



Black Holes

Black holes were predicted as mathematical singularities by the general theory of relativity from *Albert Einstein*. However, it is said that *Einstein* never believed in the real existence of such objects. In 1916 during World War I, the former director of the Astrophysical Observatory in Potsdam, *Karl Schwarzschild*, proposed a solution to Einstein's field equations for the case of a mass united in a point of no dimensions: a so-called black hole.

Popular scientific interests and science fiction literature have brought the property of an event horizon to the attention of a larger audience. Predicted by *Schwarzschild*, the event horizon is the point beyond which no matter or radiation can escape from the gravitation pull of a black hole. Meanwhile, numerous astrophysical measurements have more or less proven the existence of black holes. Although this type of object cannot be seen by definition, the effects of a black hole on its surroundings can be used to deduce its existence, for example from the observed orbital movement of stars in the immediate vicinity of this singularity.

Black holes draw attention to themselves in a spectacular way through the inflow of mass (accretion) leading to the formation of an accretion disc in which all matter unstopably spirals towards the event horizon and heats up to extreme temperatures in the process. The ensuing emission of energy from the plasma that has reached a temperature of millions of Kelvin is particularly intensive in the x-ray range. Mainly from observations with the ROSAT space telescope, astronomers know that the universe is full of super

mass-rich black holes residing in the center of galaxies. Today, it is believed that basically all galaxies the size of Milky Way harbor a black hole in their center, typically with a mass of several million times that of the sun. ROSAT observations also revealed the existence of so-called ultra-luminous x-ray sources (ULX) whose x-ray luminosity is several million-fold larger than the total luminosity of the sun. These do not reside in the dynamic center of galaxies, but mainly in regions with ongoing star formation or relatively young stars. In contrast to super mass-rich black holes, which accumulated their immense mass by accretion, these structures are thought to be black holes in a medium mass range of up to approx. 100-fold the mass of the sun. Only very few candidates are known at this time.

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