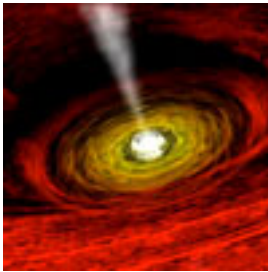




X-Ray Astronomy Field Guide

Supermassive Black Holes

Supermassive black holes with the mass of a many millions of stars are thought to lie at the center of most large galaxies. The evidence comes from optical and radio observations which show a sharp rise in the velocities of stars or gas clouds orbiting the centers of galaxies. High orbital velocities mean that something massive is creating a powerful gravitational field which is accelerating the stars. X-ray observations indicate that a large amount of energy is produced in the centers of many galaxies, presumably by the in-fall of matter into a black hole.



*Schematic of a
Black Hole*

How could a supermassive black hole form in the center of a galaxy? One idea is that an individual star-like black hole forms and swallows up enormous amounts of matter over the course of millions of years to produce a supermassive black hole. Another possibility is that a cluster of star-like black holes forms and eventually merges into a single, supermassive black hole. Or, a single large gas cloud could collapse to form a supermassive black hole.

Recent research, including results from Chandra (see 3C394, Perseus Cluster, NGC 4636, Centaurus A) suggests that galaxies and their black holes do not grow steadily, but in fits and starts. In the beginning of a growth cycle, the galaxy and its central black hole are accumulating matter. The energy generated by the jets that accompany the growth of the supermassive black hole eventually brings the infall of matter and the growth of

the galaxy to a halt. The activity around the central black hole then ceases because of the lack of a steady supply of matter, and the jets disappear. Millions of years later the hot gas around the galaxy cools and resumes falling into the galaxy, initiating a new season of growth.



Centaurus A