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H0LiCOW: correlation between black hole mass and host galaxy luminosity

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ABSTRACT
Strong lensed AGN has been considered as a unique tool to exam the correlations between the mass of the supermassive Black Hole and its host galaxies. In this work, we have adopted eight strongly lensed system from the H0LiCOW collaboration. The deep *HST* data and adopt the Lenstronomy to reconstruct the image of the source. The $\mathcal{M}_{\rm BH}$ are estimated using the board emission line. We compare our inference to the once in the literature and find a consistent result. Combining them together, we are able to constrain the γ to xxx. Our our demonstrate is demonstrate the power of using strong lensed AGNs. The sample of the data are supposed to increase rapidly.

Key words: galaxies: evolution – galaxies: active – gravitational lensing: strong

1 INTRODUCTION

Structure:

[] What is scaling relations.

[] Strong lensing provide a tool to study to higher redshift.

[] Previous work. H0LiCOW XI. H0LiCOW XII. In these two works, the host galaxy is first reconstructed using the pixellation. Then, the host image are inferred in the source plan by fitting as a Sersic model. This means, the two-step inference of the host information.

[] In this work, we adopt an independent tool and carry out a direct inference of the host properties.

[]This paper is organized as follows. Zeropoint are defined in the AB systems.

2 SAMPLE SELECTION

We adopt the eight lens systems from our H0LiCOW collaboration including HE 0435−1223, RXJ 1131−1231, WFI 2033−4723, HE 1104−1805, SDSS 1206+4332, SDSS 0246−0825, HE 0047−1756 and HS 2209+1914. For conciseness, we abbreviate each lens name to four digits (e.g., RXJ 1131−1231 to RXJ1131). In Ding et al. (2017), the simulation exercise has been performed to understand the fidelity of the source reconstruction based on these eight systems and verified that the host inference is trustworthy when its magnitude are brighter than 20 magnitude, 2−4 magnitudes dimmer than the AGN. The detailed information of the observations for these eight systems are given in Table 1 therein [**Xuheng**: Maybe we can re-summarized it again here]. We analyzed the HST imaging data of the sample and the observation has been introduced by Ding et al. (2017). Moreover, three quadruply-imaged AGNs (HE0435, RXJ1131 and WFI2033) have HST imaging data at multi-bands from which we could infer the color of the host galaxy and obtain more accurate stellar template.

To exam the evolution of the lensed system, we aim to compare.... expend the sample size and the data resolution, we adopt the recent efforts by Ding et al. (2020), including 32 QSO at redshift range $1.2 < z < 1.9$, with the local sample.

3 SURFACE PHOTOMETRY

We describe the reconstruction of the lensed host galaxy in this section. For part of the lensed systems, the lens models have been derived with host galaxies reconstructed ref[]. Aiming at the time-delay cosmography, these works focused on deriving the precise and accurate lens models, while the reconstructed the host galaxy is only a by-product. Thus, in this work, we apply our own approach to infer the photometry of the host galaxy in the source plane. As will show, we compare our inference to the previous ones for cross check purpose.

3.1 Lens model inference and host reconstruction

We simultaneously carry out the fitting process to derive the lens model, subtract the central AGN light and reconstruct the host galaxy in the source plan. We follow the common practice and assume the photometry of the galaxies (including the lensing galaxy and source galaxy) follows the 2-D elliptical Sérsic profile, which

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defines the host flux as consistent to the comparison sample. The bright AGNs are unsolved and described by a scaled PSF. We adopt the elliptical power-law models to describe the surface mass density of the deflector.

[] We adopt the Lenstronomy ref[] to perform the modeling task. We draw the mask to define the fitting region. The nearby object are considered as extended source and fitted as Sérsic.

[] We cut out the available PSFs in the files. Two approaches including QSO mask and PSF reconstruction. Subgrid with 2 and 3 are selected to describe the Sersic profile. The detail of the fitting settings: gamma as 1.9, 2.0, 2.1.

[] Top rank result combined to get the inference of the host galaxies and the way of weighting flux to get magnitude.

We present the fitting for the eight systems in the following sub-sections.

3.1.1 HE0435

The results of HE0435. A table to summarize the fitting results. The inference of the observed magnitude, Reff and sersic. Comparison to the previous inference.

The other two band.

3.1.2 RXJ1131

3.1.3 WFI2033

3.1.4 SDSS1206

3.1.5 HE1104

3.1.6 SDSS0246

3.1.7 HE0047

3.1.8 HS2209

The comparison to the previous fitting.

We summarized the inference for the eight systems in the table. name–Setts–BestFitChisq–Totalflux– Host ratio –Reff–Sersicn–magnitude - Stellar mass

3.2 Stellar mass estimates

For those ones have multi-bands, we attempt to infer the color of the host in the image plane.

How do we infer the color? All the available bands? Which is dominating the scatter?

4 BLACK HOLE MASS ESTIMATES

We use viral method to estimate the mass of the black hole. The board-line adopted. We aim to adopt the self-consistent to recalibrate the $\mathcal{M}_{\rm BH}$ of our sample. [] The recipes. [] The board lines and the resulting BH mass and listed in the table. []The summarizing table.

5 RESULTS

[**Xuheng**: Do we consider the Selection effect? We only select 8 sample? Maybe we only over plot them together and see if the results are self-consistent?]

6 DISCUSSION AND CONCLUSION

[] This work confirm the bright future of lensing.

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REFERENCES

Ding X., et al., 2017, MNRAS, 465, 4634
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APPENDIX A: COLOR INFERENCE OF THE HOST

We took the other band data and get the only arc image. We adopt these image and do the SED fitting to get the color information.

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