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Multi-Phase Fueling and Feedback Processes in Jetted AGN

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Despite major observational and theoretical progress, the role of relativistic radio jets from active galactic nuclei (AGN) in galaxy evolution remains only partly understood. Key questions concern how supermassive black holes (SMBH) are fueled, how jets are launched, and how their kinetic energy couples to surrounding media across different environments and scales—all crucial processes for regulating SMBH growth and host galaxy evolution.

Jet feedback operates across multiple scales, but its effective impact is still debated. On sub-galactic scales, jets interact with the dense interstellar medium, driving turbulence, shocks, and multiphase outflows, with uncertain effects on star formation. On galactic and circum-galactic scales, jets redistribute gas, inflate bubbles, and drive shocks. In groups and clusters, they regulate hot atmospheres, though energy dissipation and coupling remain poorly constrained. These processes are linked to AGN fueling and jet launching. Gas may reach the nucleus via mergers, disk instabilities, or chaotic cold accretion, while jets likely arise from magnetohydrodynamic mechanisms extracting energy from the spinning black hole or the inner accretion disk; the relative roles of spin, magnetic flux, and accretion state remain debated. Recent advances from VLT/MUSE, ALMA, SKA precursors, and simulations now enable new progress, which this review summarizes along with future prospects.



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