Supermassive black holes (SMBH) that lurk at the hearts of most galaxies are usually quiet. But a small fraction of them are consuming gas at a prodigious rate. The process of falling towards a black hole heats any gas unfortunate enough to be caught by its gravitational pull. The falling, heated gas emits more light than all the stars in the parent galaxy combined. This rare galactic monster is known as a quasar. Because of the vast distances to quasars and the small size of the falling gas region, we cannot figure out the details of how black holes feed by directly taking pictures of these regions, often called the “central engine” of a galaxy.

Fortunately, we can use other methods to learn about how the 'central engine' powers these quasars. Astronomers have known for a long time that quasars vary in visible light. But now, for the first time, using NASA's WISE satellite, we have discovered two quasars that varied in the mid-infrared (this is light with much longer wavelengths than you can see with your eyes). This mid-infrared light comes from a very large 'warm' region of gas near the black hole, heated by the central engine. For this enormous warm region to emit less mid-infrared light, it must be less heated by the central engine and have time to cool. And we should expect the central engine to get dimmer over the course of several years to produce such an effect. Indeed, when we looked further (via observations from the Palomar 5m telescope) these quasars showed the signatures of dramatic changes in the gas just about to fall onto the black hole, suggesting that as material flows towards the central engine black hole, it can heat and cool on timescales that are around a year.

This is one of the incredibly few instances where we can watch a process in another galaxy happen within a human lifetime. Even better, it allows us to directly test our models of how a black hole accretes material at the heart of a galaxy. And this is the first time that infrared observations have been used to directly identify and investigate these changes — but it will not be the last. Because of the enormous size of the warm, infrared emitting region, any substantial change in the infrared light of a quasar implies a very dramatic and lasting change in the innermost central engine. Thus, our new studies using data from NASA's WISE mission can help us shed light on some of the darkest objects in the universe.