Serendipitous observations reveal rare event in life of distant quasar

October 21 2008

A bit of serendipity has given astronomers a surprise view of a never-before-observed event in the birth of a galaxy.

University of Florida and University of California-Santa Cruz astronomers are the first to discover the onset of a huge flow of gas from a quasar, or the super-bright core of an extremely remote young galaxy still being formed. The gas was expelled from the quasar and its enormous black hole sometime in the space of four years around 10 billion years ago – an extremely brief and ancient blip noticed only by a sharp-eyed undergraduate and the unlikely convergence of two separate observational efforts.

"It was completely serendipitous," said Fred Hamann, a UF astronomy professor. "In fact, the only way it could have happened is through serendipity."

A paper about the research appeared online this month in the *Letters of the Monthly Notices of the Royal Astronomical Society*.

Quasars are enormously bright cores of very distant galaxies thought to contain "super-massive" black holes a billion times larger than our sun. They are seen only in the centers of very distant galaxies that formed long ago — galaxies whose light is just now reaching Earth after billions of years in transit. The quasar in question occurred about 10.3 billion years ago.

The black holes within quasars are invisible, but the cosmic material cascading toward them builds up and forms hot "accretion" disks, the source of quasars' intense light. Some of the incoming material also can be expelled from quasars to form enormous gas clouds that zoom out at extremely high speeds. With the quasar in question, the gas is flowing at an astonishing rate of 58 million mph, Hamann said.

But while astronomers had observed the presence of such gas clouds with other quasars, they had never witnessed one actually coming into being — until now.

Hamann said the discovery was initiated when Kyle Kaplan, an undergraduate at UC-Santa Cruz, earlier this spring noticed peculiarities in the spectra, or wavelengths of light, that had been observed and recorded from the quasar. The spectra were gathered in 2006 as part of an effort to study the galaxies between the quasar and Earth.

UC-Santa Cruz Professor Jason Prochaska was aware of Hamann's work on quasars and asked him to take a look.

When Hamann and other astronomers checked the spectra against the spectra of the same region recorded in a separate sky survey in 2002, they were surprised to discover that there were zero indications of the gas cloud.

"So that's how we know this appeared between 2002 and 2006," he said.

Daniel Progra, a physics professor at the University of Nevada, Las Vegas and an expert on gas outflows from astronomical objects, indicated the discovery is a lucky one.

"I am most excited about this work," he said. "We humans cannot directly monitor changes in quasars as they take very many years.

Therefore, a discovery of a change over a few years is very interesting. It is not unexpected, but chances are very small."

He said the discovery supports a computer model he developed that predicts the gas outflows are dynamic and complicated.

Hamann said the discovery also opens a window to understanding more about how quasars come into being.

"The fact that we saw one appear in so short a time frame means that it's a volatile type of structure," he said. "It could be an evolutionary phase, or maybe a transition stage from one phase to another."

It also poses interesting questions about the role of quasars in the formation of galaxies. Astronomers hope future observations will prove telling, Hamann said.

"One interesting question in astronomy is 'how does the evolution of quasars relate to the evolution of galaxies?,'" he said. "The matter ejected from quasars might be the key to this relationship because it can disrupt or regulate the formation of galaxies around quasars. This discovery is a small piece of that story that we can see happening in real time, and what we are going to do now is keep watching."

Source: University of Florida