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AGN-driven outflows in the early Universe

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The origin of the tight correlations observed between the masses of supermassive black holes (SMBHs) and host galaxy properties is still debated. Negative feedback from AGN can provide a viable explanation for these correlations. According to the theoretical models, the ejective feedback resulting from radiatively-efficient episodes of gas accretion onto SMBHs may be the main responsible for the rapid shut-off of star formation and black hole growth in the early stages of the evolution of present-day massive galaxies, which must have taken place at z>2.

Here we present near-IR (SINFONI) and millimetre (ALMA) observations of z~2.5 luminous (Lbol>1e47 Lsun) quasars showing fast and extended ionised outflows. These AGN-driven outflows appear to be able to expel a large fraction of molecular and ionised gas and suppress star formation in the outflow region. However, the detection of Halpha emission along the edges of the outflow cone indicates on-going star formation rates of at least 50 Msun/yr, suggesting either that AGN feedback does not affect the whole galaxy or that many feedback episodes are required before star formation is completely quenched. On the other hand, the detection also lead to a positive feedback interpretation: the AGN-driven outflow compress the surrounding gas inducing star formation. Our results highlight the possible double role of galaxy-wide outflows in host galaxy evolution. This is also supported by recent observations in the local Universe indicate that massive galactic outflows may ignite star formation within the outflow itself.
We also present new ALMA observations of a sample of quasars at z~6 optimised to investigate the extended emission associated with outflows as traced by the [CII]158μm line. Although strong and powerful AGN-driven outflows are expected at these redshifts, our analysis suggests that such outflows may not be as effective as expected in removing gas out of their host galaxies.

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