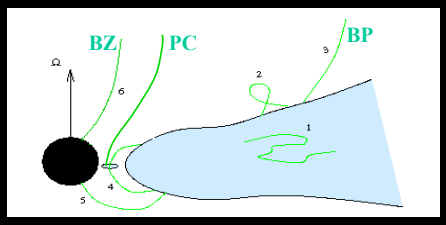
The Special Case of Kerr Black Holes: Direct Magnetic Coupling by the BZ Effect

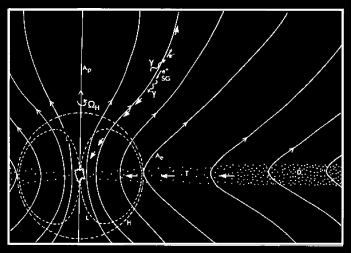


Blandford (2001; 2003)

- Accreting plasma presses magnetic field onto Kerr hole
- Magnetic field lines temporarily thread Kerr hole
- Field extracts rotational energy and angular momentum from hole

$$L_{BZ} \sim 10^{46}\, erg\, s^{-1}\, m_9\, \dot{m}\, j^2$$

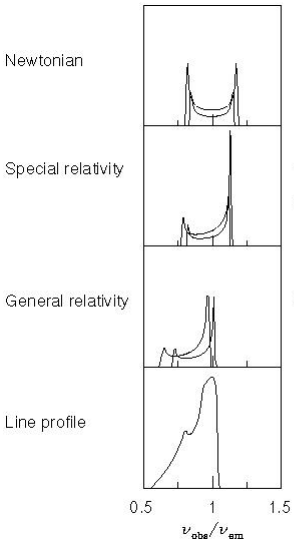
$$\gamma_{BZ} = ?????$$



Blandford & Znajek (1977)

(From Meier & Nakamura
http://www.atnf.csiro.au/education/workshops/jaunceyfest/Talks/19.DavidMeier/Meier_DJ65.ppt)

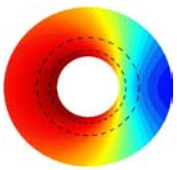
Iron Kα profiles



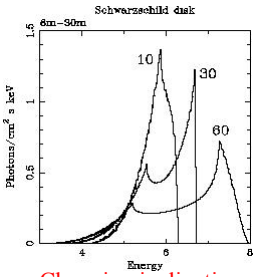
Transverse Doppler shift

Beaming

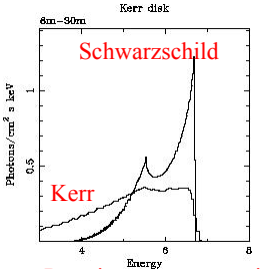
Gravitational redshift



Line of sight



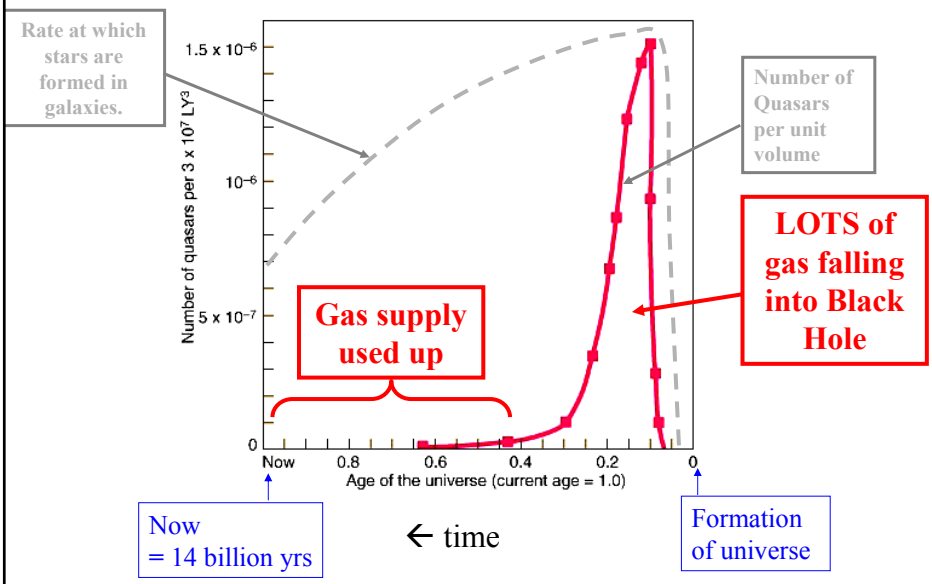
Changing inclination



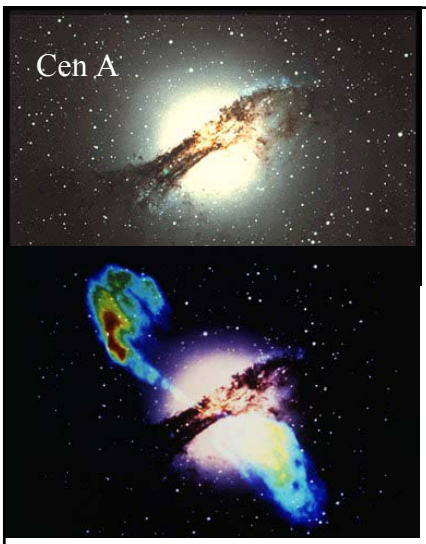
Rotating vs. non-rotating

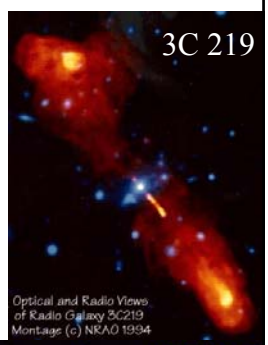
Fabian et. Al., 2000, PASP, 112, 1145

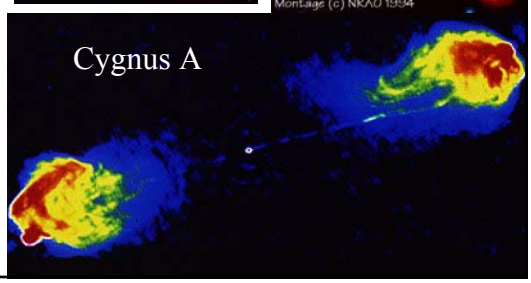
Most Quasars Lived and Died Long Ago



The Leftovers: Active Galaxies





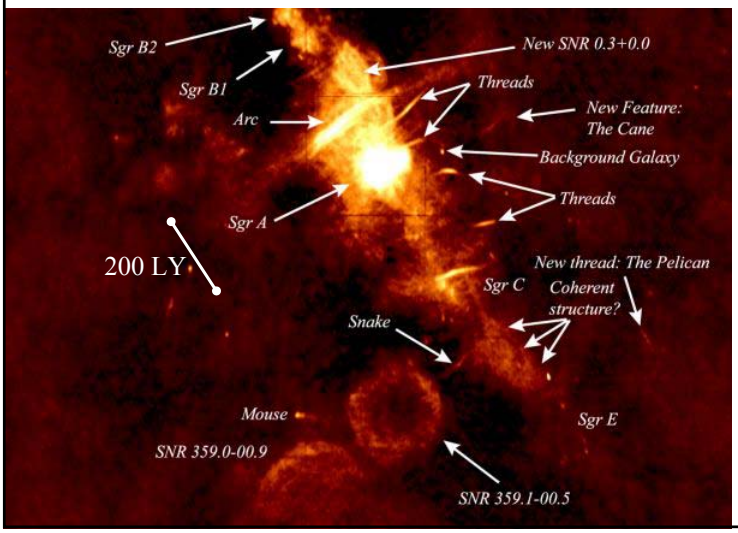


Nearby Radio Galaxies.
- Elliptical Galaxies.

Also… Seyfert Galaxies
- Spiral galaxies with very low-luminosity quasar at center.

The Center of our own Galaxy

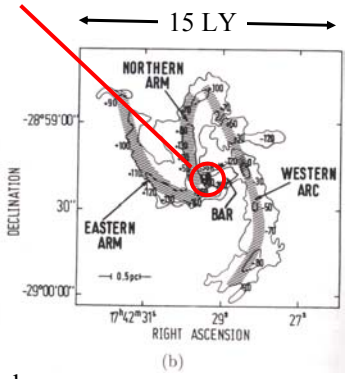
Visible light



Radio waves

Sagittarius A*

(a)

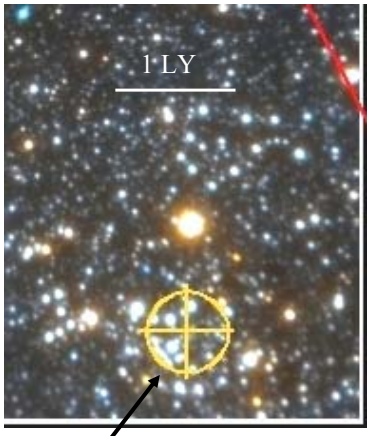


(b)

Radio observations with higher angular resolution.

Small oval is the point source Sagittarius A*
= center of galaxy

Infra-red Images of the Galactic Center

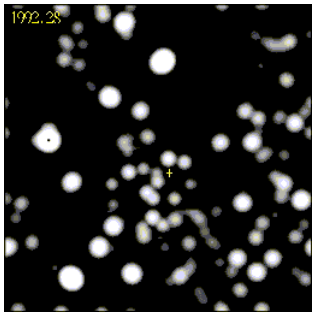


Galactic Center (Sagittarius A*)

Using "adaptive optics" technique on Gemini 8m telescope.

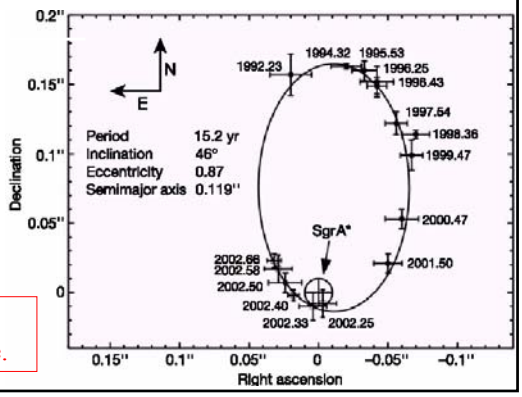
300,000 x more stars per unit volume than in vicinity of Sun

The Black Hole at the the Galactic Center



Infrared observations over 6 years.

Velocities of stars in very center
➔ 1 million $M_\odot$ black hole
at position of Sagittarius A*



Latest data (2002): follows complete orbits to within 60AU from black hole.