

# **The Shoreline Observer**

Newsletter for the  
Shoreline Amateur Astronomical Association

**December 1995**

President - Phil Sherman

Vice President - Pete Burkey

Secretary/Treasurer/Editor - Mike Henry

## **November Meeting**

The November meeting of SAAA will be held on Thursday December 21st at 7:00 PM in the West Ottawa Middle School Planetarium.

- ♦ Business Meeting.
- ♦ Sandy will give a tour of the December night sky.
- ♦ will be telling us about the constellation
- ♦ Our program will be a video.
- ♦ Mike will be bringing refreshments.

## **It's Quiz Time**

- 1) A stationary point in the Ptolemaic system that is not at the center of a circular orbit and about which a body revolves with uniform angular velocity is called \_\_\_\_\_?
- 2) The center of the Earth is located under what American city \_\_\_\_\_?
- 3) A graph showing the radial velocity of a member of a binary system plotted against time is called \_\_\_\_\_?
- 4) What year was Jan Hendrick Oort born?
- 5) What does CCD stand for?
- 6) Great jets of gas extending above the sun's surface is called \_\_\_\_\_?
- 7) What is Mike's middle name?

## **Treasurers Report**

As of Dec 18, 1995: \$248.13

## HUBBLE FINDS NEW BLACK HOLE AND UNEXPECTED MYSTERIES

Confirming the presence of yet another super-massive black hole in the universe, astronomers using NASA's Hubble Space Telescope have also found unexpected new mysteries.

The black hole and an 800 light-year-wide spiral-shaped disk of dust fueling it, are slightly offset from the center of their host galaxy, NGC 4261, located 100 million light-years away in the direction of the constellation Virgo.

This discovery is giving astronomers a ringside seat to bizarre, dynamic processes that may involve a titanic collision and a runaway black hole. This relatively nearby galaxy could shed light on how far more distant active galaxies and quasars produce their prodigious amounts of energy.

The results have been presented by the team consisting of Laura Ferrarese and Holland Ford of the Johns Hopkins University, Baltimore, MD, and Walter Jaffe of the Leiden University, the Netherlands, at a press conference at the European Space Agency (ESA), Paris, in conjunction with the "Science With Hubble Space Telescope II" workshop.

"I'm delighted by this new finding. It doesn't fit our expectations, and this should lead us to a new understanding of black holes," Ford said. "The new Hubble observations have moved us beyond the question of whether black holes exist. Now we can work on the demographics of black holes and address a number of other questions: does every galaxy have a black hole? How do they work in detail?"

Predicted by Einstein's general theory of relativity, a black hole is an extremely compact and massive object that has such a powerful gravitational field that nothing, not even light, can escape. This is the second super-massive black hole confirmed by Hubble. By measuring the speed of gas swirling around the black hole, Ford and co-investigators were able to calculate its mass to be 1.2 billion times the mass of the Sun, yet concentrated into a region of space not much larger than the Solar System.

The strikingly geometric disk -- which contains enough mass to make 100,000 stars like the Sun -- was first identified in Hubble observations made in 1992. These new Hubble images reveal for the first time structure in the disk, which may be produced by waves or instabilities in the disk.

The disk is mysterious because it is unusual to find dust in elliptical galaxies like NGC 4261, which stopped making stars long ago due to the absence of the requisite raw materials: interstellar gas and dust. The most conventional explanation is that the disk is the remnant of a smaller galaxy that fell into the core of NGC 4261. The black hole will swallow the gas from the intruder over the next 100 million years, and in the process produce spectacular fireworks, researchers predict.

Such collisions may have been more common in the past, when the expanding universe was smaller. This would help explain the abundance of quasars and active galaxies in the distant past. However, according to theoretical simulations, it's difficult, dynamically, to get an intruder galaxy to plunge directly into a galaxy's core. Another possibility is that dust ejected from ancient stars in the galaxy has fallen into the core and formed a disk. But this does not explain why the disk is off-center, which is evidence for a dynamic close encounter.

Equally as puzzling is the discovery that the black hole is offset from the center of the galaxy, and the disk's center as well. Astronomers say that because the black hole is the astronomical equivalent of the "800-pound gorilla," what can move it around? Presumably, the black hole was once at the center of the galaxy, but something has pulled it 20 light-years from the center, according to the Hubble observations. However, the black hole is so massive, scientists are searching for some way to explain how it could have been moved.

One exotic idea is that the black hole is self-propelled. The cold, dusty disk serves as a rocket "fuel tank" by feeding material onto the black hole where gravity compresses and heats it to tens of millions of degrees. Hot gas exhausts out from the black hole's vicinity producing the radio jets observed by radio telescopes as twin-lobe structures extending far beyond the galaxy. This exhaust may be pushing the black hole across space just like a rocket engine which propels an object by rapidly ejecting mass. Radio observations confirm the presence of a jet in NGC4261.

Hubble is ideally suited for hunting super-massive black holes in the universe. With the astronomical equivalent of surgical precision, Hubble's spectrographs can measure the rotation of gas near enough to a suspected black hole to capture its unmistakable gravitational signature. The speed of gas orbiting a black hole will rapidly increase toward the center of the disk -- just as the planets closer to our Sun orbit faster.

To date, two other galaxies have confirmed black holes. Hubble detected a 2.4-billion-solar-mass black hole identified in the core of elliptical galaxy M87 in 1994, and later that year, astronomers using a radio telescope array to examine the dynamics of a thin, warped disk of molecules deep in the core of spiral galaxy NGC 4258, measured a 40-million-solar-mass black hole.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc. for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and ESA.