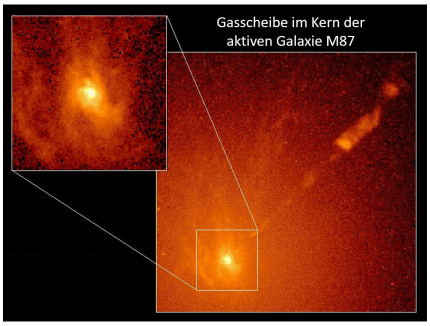
Accretion Disks around Black Holes



Accretion disks, black holes and Lyman-alpha forest

The study of geodesics in General Relativity is essential to understand the characteristics of warped spacetimes. In this METEOR an introduction to the basics of General Relativity is provided with an emphasis on black holes and their surroundings. Applications concern the study of the photon sphere and the shadow of rotating black holes, the calculation of particle motion in accretion disks and the spectral analysis of the Lyman-alpha forest of quasars.

Theory

by Jutta Kunz and Philipp Huke

The basics principles of General Relativity are studied. The Einstein equations and the geodesic equations are discussed. Important properties of black holes like their shadow as well as accretion disk models are addressed. The Lyman-alpha forest is studied to learn about the expansion of the universe.

Applications

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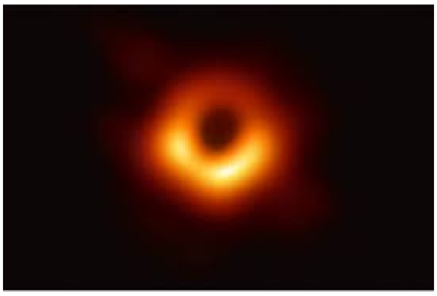
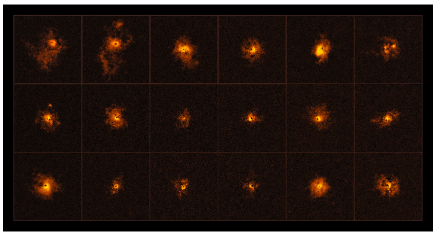
The orbits of stars at the center of the Milky Way betray the presence of a supermassive black hole with more than 4 Million $M_{\odot}$, Sagittarius A*.



The event horizon telescope reaches a resolution of 26 micro-arcseconds. Its first pictures of the shadow of M87 have been analyzed and those of Sagittarius A* are expected soon. In this project we will study how to obtain the shadow of static and rapidly rotating black holes theoretically.
Observations of accretion disks and of Active Galactic Nuclei range from radio waves to X-rays. But accretion processes in the close vicinity of supermassive black holes are not yet fully understood. Since accretion disks are very close to the black hole horizon their properties can depend significantly on the gravitational field of the black holes. In this project basic models for accretion disks will be studied.
In this project, scientific data observed with UVES, allows for spectral analysis of the Lyman-alpha forest. The line positions and depth tell about how many clouds at which red shifts were traversed by the quasar's light. Based on this a Lyman-alpha forest simulator can be build to allow for predictions of future observations. The "quality" and "quantity" of spectra will be regarded as well, in order to identify a suitable set of quasars observable with available telescopes and spectrographs.



18 Quasars observed by a team of observers of the ETH Zürich. Each quasar comes with a bright gaseous halo. Credits: ESO/Borisova et. al.

See also

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