Astronomers track changes around supermassive black hole in the NGC 2617 galaxy

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Members of the Sternberg Astronomical Institute of the Lomonosov Moscow State University have been studying changes in the appearance of emissions from around the supermassive black hole in the center of a galaxy called NGC 2617. The center of this galaxy underwent dramatic changes in appearance several years ago, becoming much brighter; astronomers were able to make groundbreaking observations. The results of these investigations have been published in the *Monthly Notices of the Royal Astronomical Society*.

Most galaxies like our own contain a giant black hole in their central nuclei. These monstrous objects have masses ranging from a million to a billion times the mass of our sun. The black hole in our galaxy is inactive, but in some galaxies, the black hole is swallowing gas that is spiraling into it at thousands of times the speed of sound, and emitting enormous amounts of radiation. These galaxies are called "active galactic nuclei," (AGNs). The energy output from around the black holes of these AGNs can exceed that of the hundreds of billions of stars in the rest of the galaxy. Just how these galaxies get their supermassive black holes is a major mystery.

The nuclei of galaxies in which supermassive black holes are actively consuming gas are classified into two types: those offering a direct view of the matter spiraling toward the event horizon, and those with inner regions obscured by dust, offering only views of slowly moving gas

much further from the black hole.

For decades, astronomers have wondered why we see the innermost regions of some active galactic nuclei but not others. A popular explanation of the two types of active galactic nuclei is that they are really the same, but they appear to be different because we are viewing them from different angles. When viewed face-on, it's possible to observe hot gas spiraling into the black hole directly. If the active galactic nucleus is tilted, then dust around the nucleus blocks our view and we can only see the more slowly moving gas a light year or more away.

The leader of the international research team involved in the investigation, Viktor Oknyansky, says: "Cases of object transition from one type to the other turn out to be a definite problem for this orientation model. In 1984, we found a change in the appearance of another active galactic nucleus known as NGC 4151. It was one of few known cases of this kind in the past. We now know of several dozen active galactic nuclei that have changed their type. In our recent study, we focused on one of the best cases—NGC 2617."

Oknyansky continues: "In 2013, a team of researchers in the U.S. found that NGC 2617 had changed from active, where the inner regions were hidden, to an exposed state. We didn't not know how long it would remain in this new unveiled state. It could last for only a short period of time or perhaps for dozens of years. The title of the paper by the U.S. astronomers was 'The man behind the curtain...' When we began our study, we didn't know how long the curtain would remain open, but we've titled our paper 'The curtain remains open...,' because we are continuing to see into the inner regions of NGC 2617.

According to the authors, there is no accepted explanation so far of what would allow observations of the inner regions of an active galactic

nucleus that was previously hidden.

Oknyansky says, "It's clear that this phenomenon isn't very rare. On the contrary, we think it's quite typical. We consider various possible explanations. One is that perhaps a star has approached too closely to the black hole and has been torn apart. However, the disruption of a star by a black hole is very rare, and we don't think that such events can explain the observed frequency of type changes of active galactic nuclei. Instead, we favour a model where the black hole has started swallowing gas more rapidly. As the material spirals in toward the black hole, it emits strong radiation. We speculate that this intense radiation destroys some of the dust surrounding the nucleus and permits us to see the inner regions."

Oknyansky continues: "Study of these rapid changes of type is very important for understanding what is going on around supermassive black holes that are rapidly swallowing gas. So what we have concentrated on is getting observations of the various types of radiation emitted by NGC 2617. This has involved a large-scale effort."

The observational data for the project were obtained using the MASTER Global Robotic Network operated by Professor Vladimir Lipunov and his team, the new 2.5-m telescope located near Kislovodsk, a 2-m telescope of the observatory in Azerbajan, the Swift X-ray satellite, and some other telescopes. This research has been conducted in cooperation with colleagues from Azerbaijan, the USA, Finland, Chili, Israel and the South Africa.

More information: V. L. Oknyansky et al, The curtain remains open: NGC 2617 continues in a high state, *Monthly Notices of the Royal Astronomical Society* (2017). DOI: 10.1093/mnras/stx149

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