INVESTIGATING THE CONNECTION BETWEEN GALACTIC OUTFLOW AND GALAXY PROPERTIES

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Understanding the impact of active galactic nuclei (AGN) on the formation and evolution of galactic outflows is crucial for gaining insights into galaxy evolution. These outflows can influence the interstellar medium, which affects star formation. To deepen our understanding of the mechanisms driving outflows and galaxy evolution it is important to comprehend how parameters of AGN (such as AGN luminosity $L_{\rm AGN}$ and the black hole mass $M_{\rm BH}$) and the host galaxy (such as the virial mass and bulge gas fraction) relate to the characteristics of galactic outflows, such as mass transfer rate, outflow radius, velocity, energy and momentum rates.

In this study we employed the MAGNOFIT (Massive AGN OutFlow Investigation Tool) software package [1] to model 50,000 AGN wind-driven outflows. For each of the main outflow properties, we checked which of the AGN and galaxy parameters are primarily controlling it with the use of the residual method [2]. We also investigated how outflow properties depend on various galaxy parameters in narrow ranges of $L_{\rm AGN}$ and $M_{\rm BH}$ to determine which other properties of the modelled systems are important in determining outflow evolution.

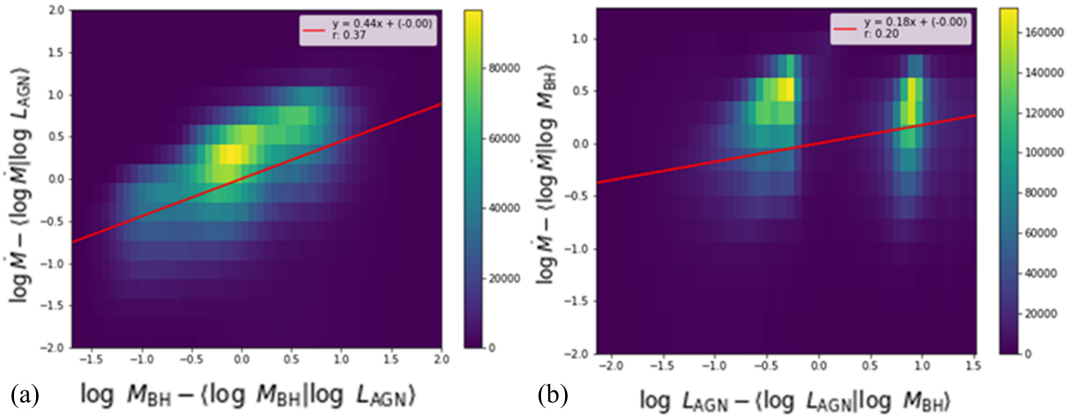

Fig. 1. Correlation between residuals of mass outflow rate and particular galaxy parameters. (a) Correlation between $\log\dot{M} - \langle\log\dot{M}|\log L_{\rm AGN}\rangle$ and $\log M_{\rm BH} - \langle\log M_{\rm BH}|\log L_{\rm AGN}\rangle$. (b) Correlation between $\log\dot{M} - \langle\log\dot{M}|\log M_{\rm BH}\rangle$ and $\log L_{\rm AGN} - \langle\log L_{\rm AGN}|\log M_{\rm BH}\rangle$.

Overall, the simulated outflow properties and their correlations with galaxy parameters agree with observational data. We find that that both AGN luminosity and black hole mass play a critical role in shaping galactic outflows. In particular, Figure 1 presents results from our residual study, suggesting that the black hole mass is a more influential parameter in regulating the mass outflow rate than AGN luminosity. This finding is supported by the fact that removing the influence of $M_{\rm BH}$ weakens the correlations between mass outflow rate and all other system parameters. In this study we will present an analysis of correlations between outflow and galaxy properties for both simulated and real systems, showcasing how both the AGN and the host galaxy combine to produce the diversity of outflows.

[1] Zubovas, K.; Bialopetravičius, J.; Kazlauskaitė, M. Monthly Notices of the Royal Astronomical Society 2022, 515, 1705-1722.
[2] Shankar, F; Bernardi, M.; Sheth, R. K.; Ferrarese, L.; Graham, A. W.; Savorgnan, G.; Allevato, V.; Marconi, A.; Läsker, R.; Lapi, A. Monthly Notices of the Royal Astronomical Society 2016, 460, 3119-3142.