

Probing the Multi-Scale Physics of Quasar Winds Using Absorption and Emission

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Abstract: Supermassive black holes (SMBHs) play a crucial role in the evolution of their host galaxies. A key driver of this process is the feedback from powerful winds launched by the SMBH, known as quasar outflows. To understand the physics of these winds, astronomers typically rely on two distinct methods: absorption spectroscopy, which probes gas along the line of sight, and emission spectroscopy, which maps the spatial distribution of the gas. However, these techniques are rarely combined, and it has remained unclear if they trace the same physical structures. In this talk, I will present results from a joint analysis of ionized outflows using both techniques to resolve this ambiguity. First, using the quasar 3C 191 as a case study, we demonstrated that absorption and emission diagnostics yield consistent kinematic and spatial constraints. This confirms that these complementary methods can indeed probe the same gas phase. Extending this analysis to a second quasar reveals the outflow's multi-scale nature. In this system, absorption traces the nuclear, small-scale wind, while emission reveals the large-scale galactic outflow. These findings demonstrate a new pathway for tracing the physical journey of the outflowing gas from the central engine out to the host galaxy.