Peculiar Ages of a Peculiar Galaxy

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NGC 5474

INTRODUCTION

- Peculiar dwarf spiral galaxy part of M101 group
- Noticeable **offset bulge** most likely from M101 interaction, also suspected to be separate object in front. (Garner+25)
- Narrow band images of Hβ and [O II], on and off band filters.
- Look at radial regions and compare to CIGALE stellar age models
- **Do we see any trends of stellar age across the galaxy?**

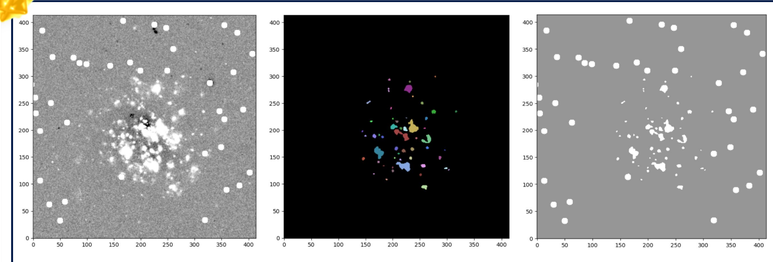

Figure 1. Left: Hβ-on band image with foreground stars masked. Middle: H II regions detected in Hβ-on band image. Right: Image segmentation map of Hβ-on band image with foreground stars and H II regions masked.

METHODOLOGY

- Mask bright foreground stars and subtract background.
- Create image segmentation maps to detect H II regions and mask them.
- This allows us to see the absorption features in the galaxy, since H II emission was so large that we couldn't see them before!

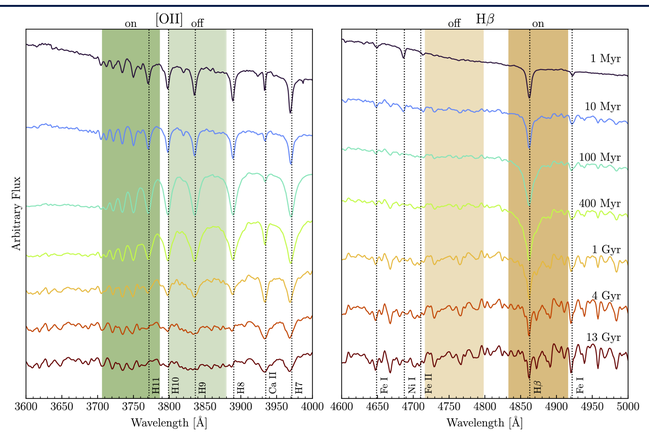

Figure 4. The SED of an instantaneous burst of star formation using CIGALE (Boquien+19), increasing in age from top to bottom. Left: the [O II] filter set. Right: the Hβ filter set. In both panels, the on-band is darker than the off-band. (Garner+24)

- Hβ absorption shows increasing absorption until 400 Myr, then decreases as A/F stars die.
- [O II] sensitive to high order Balmer lines
- [O II] slope decreases until 1 Gyr, then flattens.

MAIN DISK

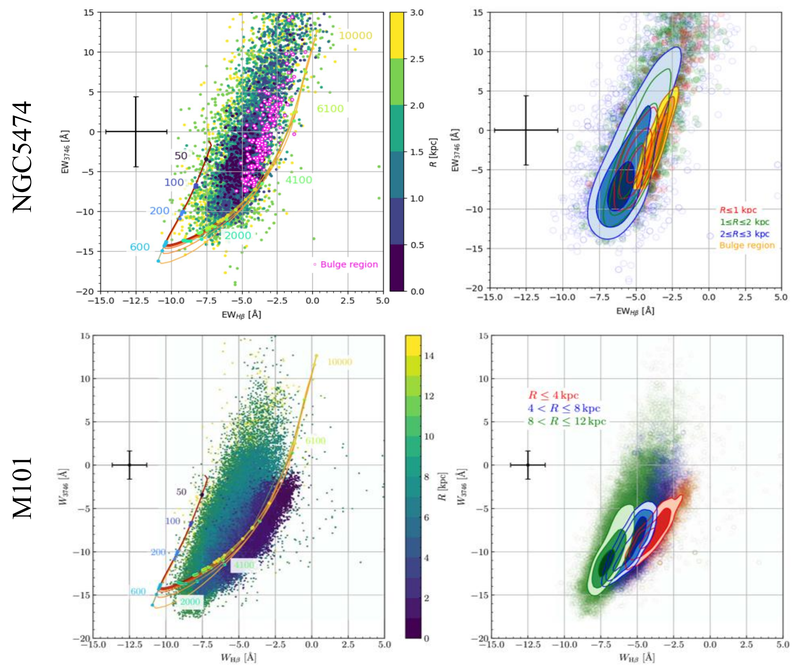

Figure 2. Comparing radial age relations of NGC 5474's main disk and M101 (Garner et al 2024) as distance form kinematic center of each galaxy. The bulge center is roughly 1 kpc from the kinematic center, not indicated here. Contours show the data point density for different radial ranges, with 30%, 50%, and 80% of all data points in each range.

- Plot of the equivalent width (EW) of Hβ and [O II] absorption because that ratio is an age indicator.
- Expect an older population to have more positive Hβ and [O II] EWs.
- The lines in left plots are model ages given by CIGALE.
- Sharp turn at 600 Myr, the average lifetime of the high mass A/F stars and largest producers of Balmer absorption.
- The right plots are contours; the contour furthest right contains the older population.

M101 COMPARISON

- In NGC 5474, there is no radial age trend, i.e., regardless of radius all points lie between the model tracks
- The bulge is distinct from the disk, suggesting a different star formation history or significantly older populations
- In contrast, M101 has a clear age relation, i.e., stars get younger as the radius increases.
- This difference between M101 and NGC 5474 could be explained by different mixing timescales: the size of NGC 5474 is small enough that total radial mixing might occur rapidly (e.g., Roy & Knuth 95)
- Thus, the disk of NGC 5474 is consistent with other dwarf galaxies, while the bulge has age characteristics comparable to dwarf elliptical galaxies. (Bellazzini+20)

OUTER DISK

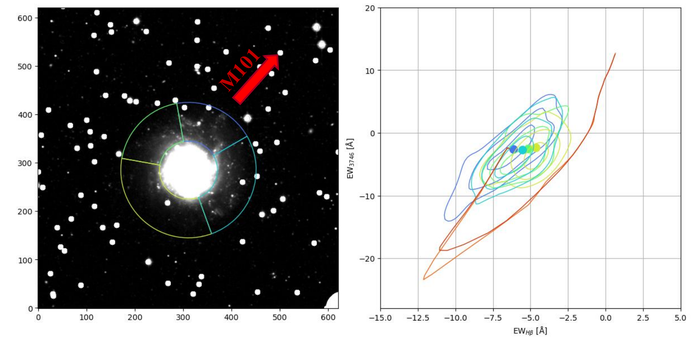

Figure 3. Wedge regions of NGC 5474's outer disk. Region within the wedge contours plotted on the left with 30%, 50%, 80% data points. The point within each contour is the median value of the EW of each wedge. Red arrow indicates the direction of M101, which is northwest in the image.

- The wedge sizes were chosen by isolating the youngest and oldest populations.
- A slight trend is shown where the dark blue region has slightly younger stars and the yellow region has slightly older stars.
- The outer disk extends most in the northwest direction; the direction of M101.
- The northwest wedge has the youngest population, suggesting a burst from the interaction with M101.
- Tidal debris can be found in the northwest direction as well, not seen in the image. (Garner+21)

CONCLUSION

We looked at absorption features of NGC 5474 to analyze any age trends that could explain the peculiar offset bulge. We found that while the rest of the galaxy has a mixed age stellar population, the bulge is noticeably separate and contains an older population. Looking at the outer disk reveals an older population on the southeast and a younger population on the northwest, suggesting tentative evidence of an interaction with M101.

REFERENCES

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