

Optical Structure of Tidal Bridge in Arp 104

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Introduction

Strongly interacting galaxy pairs provide a basis for studies of tidal bridges. We obtained moderately deep, multi-color optical images with the WIYN 0.9-m telescope at Kitt Peak for Arp 104, a unique system with an extended stellar tidal bridge. Arp 104 consists of two interacting galaxies, NGC 5218 in the north and NGC 5216 in the south. NGC 5218 is obviously disturbed with a nuclear starburst (Olsson et al. 2007, Smith et al. 2007) with a plume extending northeast and a bridge extending south. At the south end of the bridge, NGC 5216 is an elliptical galaxy with a tail to the southwest. The bridge appears extremely smooth, narrow, and extended.

Data Reduction

We used IRAF to do the reduction of the optical data.

- Corrected for CCD irregularities by subtracting the combined bias exposure from the combined flat field image.
- Created a map of the bad pixels on the CCD to be corrected for during the final processing.
- Used the combined flat field image, the combined bias exposure, and the bad pixel map to remove instrument generated errors.

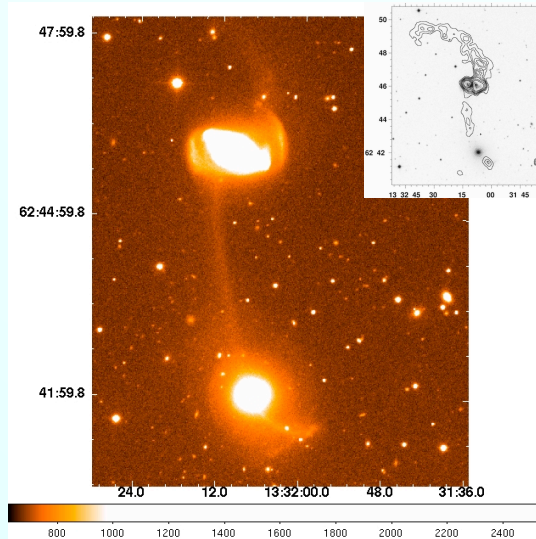
This was done for each raw image in the data set. These images were then aligned and combined using imcombine. The final combined R band image is a combination of three 600 second exposures.

Photometry

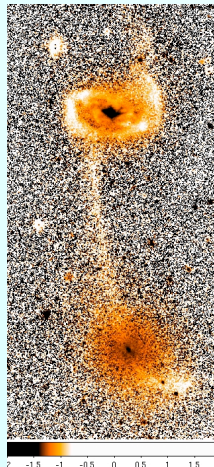
We used the apphot package in IRAF to do the photometry for the system.

- The absolute magnitude of the northern galaxy is $-20.4 = M_g$ and the absolute magnitude of the southern galaxy is $-20.0 = M_g$.
- The density of stars in the bridge between the two galaxies is $\rho \leq 0.01 - 0.001 M_\odot$.
- The average g-r color for the northern galaxy is 0.7 ± 0.2 .
- g-r color for the southern galaxy is 0.8 ± 0.2 , consistent with an elliptical galaxy.
- g-r color for the bridge, on average, is 0.5 ± 0.2 , similar to the outer parts of NGC 5218 where this material probably originated.
- The surface brightness of the bridge is smooth to $\sim 10\%$.

Images



Above: A combined R band image of Arp 104 showing the smooth structure of the bridge. The inset displays the HI contours. The contour levels are (0.05, 0.075, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4) Jy beam⁻¹ km s⁻¹ (Cullen et al. 2003, 2007).



Left: The color map of Arp 104. White represents blue and orange represents red.

Discussion

- The northern galaxy (NGC5218) is a disturbed disk galaxy with a central starburst region.
- NGC5216, the southern galaxy, is a red elliptical galaxy which has little to no star formation.
- The tidal debris around the galaxy pair is asymmetric. HI dominates the northern region, while luminous matter dominates the south.
- The bridge between the two galaxies is optically smooth; it is uniform to $\sim 10\%$ in surface brightness. It can also be inferred by the color of the bridge that it contains an intermediate age stellar population. Little to no HI resides in the bridge as seen by the HI contours.
- The tidal bridge is possibly stripped from the outer regions of the northern galaxy--the colors of these two features are very similar--and/or it is enriched by star formation.
- Intermediate colors of the tidal bridge are consistent with an intermediate aged stellar population and the earlier marginal results of Schombert et al. (1990).

Where is this headed?

- Why is the bridge between the two galaxies uniform?
- What is the dynamical history of Arp 104?
- Why are the tidal features asymmetric?
- Where will the tidal features end up?

References

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Acknowledgements

Research supported in part by the National Science Foundation through grant AST-0708967 to the University of Wisconsin. Research also supported in part by the National Space Grant College and Fellowship Program and the Wisconsin Space Grant Consortium.

We also thank the staff of the WIYN 0.9m.

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