Monthly Notices
of the
ROYAL ASTRONOMICAL SOCIETY

MNRAS **498,** 5511 (2020) doi:10.1093/mnras/staa2758

Erratum: On spin dependence of the Fundamental Plane of black hole activity

by Caner Ünal [1]★ and Abraham Loeb[2]★

[1]*CEICO, Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague, Czechia*
[2]*Department of Astronomy, Harvard University, 60 Garden St., Cambridge, MA 02138, USA*

Key words: errata, addenda – accretion, accretion discs – black hole physics – galaxies: jets – quasars: individual: supermassive black holes.

The paper 'On Spin Dependence of the Fundamental Plane of Black Hole Activity' was published in MNRAS, 495, 278-284 (2020). During the proofing stage, a segment of the conclusions section was inadvertently deleted so we include the complete conclusion section in this erratum.

1 SUMMARY AND CONCLUSIONS

In accreting and outflowing BHs, the FP relation is one of the most important scalings relating three variables: the radio luminosity (indicating jet power), X-ray luminosity (indicating bolometric disc luminosity), and the BH mass. Although standard FP equation gives a good description of jet producing systems with sub-Eddington accretion rate, there are still considerable deviations around this relation. In order to explain these deviations, we investigated the spin dependence of the jet power and accretion power. We can summarize the effects of the BH spin on the jet and accretion power as follows: as the spin grows (i) a larger fraction of the gravitational energy can be released as radiation since the inner orbits of the accreting matter could come closer to the horizon, (ii) the magnetic field amplitude around the horizon grows since the source for the magnetic field comes closer, (iii) the angular frequency of the horizon grows, and (iv) the size of the horizon decreases.

We derived three main results:

(i) We estimated the spin dependence of the dominant jet production mechanism, Blandford-Znajek process. We found that although for small spins, jet power is proportional to angular frequency quadratically as in the famous perturbative result, for moderate and large spins this is not the case. The jet power depends on the angular frequency more strongly (with sixth power) for very large values of spin parameter;

(ii) We showed that standard Fundamental Plane cannot explain the data purely by assuming L_X and L_R are only functions of M and $\dot{m}$. We gave an explicit example by using the data of 3 AGNs which have nearly same mass and X-ray power, but significantly different radio power;

(iii) By using data on 10 AGNs, we showed that BH spin could have an important role in the black hole activity. Our Spin Modified Fundamental Plane (SMFP) relation shows significantly well agreement with the data. The many orders of magnitude scatter of the data in the standard FP relation drops to about an order of magnitude scatter in the SMFP. The remaining deviations can be explained by various sources, including the thickness of the accretion disk, uncertainties in the data, the environment around the AGN and uncertainties in the correlation between radio-jet power and X-ray-accretion power. In conclusion our results, if confirmed with more data, do not only stress the vital role of BH spin in accreting and outflowing BHs, but could also provide a strong observational indication for the existence of the Blandford-Znajek process.

★ E-mail: unalx005@umn.edu (CU); aloeb@cfa.harvard.edu (AL)

This paper has been typeset from a TEX/LATEX file prepared by the author.