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This week's paper on quasar feedback follows up nicely on last week's paper by describing the actual method by which bright quasars affect cold gas, and subsequently star formation, in galaxies.

The model begins by examining what happens to massive black holes (M_{BH}>$10^8 M_\odot$) at the center of galaxies as the effects of their growth and subsequent feedback are applied throughout a galaxy. Initially, the black hole is surrounded by an accretion disk, and the galaxy consists of large regions of virialized warm/hot diffuse gas, with small pockets of cold dense gas scattered throughout the diffuse gas[1]. These cold clouds are stable in their surroundings, and the ionization and momentum flux from the quasar is negligible because the cloud effectively has a relatively low surface area for absorption. When the model starts running, the black hole begins radiating at its Eddington luminosity, forcing a shock driven flow outwards[2].

This outflow is driven only in the diffuse gas, as other models have shown that this energy or momentum transfer efficiency would have to be superbly efficient to drive a shock through the cold gas. If only the hot gas is driven, however, the required energy/momentum is reduced tenfold, making this mechanism far more probable. As the shock flows by a cold cloud, the ambient pressure on either side of the cloud perpendicular to the flow of the shock drops enough to cause substantial instabilities within the cold cloud. These instabilities are exacerbated by continued diffuse outflow, and the material spreads again the direction perpendicular to the outflow into the most diffuse regions. As was stated earlier, these clouds are normally unaffected by ionization and momentum flux due to their low absorption area, and as this happens the cloud's surface area grows relative to the volume, which allows the cloud to more efficiently ionize and absorb momentum flux from the AGN[3]. If the cloud gains enough energy it can become unbound and dismantle, though this appears capably shielded by clouds below a characteristic mass.

This feedback scenario shows the potential for black holes to slowly dismantle cold star-forming clouds over long timescales (~10^8 years), diffusing them throughout the galaxy and halting star formation. Fortunately, this timescale is huge and it is unclear whether or not AGN are capable of sustaining sufficient luminosity to cause this destructive phenomena. What this model demonstrates, however, is that it is "possible that the cold gas reservoir is destroyed and/or blown out of the galaxy *despite* inefficient coupling of "initial" feedback mechanisms that originate near the BH;"[4] rather, in spite of the fact that the shock doesn't propagate through the cold gas directly, the hot gas's outflow is sufficient to cause the observed depletion of cold gas in BH-centered galaxies.

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[1] The gas makes up 10% of the total mass of the galaxy, and 90% of the gas mass is found in these cold dense pockets. Clouds range in size up to $10^7 M_\odot$

[2] "If sufficient energy or momentum is injected into the ISM near the BH on a timescale short enough to halt accretion, then it will yield a supersonic pressure or momentum driven outflow that propagates to large scales." (1-2) Aside from supernova, what sources of momentum/energy injection are there?

[3] "In a couple of local dynamical times, ~90% of the original cold cloud mass becomes vulnerable to secondary radiative feedback." (4)

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