



The Chandra X-Ray Observatory recently confirmed the discovery of an infant black hole in the nearby galaxy Messier-100. The product of the supernova of a star with a mass of 20 times our sun, the resulting black hole may only involve about 8 times our sun's mass.

For black holes that do not rotate, called Schwarzschild Black Holes, there are several different sizes for such black holes that all scale with the mass of the black hole. When referring to the size of a black hole, astronomers usually mention its mass, which is well defined, rather than its diameter, which depends on the specific kinds of physical processes involved.

The Schwarzschild Radius – This is the distance from the center of the black hole at which an incoming person, or light signal, can enter the black hole interior, but cannot emerge back out into the universe. It is also called the Event Horizon. It is a perfectly spherical surface with a radius of $R_s = 3.0 M$ kilometers, where M is the mass of the black hole in multiples of the sun's mass ($1 M = 2.0 \times 10^{30}$ kg). For the SN1979C black hole, with an estimated mass of $8 M$, what is its Schwarzschild Radius, R_s , in kilometers?

Last Photon Orbit – At this distance outside the Event Horizon, an incoming photon of light can enter into an exactly circular orbit, where it will stay until it is disturbed, at which time it will fall into the Event Horizon and never get back out. If $R_p = 1.5 R_s$, what is the radius of the photon orbit for black hole SN1979C in kilometers?

Last Stable Particle Orbit – Inside this distance, a material particle cannot be in a stable circular orbit, but is relentlessly dragged to the Event Horizon and disappears. This occurs at a distance from the black hole center of $R_l = 3.0 R_s$. How close can a hydrogen atom, an asteroid or a planet remain in a stable circular orbit around the SN1979C black hole?

Problem – An asteroid is spotted at a distance of 700 km from a black hole with a mass of 120 solar masses. Can it escape or remain where it is?