What's up in Astronomy By Eric Erickson

Offered Title: Black Hole Lagniappe

A reader asked me to discuss the technology that made the recent Event Horizon Telescope (EHT) black hole image possible. So, here's a little extra (lagniappe in Louisiana French/Creole) info about black holes.

Imaging a black hole with radio telescopes was first proposed by Heino Falcke in 1993. His team's research led to the eventual development of the Event Horizon Telescope. The idea was simple, use several radio telescopes widely separated, producing the resolution equivalent to a huge telescope. The process is called Very Long Baseline Interferometry (VLBI). You need at least three radio telescopes for VLBI. The information each collects is combined and processed into one image.

In the 1950s Roger Jennison at Jodrell Bank Observatory worked out a technique that made VLBI possible. It involved capturing information about the visibility phases and time differences inherent when gathering data through different atmospheres and from widely separated instruments. The technique, called "closure-phase" or "self-calibration" corrected the data for atmospheric differences and timing due to distance.

This VLBI technique has been used widely since 1974, but not to the extent of the Event Horizon Team. They coordinated the data collected by eight (I mistakenly reported six) radio telescopes, several separated by our Earth's diameter. This produced resolution enough to image the supermassive black hole in M87, 50 million light years away. Due to the extreme telescope separations and widely differing conditions, new algorithms had to be developed to correct for differences in phases and timing, but the basic idea is the same. The resulting resolution of EHT is such that a newspaper in New York could be read by someone sitting in Paris!

The first target for EHT was Sagittarius A* (Sag A*, pronounced Sagittarius A star), the supermassive black hole at the center of our home galaxy, The Milky Way. Data processing was delayed however because hard drives from the South Pole Telescope were stuck there for the winter. So, M87 got first billing.

How do we know Sag A* is a black hole? It's a strong radio emission source and the concentration of mass and density is beyond what a cluster of stars would produce. Although it hadn't yet been imaged directly, several teams found numerous stars in orbit around the seemingly blank spot where Sag A* appears to exist. Evidence!

All the black holes we know of have been detected due to the stuff around them. Debris, gases, even stars are known to orbit black holes. Friction caused by gravity and proximity makes it all glow, and if something big should fall in, the black hole "burps" a bright plasma flare.

A "naked" black hole (singularity) has not been detected yet. It might appear as a distortion of stars images behind it.

What's in the Sky?

May 2; pre-dawn; east: Watch Venus rise just before sunup. A crescent Moon tags along about 5 degrees behind to the right.