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ASTRONOMY

Scientists racing to discover how black holes blast energy

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Keeping a proper balance between heating and cooling is a problem that concerns nearly everyone, whether we're talking about long-term climate change on Earth or the short-term comfort of our homes.

In summertime, a house suffers from an excess of heat. Solar energy is absorbed by the roof, and the heat of the outside air leaks in through the walls. The house loses energy by radiation, glowing in infrared light. Since this isn't very efficient, most of us have air conditioners to pump out the heat more quickly.

In wintertime, the energy lost by radiation and leakage exceeds solar heating, so we turn on the furnace.

In clusters of galaxies, the furnace is the massive black hole at the center of the cluster's dominant galaxy.

Black holes can be incredibly powerful, pumping out enough energy in a nanosecond to power our civilization for billions of years.

Yet in proportion to their home clusters, they are tiny. Imagine your basement furnace the size of a small virus and you'll get the idea.

If it strikes you that it might be tricky to distribute the heat of a virus-size furnace around your house, you'll understand the problems astronomers are having in figuring out how energy from a black hole is spread millions of light-years around a galaxy cluster.

Most of the ordinary matter in a galaxy cluster is diffuse, hot gas at temperatures approaching 100 million degrees. Just as a house cools by radiating infrared light, this gas cools by radiating X-rays, which we can observe with orbiting telescopes.

What we see is that black-hole furnaces are sputtery, noisy and occasionally explosive. They blast shock waves into the cluster and inflate blobs of hot gas that bubble away from the center. Somehow, this energy finds its way into the gas and eventually emerges as observable X-rays.

We think that this process probably involves turbulence and magnetic fields. Figuring out for sure is going to involve some of the most complex supercomputer simulations ever attempted in astronomy.

The next few years will be an exciting and competitive time for astronomers racing to discover the results.

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