J. Astrophys. Astr. (2014) **35,** 429–430

Estimating Black Hole Spin of PG 1322 + 659 with Observed Optical and X-ray Continuum Spectrum

Bei You[1,2,*] & Xinwu Cao[1]

[1]*Shanghai Astronomical Observatory, Chinese Academy of Sciences, 80 Nandan Road, Shanghai 200030, China.*
[2]*University of China Academy of Sciences, 19A Yuquanlu, Beijing 100049, China.*
[*]*e-mail: youbei@shao.ac.cn*

Abstract. We fit the observed Spectral Energy Distribution (SED) of a bright radio quite quasar PG 1322 + 659 in optical and hard X-ray bands with an accretion disk–corona model to estimate BH spin a.

Key words. Galaxies: quasars—accretion disk: X-ray.

1. Introduction

You *et al*. (2012) calculated the emergent spectrum of a standard accretion disk with a corona surrounding a massive Kerr black hole to reproduce UV/optical and hard X-ray spectrum. The measurements of spin a is important but still controversial for AGNs because of the degeneracy problem due to other physical parameters such as $M_{\rm bh}$, accretion rate $\dot{m}$ and viewing angle $\theta_{\rm obs}$. In this work we try to estimate BH spin a for PG 1322 + 659 via fitting the observed spectrum.

2. Model

The accretion disk is heated by the gravitational power of matter via viscosity process, and a fraction of the power is transported to the corona (You *et al*. 2012). The high energy photons from the corona are intercepted by the cold disk, part of which are reflected by the disk. The energy equation for the accretion disk-corona is

$$Q^+_{\rm dissi} - Q^+_{\rm cor} + \frac{1}{2}(1-\eta)Q^+_{\rm cor} = \frac{4\sigma T_{\rm d}^4}{3\tau}, \tag{1}$$

where the definition of $T_{\rm d}, \tau, \eta, \sigma$ can be found in You *et al*. (2012). We adopt the ratio of the power dissipated in the corona to the total power as a free parameter to determine the power in the corona, ie., $Q^+_{\rm cor} = \eta Q^+_{\rm dissi}$, where η can be constrained by the observed ratio of the observed X-ray luminosity to bolometric luminosity.

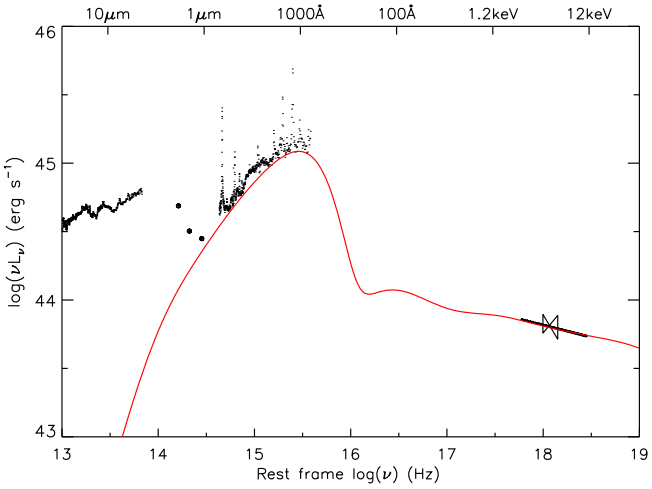

Figure 1. SED of PG 1322 + 659 from IR/optical to hard X-ray is plotted with dots. Three circle + cross points are near-IR JHK data. The solid black line represents X-ray spectrum fitted with a power law. The red line is the best-fitting result.

3. Results

PG 1322 + 659 (z=0.1684) is a radio quiet quasar with X-ray continuum emission from the corona. The BH mass $\log M_{\rm bh} = 8.29$ is adopted from Tang *et al.* (2012) independent of our model. We adopt the dimensionless accretion rate $\dot{m}$, spin a, ratio η and the viewing angle $\theta_{\rm obs}$ as free parameters to fit the observed continuum spectrum shape in UV/optical and hard X-ray bands. The best-fitting and observed spectra are plotted in Fig. 1, and $\dot{m} = 0.3$, $a \approx -0.5$, $\eta = 0.5$, $\theta_{\rm obs} \approx 20.0°$.

Acknowledgements

This work is supported by the National Basic Research Programme of China (grants 2009CB824800, 2012CB821800), the NSFC (grants 11173043, 10821302, 10833002, 11373056, 11073020 and 11133005).

References

Tang, B., Shang, Z., Gu, Q., Brotherton, M. S., Runnoe, J. C. 2012, *ApJS*, **201**, 38.
You, B., Cao, X., Yuan, Y.-F. 2012, *Astrophys. J.*, **761**, 109.