A Spectroscopic Study of the Odd Planetary Nebula Abell 57

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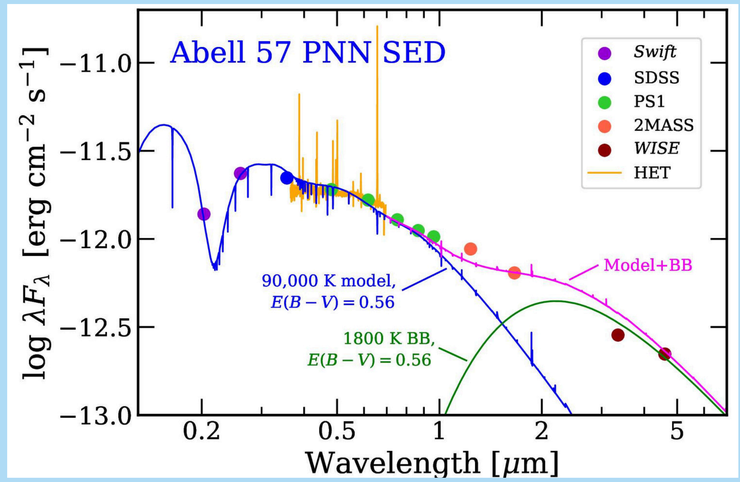
MOTIVATION

- Planetary nebulae (PNe) are the last stage of evolution for low-to-intermediate-mass stars
- Characterized by extremely hot stars ionizing their ejected envelopes
- The ***EGB-6*** class is a unique and poorly understood group of planetary nebulae[a]
- Have dense compact emission knots (CEKs) unresolved* from the central star
- Theorized to be formed when the PN progenitor has a binary companion onto which the stellar outflow from the PN was accreted
- We aim to test whether ***Abell 57*** is a member of this fascinating group of PNe[b]



The spectral energy distribution of ***Abell 57's*** central star shows the presence of a cool object

METHODS

- We used the Low-Resolution Spectrograph on the *Hobby-Eberly Telescope* to obtain spectra of ***Abell 57***
- These spectra were analyzed to obtain measures for the fluxes of the emission lines of various diagnostic species
- These diagnostic species were used to infer PN and CEK characteristics such as electron density, electron temperature and reddening
- We used the photo-ionization simulation software **CLOUDY** to create a model of the PN, matching the observed and predicted emission line fluxes to then determine other characteristics of the nebula[c, d, e]

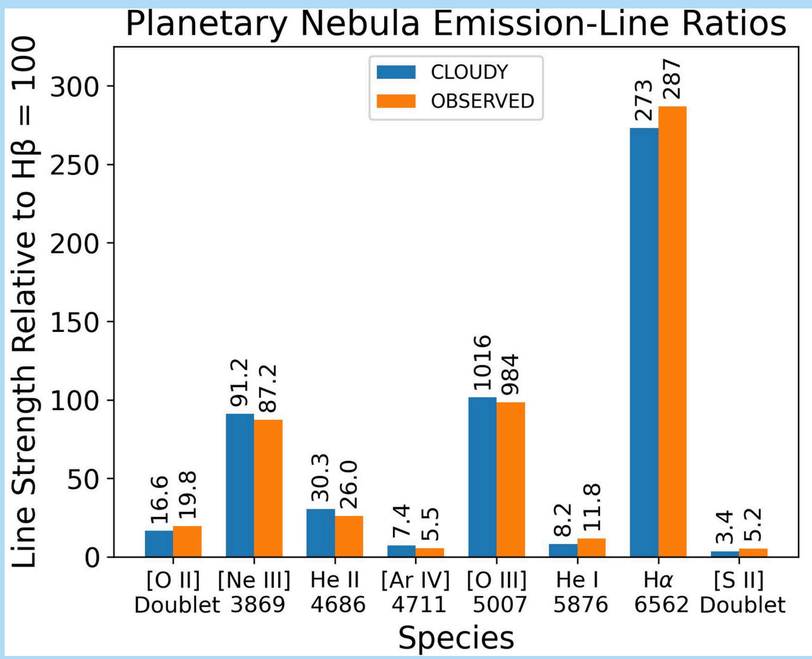
RESULTS & FUTURE

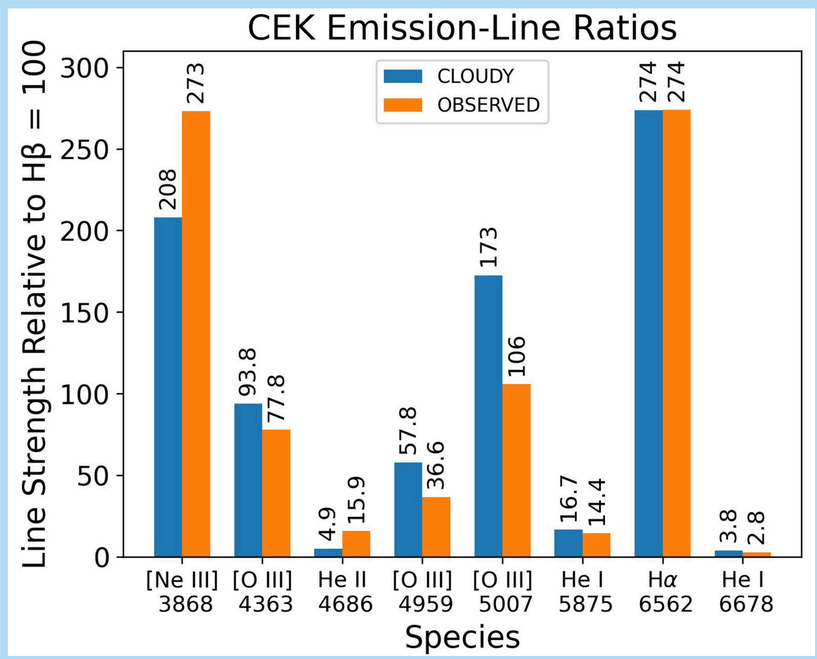
- We found the central star to be a 90,000 K white dwarf
- We used **CLOUDY** to model the densities, metallicities and sizes of the PN and CEK
- We found the **CEK** to be extremely dense (**log(n_e= 7.2)**) and approximated it to be a **sphere** with radius **~4.5 AU** and an ionized mass of **log(M)=-7.8 $M_\odot$**
- We aim to use the *Hubble Space Telescope* and the *James Webb Space Telescope* to obtain higher resolution spectra and direct imaging of the nebula

REFERENCES

a Frew, D. J., & Parker, Q. A. 2010, PASA, 27, 129
* Using ground-based observations
b Bond, H. E., Chaturvedi, A. S., Ciardullo, R., et al. 2024
c Ferland, G. J., Korista, K. T., Verner, D. A., et al. 1998, PASP, 110, 761
d Ferland, G. J., Chatzikos, M., Guzmán, F., et al. 2017, RMxAA, 53, 385
e Chatzikos, M., Bianchi, S., Camilloni, F., et al. 2023, RMxAA, 59, 327

An amateur astronomer's image of ***Abell 57***. We find the central star is accompanied by a dense knot of nebulosity, possibly associated with a binary companion star. *Credit: Jerry Macon*





A comparison of our observed and modeled flux ratios for the ***Abell 57*** planetary nebula and compact emission knot