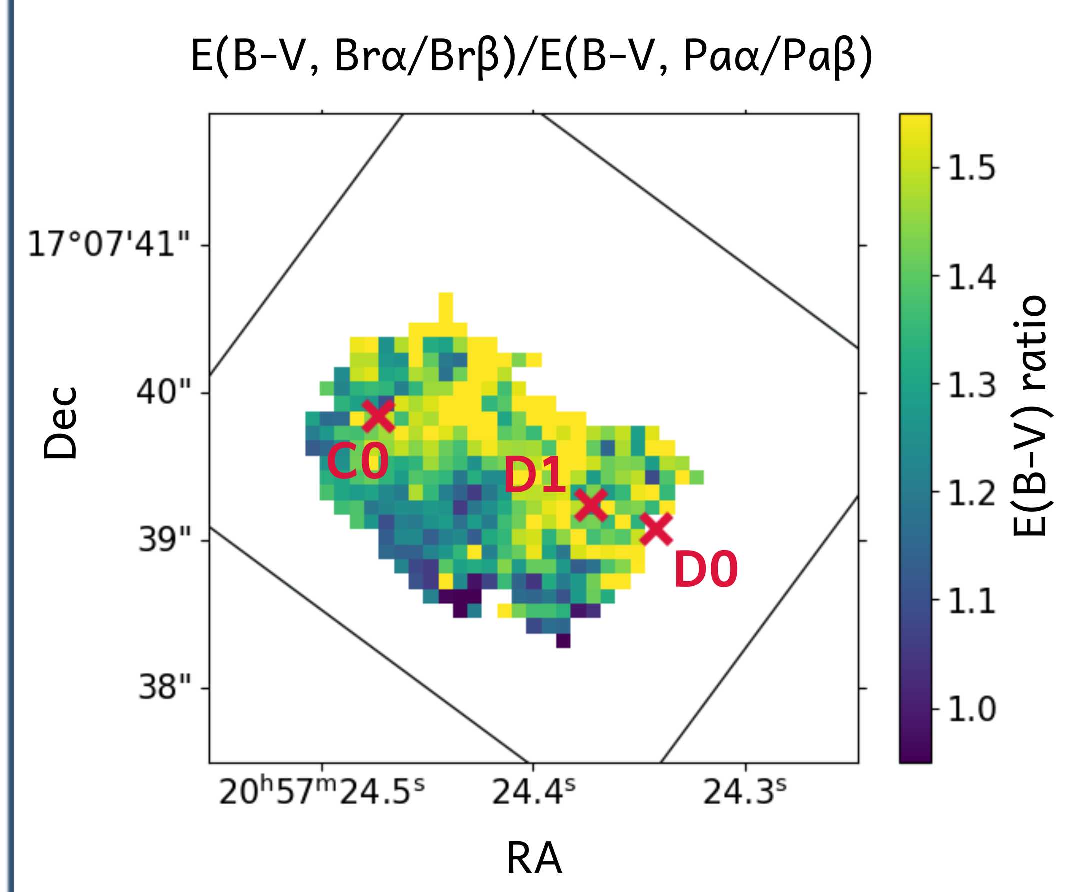
4. Calculate reddening $E(B-V)$ assuming a nebular attenuation curve $k(\lambda)$ from Calzetti et al. 2000. [5]

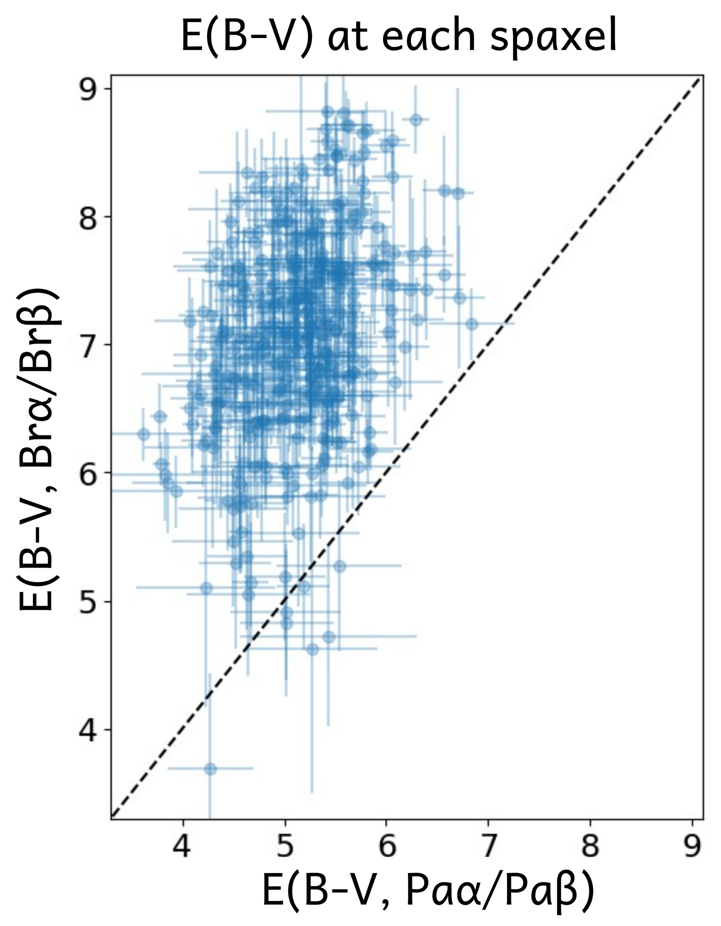
$$E(B-V) = \frac{A(\lambda_2) - A(\lambda_1)}{k(\lambda_2) - k(\lambda_1)} \quad [4]$$

5. Results



- The two HI decrements show roughly the same trend in E(B-V).
- Among all the measurable spaxels (~98%), Brα/Brβ-based attenuations are larger than Paα/Paβ.
- Interestingly, the peak attenuations in the two maps are different.
  - Brα/Brβ based attenuation is largest around source D1, while Paα/Paβ shows the highest attenuation in the south of the FoV.
- There are regions where both Paα/Paβ and Brα/Brβ give comparable attenuation values within uncertainties.





6. Conclusions

- We estimate the spatially resolved dust attenuation of a dust-obscured overlap region in the local LIRG II Zw 096 using Paα, Paβ, Brα, and Brβ.
- The attenuation maps E(B-V, Paα/Paβ) and E(B-V, Brα/Brβ) exhibit different attenuation structures from each other.
  This implies:
  - We may need HI decrements at longer wavelengths to accurately estimate the dust attenuation.
  - The inherent attenuation may deviate from the assumed Case B and/or Calzetti et al. 2000 curve.

7. Future work

- Estimate dust attenuation using other available H line pairs from JWST and VLT/MUSE to investigate other HI decrements through optical to NIR wavelengths.
- Derive the spatially resolved dust attenuation curves.

[1] Inami et al. 2022 [2] Inami et al. 2010 [3] Goldader et al. 1997 [4] Reddy et al. 2020 [5] Calzetti et al. 2000