Stellar population in the vicinity of the H II region G331.03–00.15

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Outline

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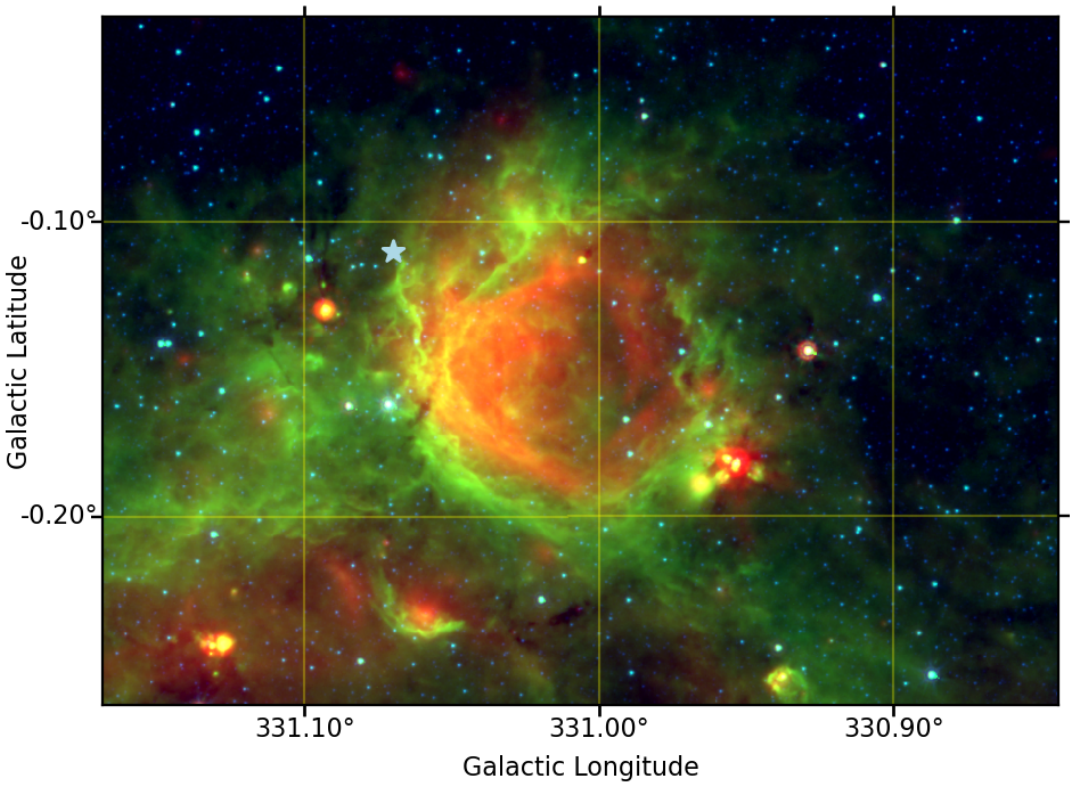
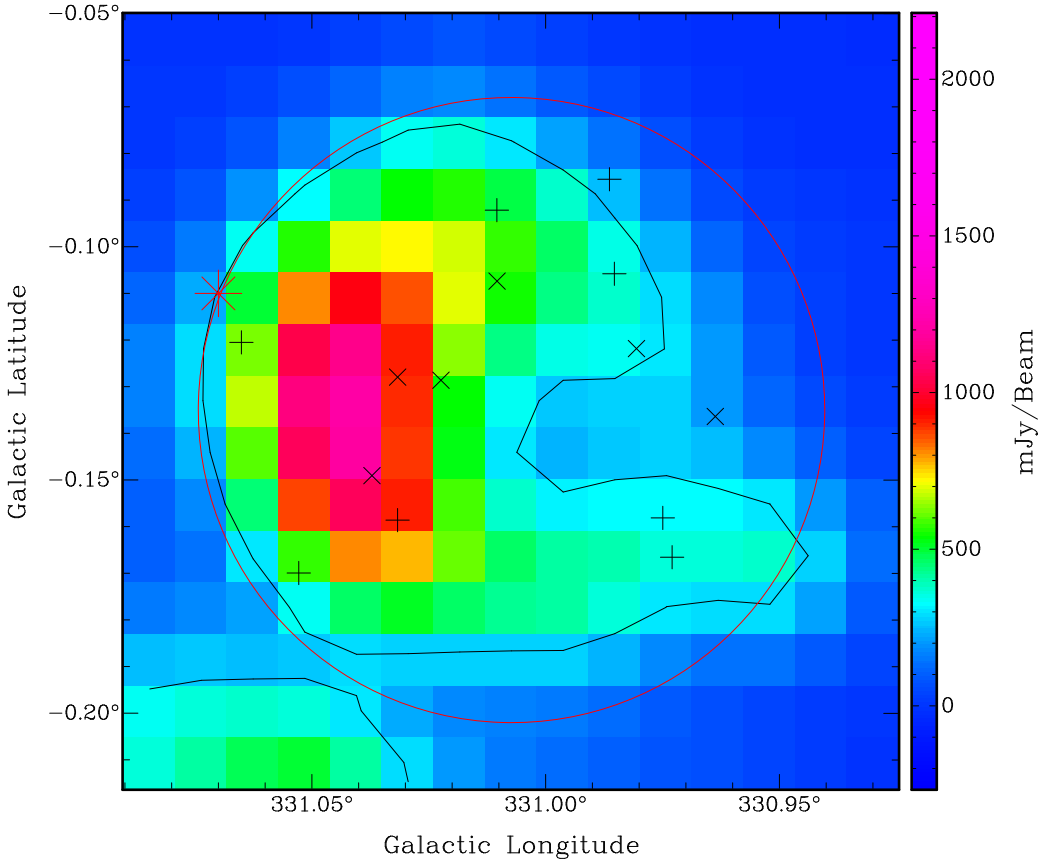
Introduction: WR 1051–67L & its local medium



Three–colour composite image of H II region G331.03–00.15 (24 μm, 8 μm, 4.5 μm)

- WR 1051–67L
  - $l = 331.^{\circ}07, b = -0.^{\circ}11$
  - identified as WC7 $\pm$ 2 using NIR data
  - 6.61 $\pm$ 1.65 kpc
- G331.03–00.15 (G331 for short)
  - Fourth Quadrant ($l = 331.^{\circ}055$, $b = -0.^{\circ}144$)
  - $7.44^{+1.13}_{-1.06}$ kpc
- WR 1051–67L as a possible ionising source of G331

Introduction: WR 1051–67L & its local medium



Emission at 1420 MHz. **Red** circle: VVV candidate sources search area. (*): WR 1051-67L. (**x**) and (+): Giant and MS final candidates, respectively.

- $S_{1420} = 2.9 \pm 0.4$ Jy
  - $N_{\rm UV} = (2.1 \pm 0.7) \times 10^{49}$ ph s^{-1}
  - WC7: $N_{\rm Ly} = 1.26 \times 10^{49}$ ph s^{-1}
- Catalogue of NIR point sources of the VISTA Variables in the Vía Láctea (VVV) DR2 survey

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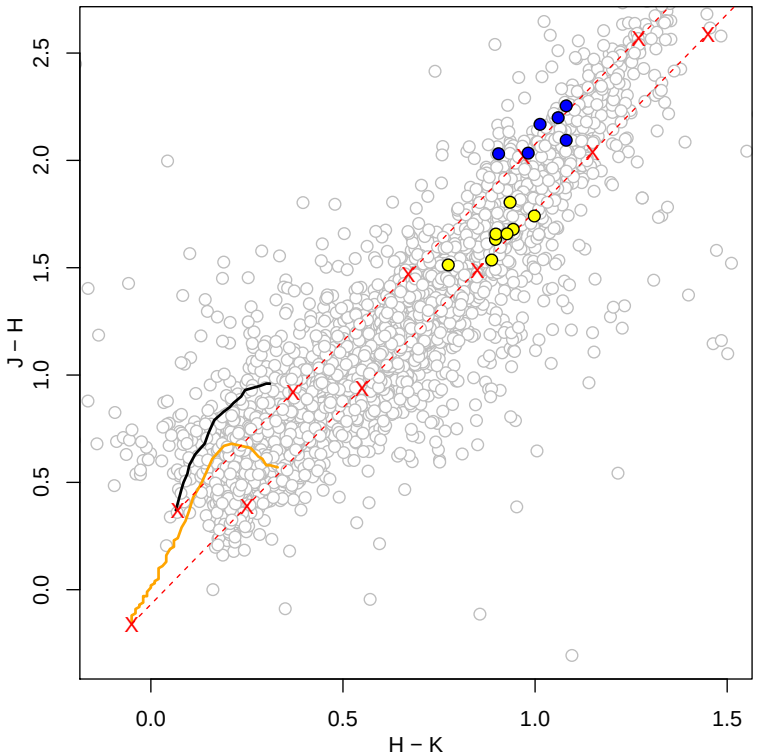
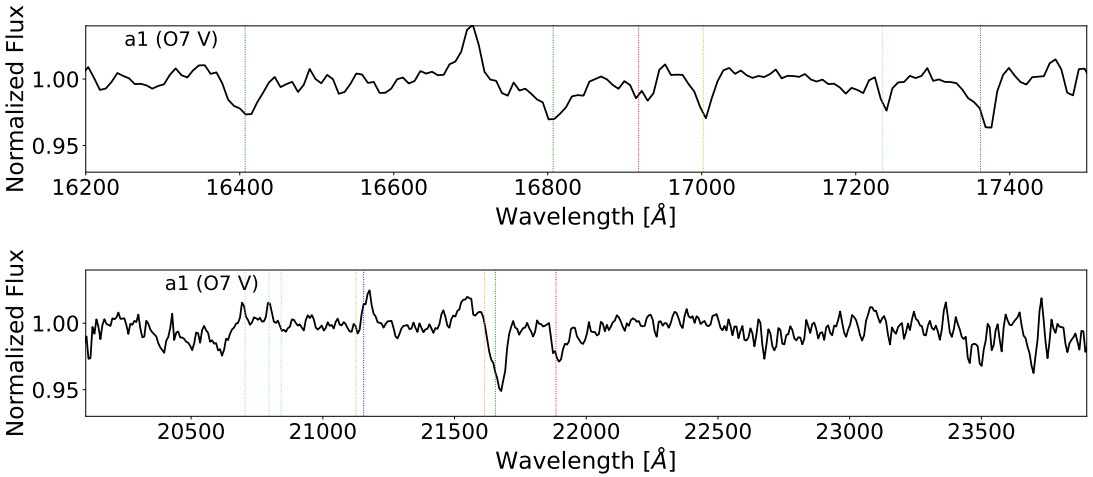
Identification of other high–mass stellar sources



Yellow and **blue** circles: **O V** and **O III** candidates, respectively. **Orange** and **black** lines: de–reddened **early–type MS** and **Giant sequence**, respectively.

- IR reddening–free pseudo parameter: $Q_{IR} = (J - H) - 1.83 \times (H - K_s)$
  - $-0.15 < Q_{IR} < 0.1$ (MS candidates)
  - $Q_{IR} > 0.1$ (Giant candidates)
- J, H and K_s bands
  - 7440 pc
  - 14 mag $< A_V <$ 17.5 mag
- 6 candidates to O III stars and 8 to O V stars

Identification of other high–mass stellar sources



Spectrum of the discovered **O7 V** star in the H (top) and K–bands (bottom).

- Gemini/FLAMINGOS–2
- VVV J161007.73–515003.72
- Colourised vertical lines:
  - **H–lines** at 1.6411 μm, 1.6811 μm, 1.7367 μm, and 2.1661 μm
  - **He I** $\lambda\lambda$1.7007, 2.1126, and 2.1614
  - **He II** $\lambda\lambda$1.6923 and 2.1891
  - **N III** λ2.1155
  - **C IV** $\lambda\lambda$2.0706, 2.0802, and 2.0842.

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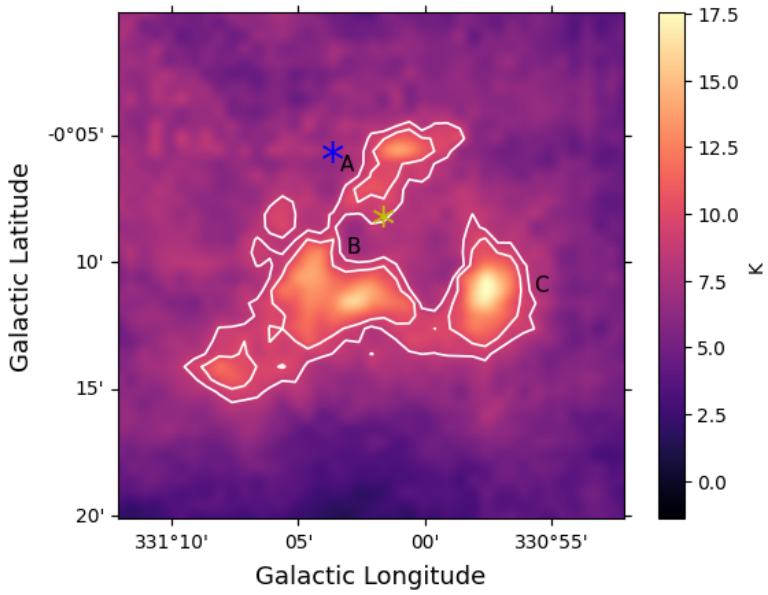
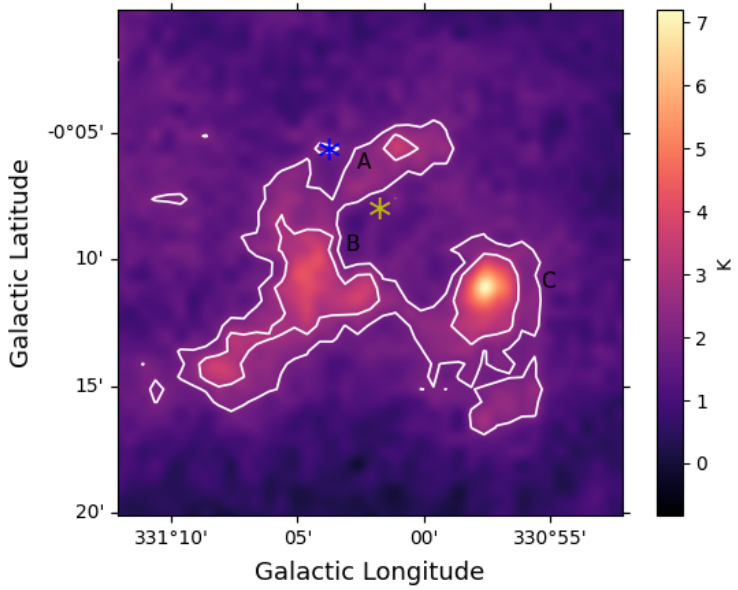
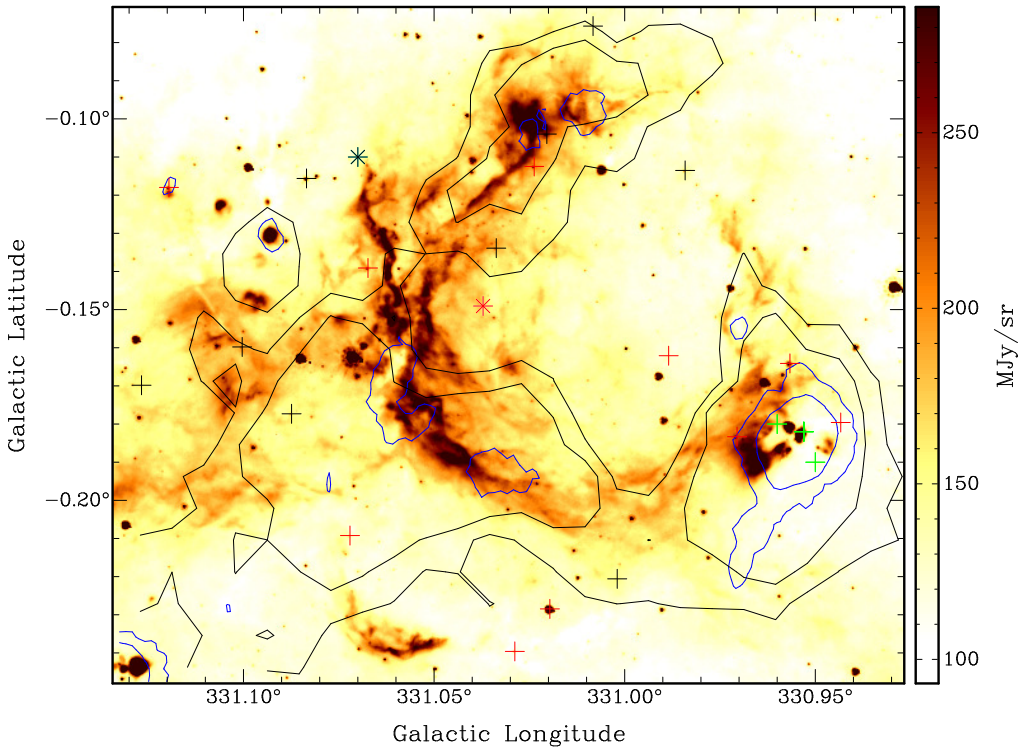
Molecular gas and star formation activity







Emission map at 8 μm. **Black** and **blue** contour levels: **CO** and **870 μm** emission, respectively. (+): spots of molecular masers. (*): WR 1051–67. (*): O7 V star. (+): Class I cYSOs. (+): Class II cYSOs.

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Summary/Conclusions

- An observational and multi–frequency study of the H II region G331.03–00.15 was carried out to investigate its local medium and the massive stellar population associated with it.
- Taking into consideration the projected position and estimated distance of the WC–type star WR 1051–67L, we propose it as a possible ionising source of G331.
- Based on an energy analysis of the H II region, we inferred that additional UV photons would be needed to maintain the ionised region.
- Via low–resolution, H and K–band spectroscopic analysis, we classified 14 NIR science spectra obtained with Gemini/FLAMINGOS–2, and identified one new O7 V star.
- The location of the newly–discovered O star shows good agreement with the morphology of G331 as seen in the MIR bands, and presents a scenario in which the presence of other massive stars would not be essential for the formation of the region.

Summary/Conclusions

LLAMA and sistematic studies of local ISM around massive stars

- Large molecular lines surveys: sistematic studies of molecular content and distribution in the vicinity of massive stars
- Analysis of molecular abundances and how they relate to UV photon content from massive stars
- Study of molecular clumps in massive star-forming regions

Thank you!

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