Physics Colloquium

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Supermassive Black Hole Winds: Can They Influence Galaxy Evolution?

Supermassive black holes (SMBHs) are thought to reside at the centers of all massive galaxies, and have masses that correlate with properties of their host galaxies. This is surprising, as SMBHs gravitationally control only their local vicinity compared to the vast scales of galaxy bulges. This may be explained by "feedback", whereby the SMBH and galaxy bulge grew together by exchanging energy and material, linking their evolution. We can study this process by observing active galactic nuclei (AGN), which are SMBHs that are actively accreting gas and dust. This releases radiation back into the galaxy that drives powerful outflows of ionized and molecular gas. This may regulate the SMBH growth, and disrupt star formation by evacuating gas from the nucleus. To gain a deeper understanding of the physics involved, we study nearby active galaxies where we can spatially-resolve the ionized emission line gas participating in the outflow. As part of my dissertation work, I have used observations from the Hubble Space Telescope, and plasma photoionization models, to quantify the mass and energy of these outflows in several nearby AGN. We find that the outflows are limited to the inner few thousand light-years of the galaxy, but scale up with AGN luminosity. The outflows are energetic enough to reach theoretical benchmarks for effective feedback, indicating they can carry sufficient power to impact their host galaxies. These results will aid us in interpreting future observations of more powerful outflows in the early universe, where feedback is thought to strongly influence star formation and galactic structure.

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