New Hot Papers - 2010

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Stefan Gillessen talks with *ScienceWatch.com* and answers a few questions about this month's New Hot Paper in the field of Space Science.

Article Title: Monitoring Stellar Orbits Around The Massive Black Hole In The Galactic Center
Authors: **Gillessen, S**;Eisenhauer, F;Trippe, S;Alexander, T;Genzel, R; Martins, F;Ott, T
Journal: ASTROPHYS J, Volume: 692, Issue: 2, Page: 1075-1109, Year: FEB 20 2009
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SW: Why do you think your paper is highly cited?

This paper summarizes the current status of a large project conducted at the Max-Planck-Institute for Extraterrestrial Physics (MPE), led by Reinhard Genzel. Since 1992, the group has been observing the motions of stars in the very center of the Milky Way, apparently in Keplerian motion around the central black hole. From such data, a multitude of interesting conclusions can be drawn.

Particularly interesting is the fact that the mass of the black hole and the distance to it can be determined in a geometric fashion, i.e., without any intermediate steps of calibration. Hence, these measurements are very reliable and therefore, other authors who use either the mass or the distance in their work frequently cite the MPE paper.

The distance, for example is a key parameter in all models of the Galaxy; the mass measurement, on the other hand, yields an important point in the correlation between central black hole mass and galaxy properties such as the velocity dispersion.

Furthermore, the MPE paper, for the first time, gives the orbital elements of almost 30 stars. Since these stars are mostly young, the orbital elements probably can be used as probes for the formation of these stars orbiting so enigmatically close to the black hole. This currently is a hot topic in Galactic Center research.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The paper summarizes and reanalyzes a large data set collected at two telescopes over 16 years, implementing state-of-the-art, high-angular resolution techniques of near-infrared observing.

The analysis methods have improved significantly over the past five years, as a result of which, the black hole in the Galactic Center could be characterized with unprecedented precision. Also, many new orbits are presented, bringing the number from one in 2002 and six in 2005 to almost 30 in 2009.

"The future of stellar orbit science in upcoming years will be dominated by an ever-increasing number of orbits and an increased accuracy of all quantities involved."

SW: Would you summarize the significance of your paper in layman's terms?

This paper is important, because it shows that beyond any doubt the center of the Milky Way hosts a massive, dark object, the mass of which is more than four million times the mass of the Sun. The most conservative interpretation of this finding is that there is a black hole.

SW: How did you become involved in this research, and were there any problems along the way?

Currently I am working as a postdoc in the MPE group. In fact, this project was the reason why I decided to work at MPE. Hence, stellar orbits are the main focus of my scientific work. The beauty of this work is that it is conceptually easy.

This, however, does not mean that it is not cumbersome. Indeed, most of the work is about fighting systematic error sources and some patience is required, too, since the stars move fast for astronomical standards, but timelines of many years are still required.

SW: Where do you see your research leading in the future?

The future of stellar orbit science in upcoming years will be dominated by an ever-increasing number of orbits and an increased accuracy of all quantities involved. A big step forward will happen, once the resolution can be increased further.

The current generation of telescopes has reached their theoretical limit and substantial improvements will require either larger telescopes—such as the European Extremely Large Telescope—or interferometers—mainly the Very Large Telescope Interferometer (VLTI) on Cerro Paranal in Northern Chile.

SW: Do you foresee any social or political implications for your research?

There are no social or political implications from this research. Still, it is worth pointing out that the work done at MPE has some implications for our view of the Universe: We have to accept that black holes do exist. They are no longer just theoretical concepts, but reality.

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PROPER MOTIONS; CENTRAL PARSEC; ESO VLT.

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