SIGNALS of Giant HII Regions:
Resolved Ionization & Abundance Properties of NGC 604

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BACKGROUND:

Extragalactic giant HII regions provide excellent laboratories to study star formation processes, massive stars, and the properties of the surrounding gas. However, most studies take a single spectrum and assume it to be characteristic of the entire region. Do strong variations in these properties of giant HII regions exist when studied spatially?

METHODS

1. Collected data cubes with SITELLE at CFHT in three filters targeting bright optical emission lines: [OII]λ3727, Hβ 4681, [OIII]λλ4959,5007, [NII]λλ6548,6584, Hα 6562, [SII]λλ6717,6731
2. Extract spectra from individual spaxels using ORCS (Martin+20) and fit with a sincgauss function to produce emission line maps

RESULTS

I extracted an integrated spectrum for NGC 604 and computed globally averaged properties, finding it to be mildly star-forming, having slightly sub-solar abundances, and having low electron densities, comparable to other studies (e.g., Vílchez+88; Maíz-Apellániz+04; Esteban+09; Rogers+22).

I constructed 2D emission line maps to explore various physical properties:

- Density structure shows low densities across the region with regions of elevated density near the core
- Excitation maps show strong variations across the region with two discrete sources present.
- Abundance-sensitive maps show strong variations, likely explained by ionization changes and not true abundance inhomogeneities

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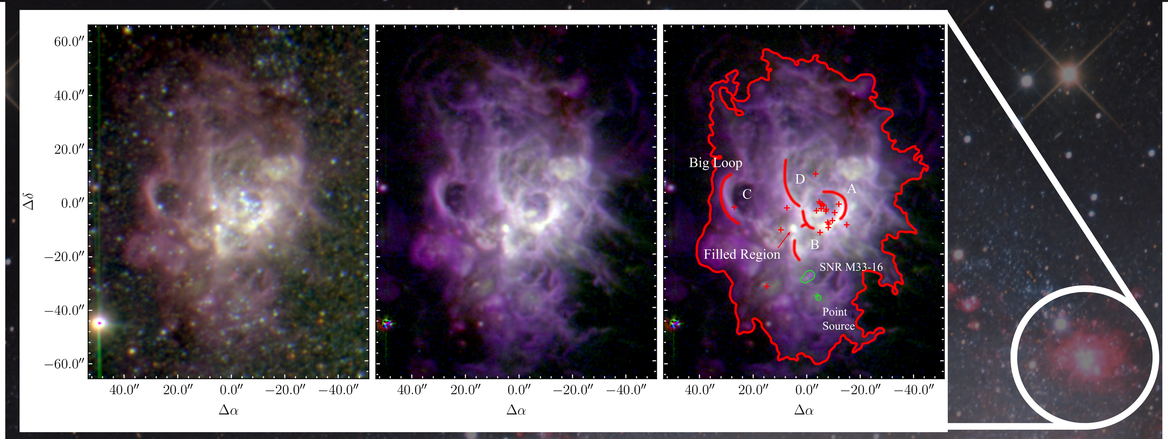
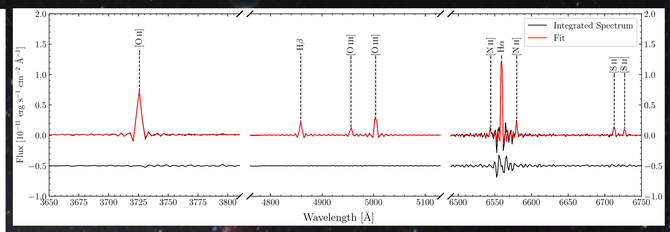
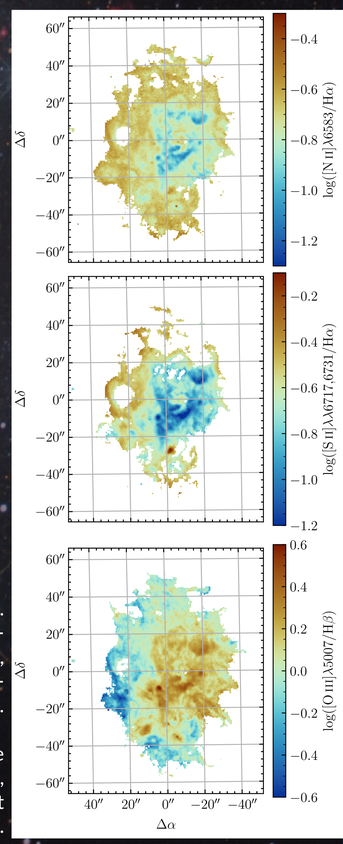


Giant HII regions are not idealized homogeneous spheres of ionized gas. Spatially-resolved data is needed to fully understand them and place them in a galactic context.

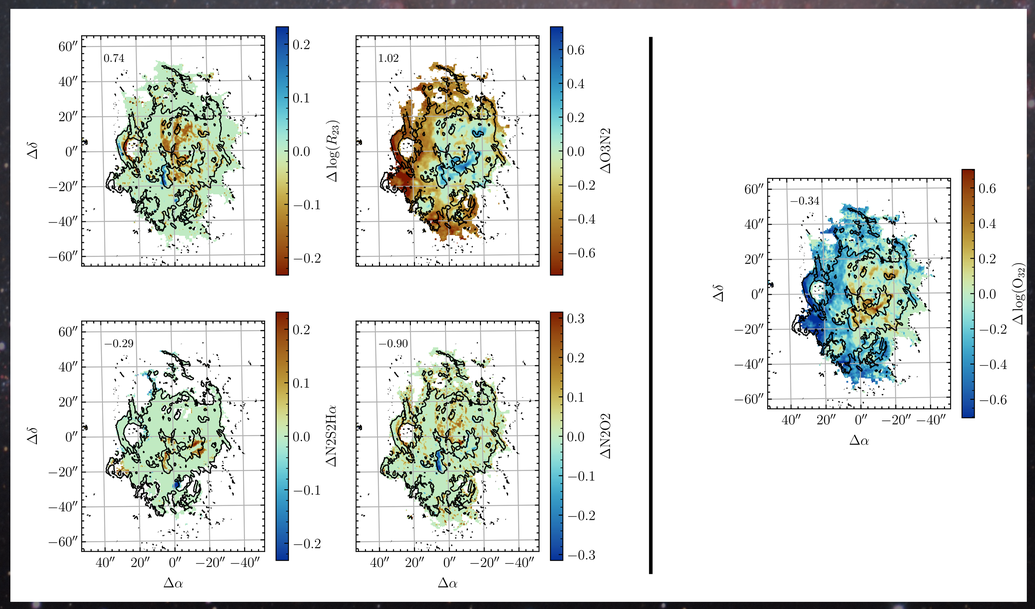


The integrated spectrum of NGC 604 with the apparent strong lines indicated. The black line represents the spectrum, while the red line is the fit performed by ORCS using a sincgauss function. The black line below the fit are the residuals.

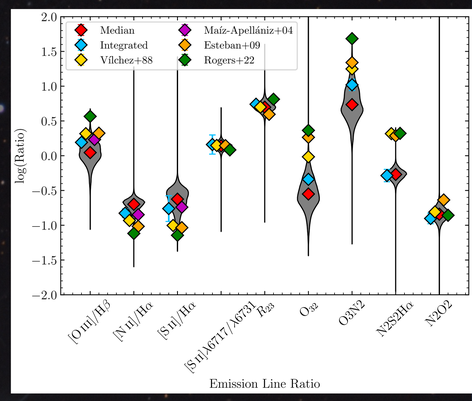


Various excitation ratios. The top two are low-excitation sensitive ratios, while the bottom is a high-excitation sensitive ratio.

Note the point source visible in the top and bottom panels, and the supernova remnant visible in the middle panel.



Maps of strong-line abundance indicators after subtracting the integrated value. The number in the top left of each panel is the line ratio value of the integrated spectrum. The color bars have been chosen so that bluer colors are metal-poor compared to the integrated value while the redder colors are metal-rich compared to the integrated value. The green colors are those that have been masked.



Violin plots comparing the effects of resolution on line ratios. The gray violins show the distribution observed in the maps. The diamonds indicate observed emission line ratios in this paper and from the literature.

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References

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