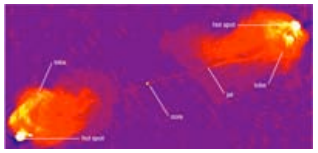
Active Galactic Nuclei

M87

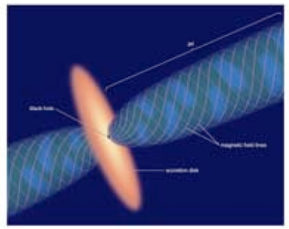


Cygnus A

(Artist's conception)

- AGNs were often called "QSOs", "radio galaxies", or "Seyfert galaxies", depending on how they look, for historical reasons.
- Very energetic souces, and luminosity varies in hours to days
  - This evidence strongly argues that AGNS are compact objects.
  - Black holes!

Supermassive Black Holes



- The primary source of energy for black holes is *gravitational energy*.
- The accretion disk surrounds the central black hole
  - As gas swirls down into the hole, it forms disk owing to conservation of angular momentum
  - Gas is heated by gravitational energy
- Very efficient way to generate energy -- $E=(0.1\text{-}0.4)mc^2$
  - Compare: $E=0.007mc^2$ for nuclear reaction in the Sun