

THE ROTATING DISK AND HOURGLASS-SHAPED NEBULA AROUND 89 HERCULIS

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CONTEXT

There is a class of binary post-AGB stars that show evidence of being surrounded by stable, rotating disks [1,6]. These sources exhibit a significant NIR excess and narrow CO line profiles, characteristic of rotating disks. Their SEDs reveal the presence of hot dust close to the stellar system, and its disk-like shape has been confirmed by interferometric mm and IR data [2,5]. The mm observations also confirm the presence of an expanding structure surrounding the rotating disk. Thus, we can identify two categories: disk-containing nebulae dominated by the rotating component, and those dominated by the expanding structure.

RESULTS & CONCLUSIONS

Previous NOEMA mm-interferometric studies of 89 Herculis were affected by flux losses in the most extended regions [3], preventing the true size of the nebula from being detected and, consequently, making it impossible to estimate the total mass of the hourglass-shaped extended component. Thus, we performed on-the-fly observations of this source with the IRAM-30m telescope to obtain total-power maps of the ¹²CO and ¹³CO *J* = 2-1 emission lines. Then, we combine these total-power maps with our previous NOEMA data, resulting in a comprehensive dataset that captures the full extent of the nebula. The new combined maps provide a complete picture of the detectable flux and offer high spatial resolution thanks to the interferometric data (see figure). The hourglass-shaped outflow surrounding the rotating disk is larger and more massive than previously estimated. According to our new maps and our accurate model, the total nebular mass is $1.8 \times 10^{-2} M_{\odot}$, with $\sim 65\%$ of the mass coming from the outflow. Therefore, we classify the nebula surrounding the binary post-AGB star 89 Herculis as being outflow-dominated. See [4] for details.

REFERENCES

- [1] Bujarrabal, V., Alcolea, J., Van Winckel, H., et al. 2013a, A&A, 557, A104
- [2] Bujarrabal, V., Castro-Carrizo, A., Alcolea, J., et al. 2016, A&A, 593, A92
- [3] Gallardo Cava, I., Gómez-Garrido, M., Bujarrabal, V., et al. 2021, A&A, 648, A93
- [4] Gallardo Cava, I., Alcolea, J., Bujarrabal, V., et al. 2023, A&A 671, A80
- [5] Kluska, J., Van Winckel, H., Hillen, M., et al. 2019, A&A, 631, A108
- [6] Van Winckel, H. 2003, ARA&A, 41, 391

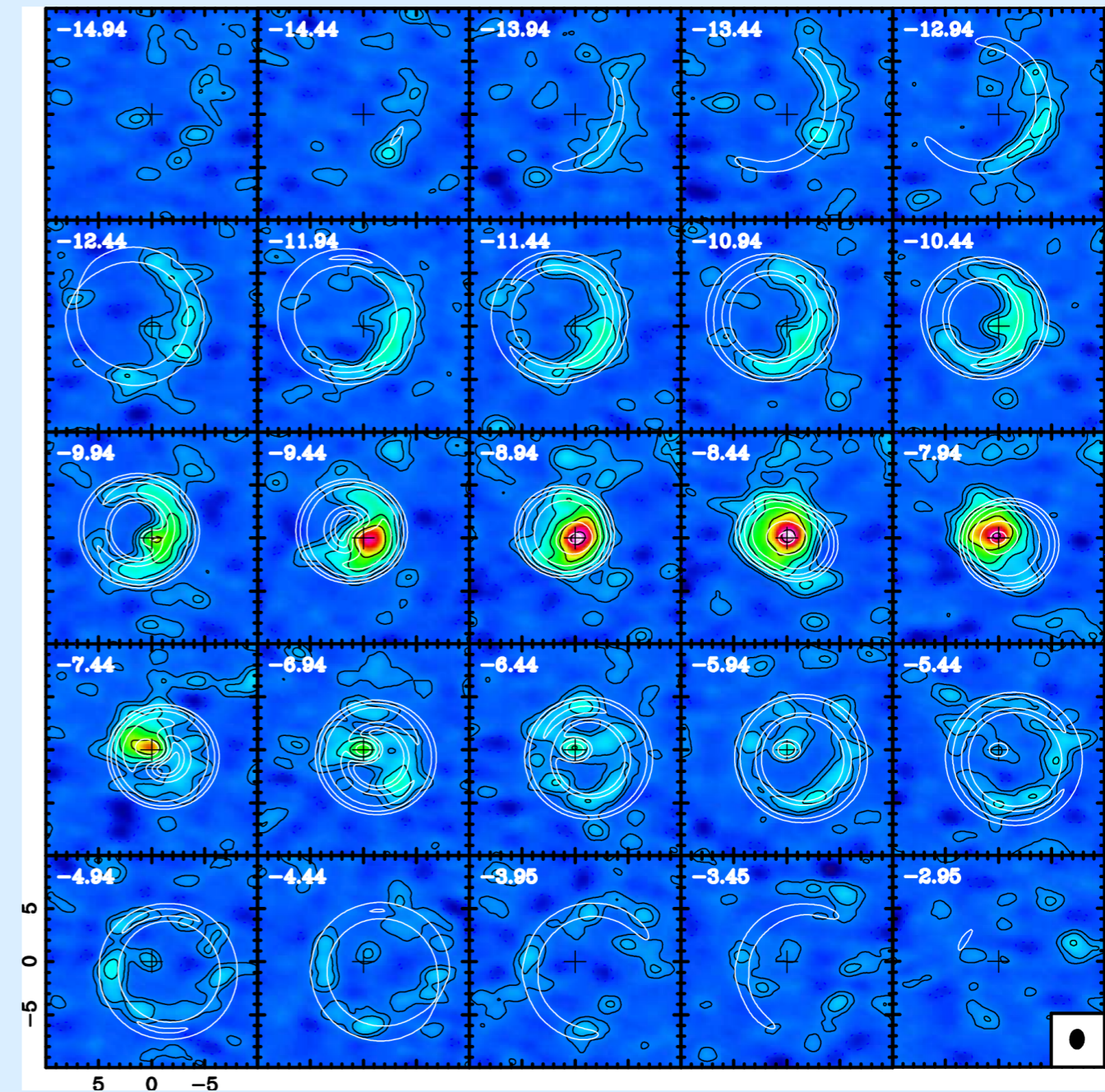


Figure: Velocity maps of the ¹²CO *J* = 2-1 line emission around 89 Herculis, with model predictions (white contours) superimposed on the NOEMA + IRAM-30m observations. Offsets are in arcseconds. Adapted from [4].