



UNVEILING THE HOST GALAXIES OF NARROW-LINE SEYFERT 1s

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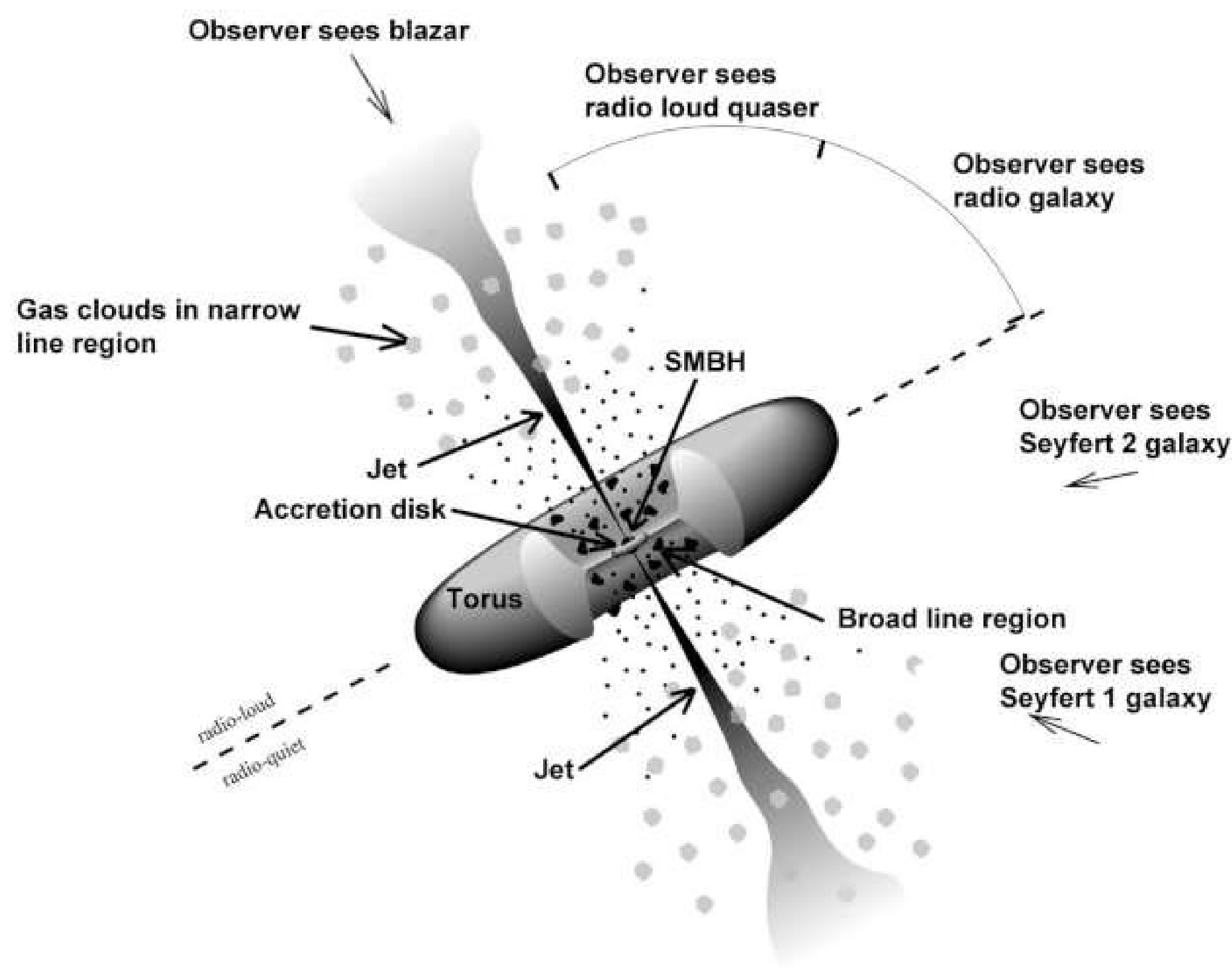
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Introduction

Narrow-line Seyfert 1 (NLS1) galaxies are a subclass of active galactic nuclei (AGN) characterized by distinctive emission-line properties. Studying their host galaxies can help us understand the relationship between nuclear activity and galaxy structure.

The goal of this project is to investigate the host-galaxy morphologies of eight NLS1 galaxies using near-infrared imaging and two-dimensional surface-brightness modeling.

Schematic diagram of an AGN (Urry, C. M., & Padovani, P. (1995)).



GALFIT

We are using GALFIT to extract quantitative structural information about astronomical objects from two-dimensional digital images (Peng, C. et al. (2010))

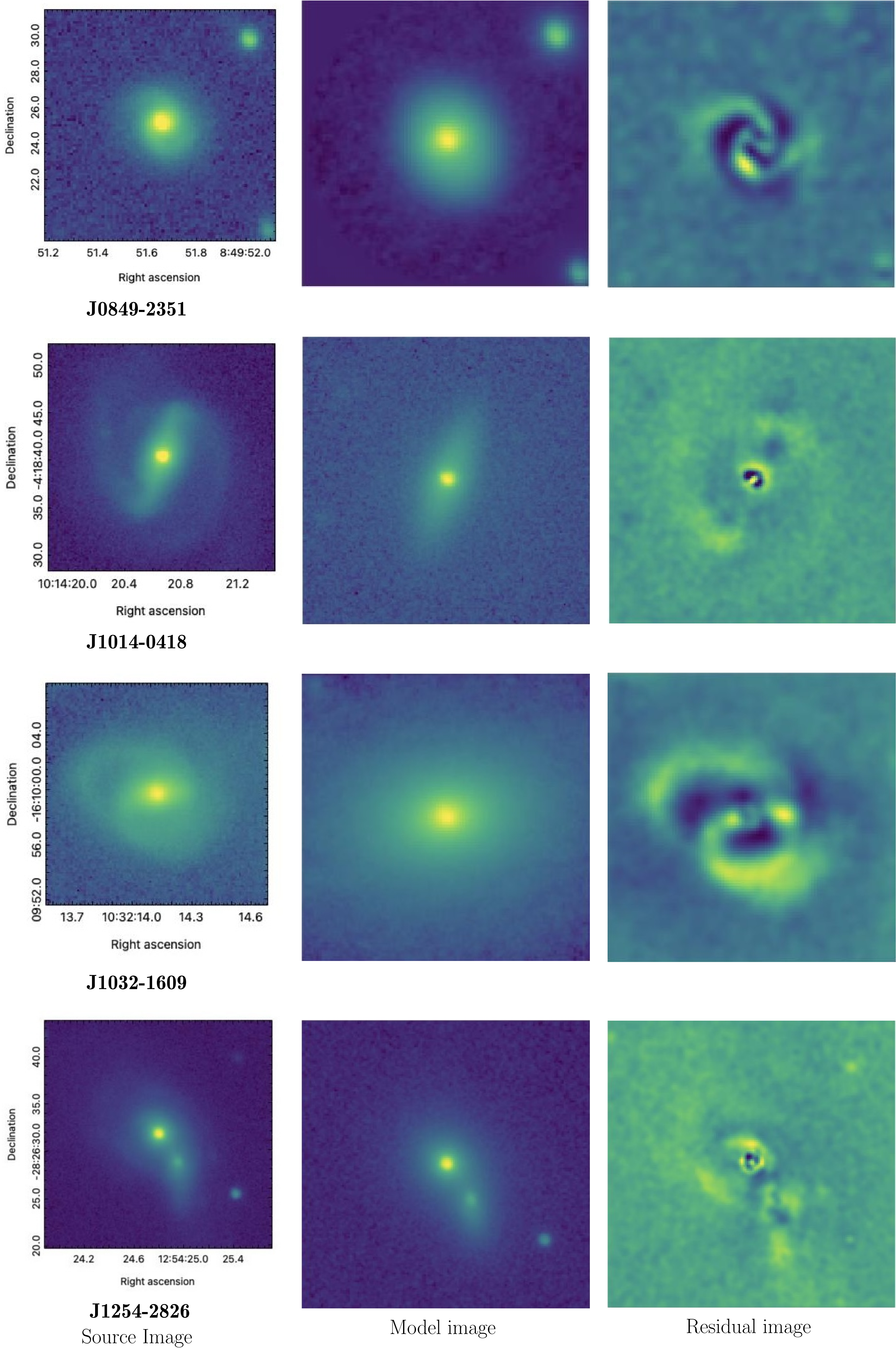
What Does GALFIT Do?

GALFIT fits parametric mathematical functions (models) to model light profiles in 2-D images. Essentially, it can deconstruct complex galaxies by its distinct components (Bar, Disk, Bulge, Spiral Arms) by combining two or more model functions. It can also fit sources with just one parameter to measure the global galaxy morphology and total magnitude.

Sample and Telescope Used

The figures to the right are four of the eight sources we are working on. The ones shown are the ones that have the most progress. Residual images are the result when the source image has a Sérsic and a PSF (Point Spread Function) that is subtracted from it, leaving the remaining structure of the source. The observations were obtained using the FourStar near-infrared camera on the 6.5 m Magellan Baade Telescope at Las Campanas Observatory in Chile.

GALFIT Modeling Sequence (Source, Model, Residual)



Parameter Types

Point Spread Function (PSF)

A point spread function models how light from a point source spreads out due to atmospheric and instrumental effects. We use stars to estimate the PSF when modeling the AGN.

Sérsic Profile

A Sérsic profile describes how a galaxy's surface brightness changes with distance from its center. The Sérsic index (n) controls the shape of the profile. The Sérsic profile is commonly expressed as:

$$I(r) = I_e \exp \left\{ -b_n \left[\left(\frac{r}{r_e} \right)^{1/n} - 1 \right] \right\}$$

Common Sérsic index values:

- $n = 0.5$: Often associated with Gaussian-like profiles
- $n = 1$: Exponential profile, often used for disks
- $n \approx 4$: de Vaucouleurs profile, often used for bulges

Model Parameters

Source	Function	Mag	r_e (kpc)	n	Axial Ratio	PA (°)	Notes
J0849-2351	PSF 1	16.2676	—	—	—	—	—
	Sérsic 1	15.6494	2.69	0.5	0.7714	24.5270	Bar
	Sérsic 2	16.0160	0.74	2.0	0.6645	-33.1432	Bulge
J1014-0418	PSF 1	12.6713	—	—	—	—	—
	Sérsic 1	12.6006	3.65	0.6190	0.3200	-19.6547	Bar
	Sérsic 2	11.8619	11.31	2.6508	0.9008	9.1392	Disk + Bulge
J1032-1609	PSF 1	15.6922	—	—	—	—	Source may be too complicated
	Sérsic 1	12.1339	4.82	4.3837	0.6468	-81.4868	Classical Bulge?
J1254-2826	PSF 1	12.9704	—	—	—	—	—
	Sérsic 1	12.6951	3.68	2.7438	0.7891	42.7809	Disk + Bulge
	Sérsic 2	14.1299	2.79	1.1596	0.4785	13.3664	Bar

Notes. Columns: (1) Function used for modeling, (2) Magnitude, (3) Effective radius, (4) Sérsic index, (5) Axial Ratio, (6) Position Angle, (7) Additional notes. Source and model are in log scale, while residual is in linear scale. Residuals have been smoothed over 3px.

Conclusions and Future Work

Preliminary Findings

- Several sources show complex morphologies that may indicate interactions or merger activity with nearby objects.
- Some sources exhibit possible bar-like structures.

Next Steps

- Complete GALFIT modeling for the remaining sources.
- Evaluate model quality using the residual images.
- Compare host-galaxy structures across the eight NLS1 galaxies.

References

Varglund et al. (2023). Host-galaxy study of southern narrow-line Seyfert 1 galaxies. *arXiv:2309.03277*.
Peng, C. Y., Ho, L. C., Impey, C. D., & Rix, H.-W. (2010). Detailed decomposition of galaxy images. II. Beyond axisymmetric models. *The Astronomical Journal*, 139(6), 2097–2129.
Urry, C. M., & Padovani, P. (1995). Unified Schemes for Radio-Loud Active Galactic Nuclei. *Publications of the Astronomical Society of the Pacific*, 107, 803.