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The Milky Way's supermassive black hole: How good a case is it? A challenge for astrophysics and philosophy of science

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The compact and, with 4.3+-0.3 million solar masses, very massive object located at the center of the Milky Way is currently the very best candidate for a supermassive black hole (SMBH) in our immediate vicinity. The strongest evidence for this is provided by measurements of stellar orbits, variable X-ray emission and strongly variable polarized near-infrared emission from the location of the radio source Sagittarius~A* (SgrA*) in the middle of the central stellar cluster. If SgrA* is indeed a SMBH it will, in projection onto the sky, have the largest event horizon and will certainly be the first and most important target of the Event Horizon Telescope (EHT) Very Long Baseline Interferometry (VLBI) observations currently being prepared. These observations in combination with the infrared interferometry experiment GRAVITY at the Very Large Telescope Interferometer (VLTI) and other experiments across the electromagnetic spectrum might yield proof for the presence of a black hole at the center of the Milky Way. It is, however, unclear when the ever mounting evidence for SgrA* being associated with a SMBH will suffice as a convincing proof. Additional compelling evidence may come from future gravitational wave observatories. This manuscript reviews the observational facts, theoretical grounds and conceptual aspects for the case of SgrA* being a black hole. We treat theory and observations in the framework of the philosophical discussions about (Anti) realism and under- determination, as this line of arguments allows us to describe the situation in observational astrophysics with respect to supermassive black holes. Questions concerning the existence of supermassive black holes and in particular SgrA* are discussed using causation as an indispensable element. We show that the results of our investigation are convincingly mapped out by this combination of concepts. Questions concerning the existence of supermassive black holes and in particular SgrA* are discussed using causation as an indispensable element. We show that the results of our investigation are convincingly mapped out by this combination of concepts.

Figure.1: Model image of the shadow of the black hole. Relativistic effects brighten the right left side and dim the right side of the temporary accretion disk surrounding the black hole at the center. The dark region close to the position of the black hole at the center of the image is called the shadow of the Black Hole

Biography

Andreas Eckart is a full Professor for experimental Physics and the Managing Director of the I. Physikalische Institut at the University of Cologne. Since 2006, he is an External Member of the Max-Planck-Institute for Radioastronomy (MPIfR) in Bonn, Germany and Scientific Member of the Max-Planck-Society (MPG). He has also been the Otto Hahn Medal awarded by the Max Planck Society (1984) and the Manne Siegbahn Medal awarded by the Manne Siegbahn Laboratory (2003), Stockholm University, Sweden. Research interests lies in the Galactic Center and nuclei of other galaxies.

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