

# A New Interest on AGNs

- No stationary cooling flows in clusters of galaxies
- CDM/SAM models fail to make elliptical galaxies (i.e. Passively evolving galaxies)
- No stationary cooling flows in ellipticals
- Central supermassive black holes (SMBHs) are ubiquitous

AGNs may save the day!!!

- 2001: The collapse of the (stationary) Cooling-flow model for clusters of galaxies

(Bohringer et al.2002)

- The ICM does not cool below  $\sim 1$  keV. Something must keep it hot.

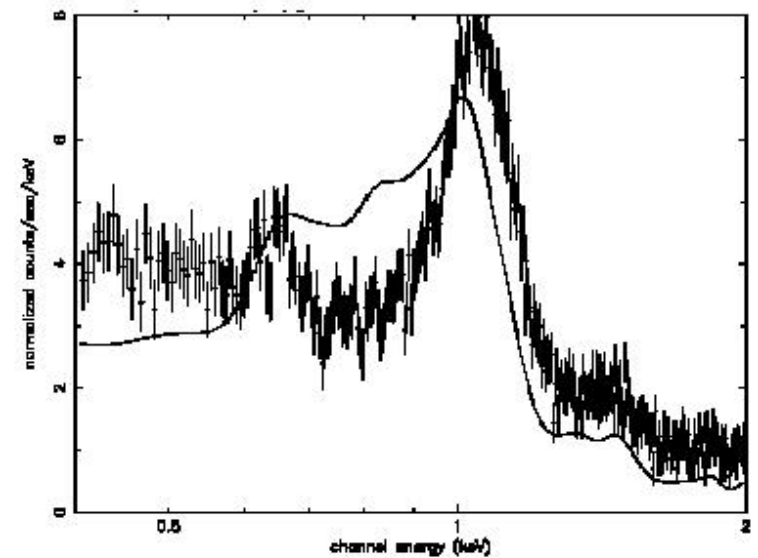


Fig. 2. *XMM EPN*-spectrum of the central region of the M 87 X-ray halo in the radial range  $R = 1-2$  arcmin. The spectrum has been fitted with a cooling flow model with a best fitting mass deposition rate of  $0.96 M_{\odot} \text{ yr}^{-1}$ , a fixed absorption column density of  $1.8 \times 10^{21} \text{ cm}^{-2}$ , the galactic value, and a parameter for  $T_{\text{cool}}$  of 0.01 keV.

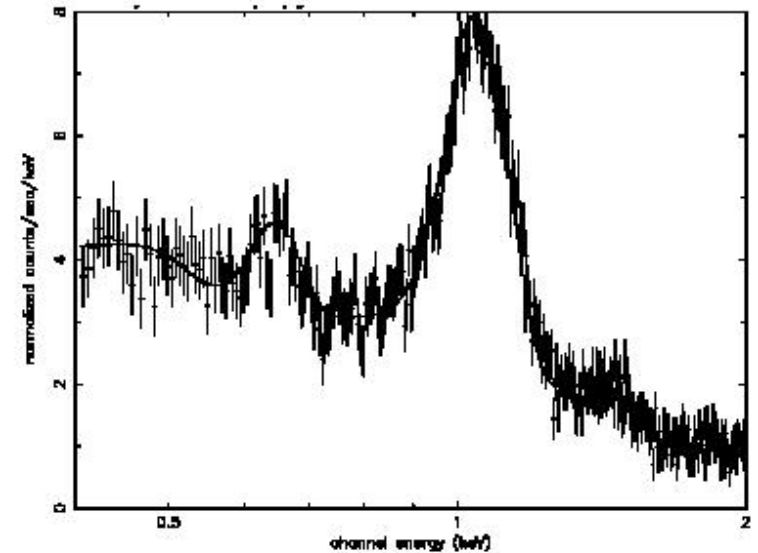
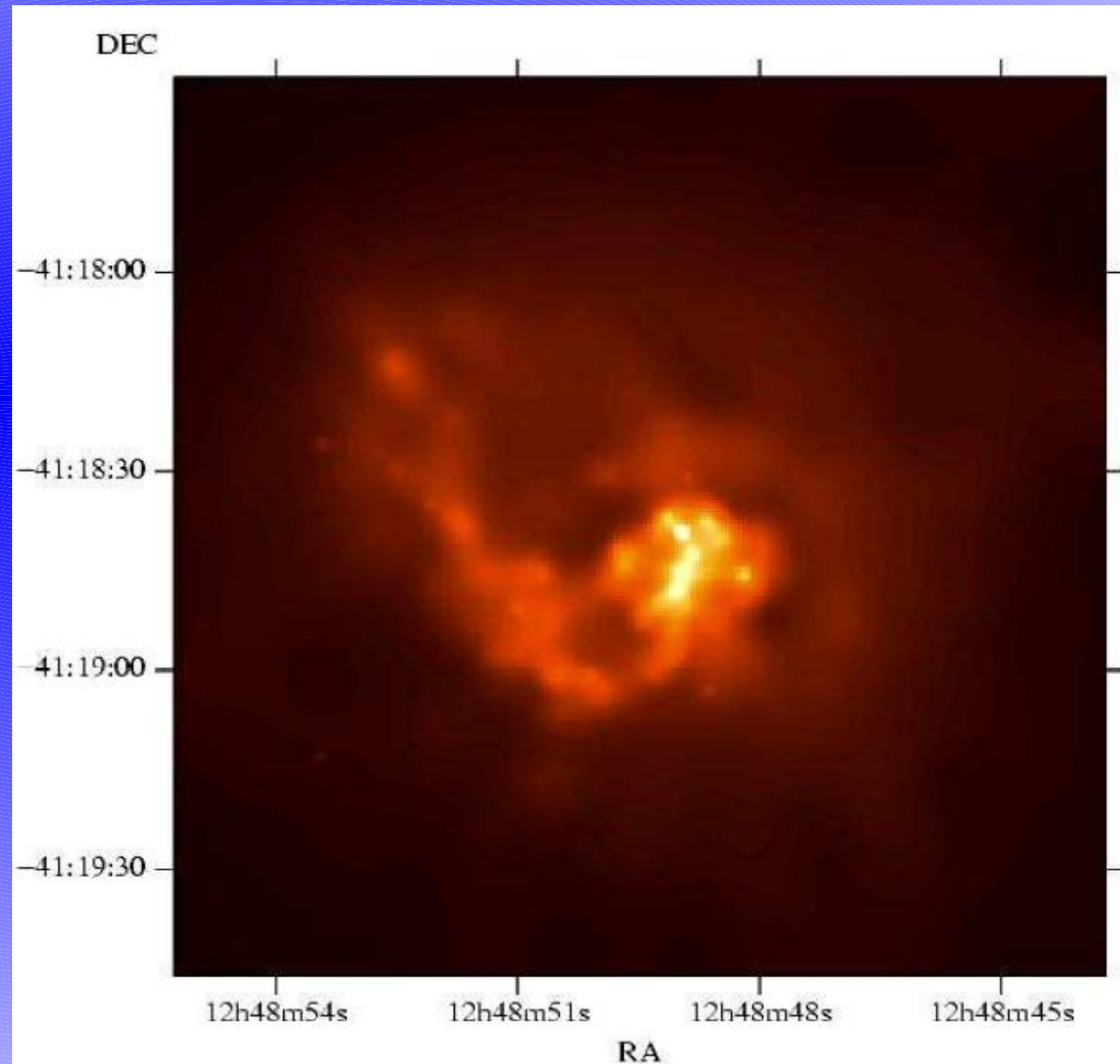


Fig. 3. *XMM EPN*-spectrum of the central region of the M 87 X-ray halo in the radial range  $R = 1-2$  arcmin fitted by a cooling flow spectrum artificially constrained to emission from the narrow temperature interval 1.44–2.0 keV yielding a mass deposition rate of  $2.4 M_{\odot} \text{ yr}^{-1}$ . The parameter  $T_{\text{cool}}$  was treated as a free fitting parameter.

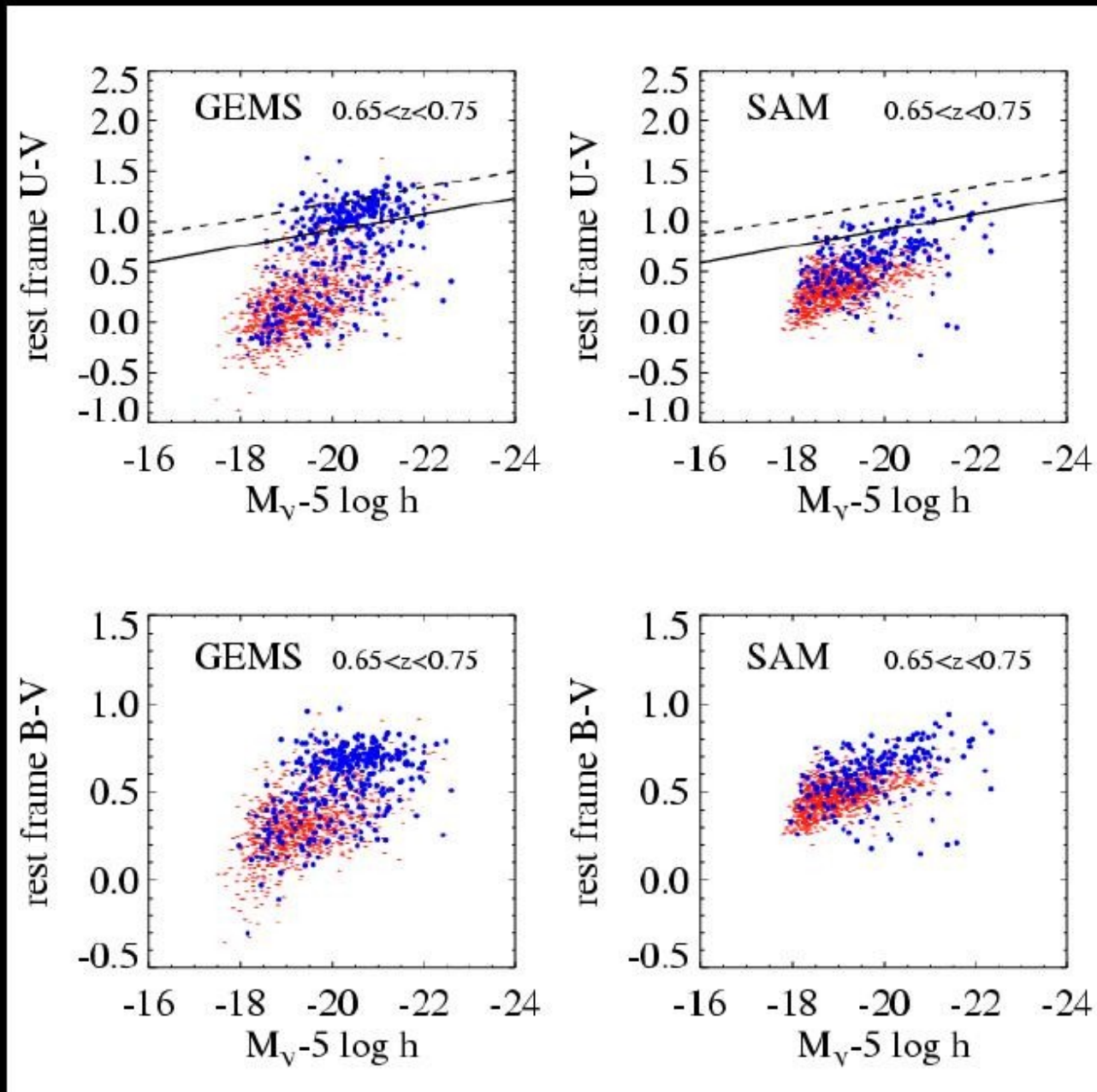
# The ICM does not look stationary at all on Chandra images

- For example, this is Centaurus cluster (from Sanders & Fabian 2002)



*the problem is even worse at high redshift...* Somerville 2004

red:  $n > 2$   
blue:  $n < 2$

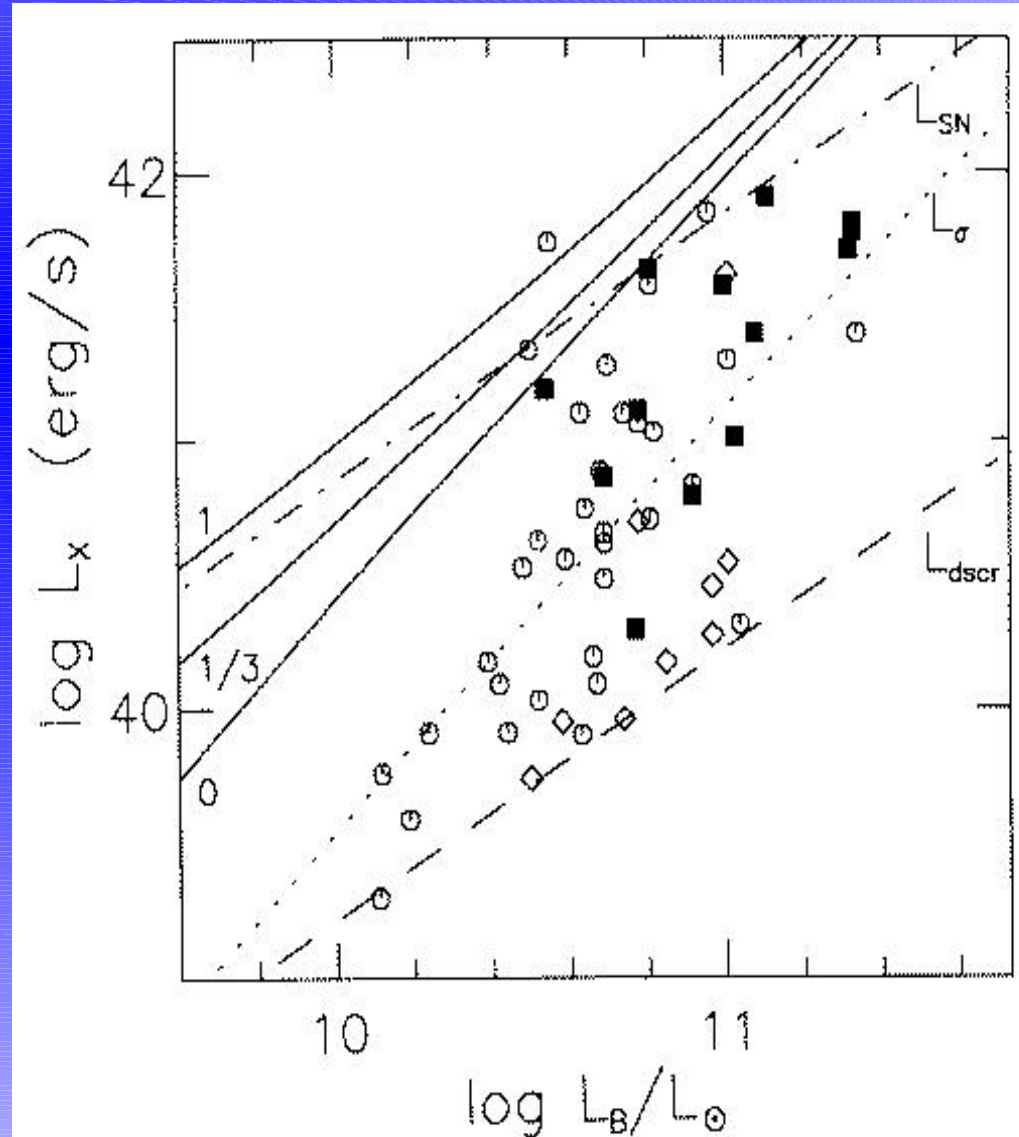


red:  $B/T > 0.5$   
blue:  $B/T < 0.5$

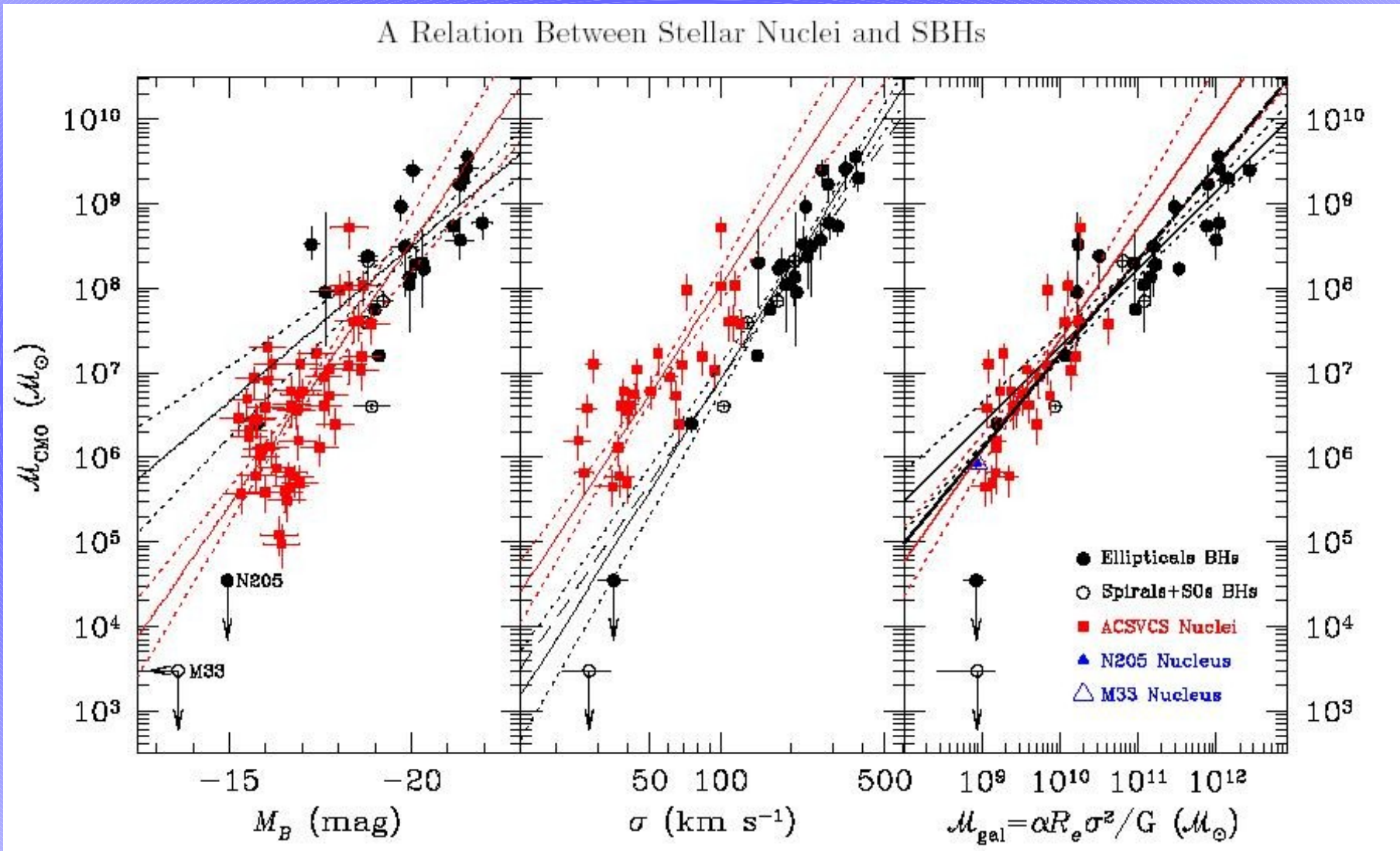
# The problem is actually much older ...

- From Ciotti et al (1991):

Something must suppress cooling flows in elliptical galaxies.



# As we all know: all major galaxy has its own SMBH



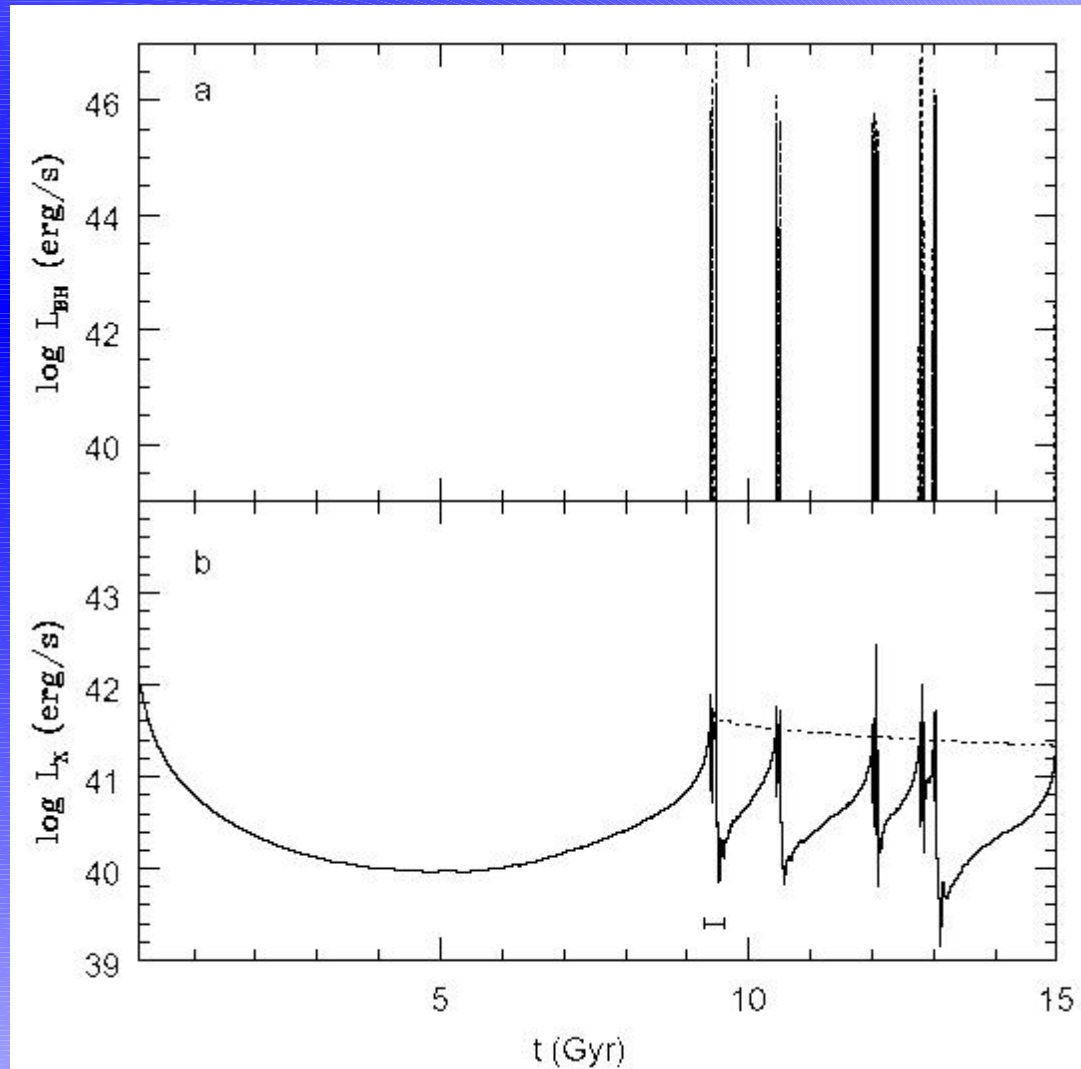
- Ferrarese et al. (2006)

# General appeal to SMBHs/AGNs Feedback

- To suppress cooling flows in clusters (vast literature)
- To suppress star formation in massive DM halos (first CDM/SAM model with AGN feedback by Granato et al. (2001). Now the SMBH-AGN/Galaxy Co-evolution is the new paradigm
- For an even earlier attempt to suppress cooling flows in ellipticals see Ciotti & Ostriker (1997)

# An early hydrodynamical simulation of an accreting SMBH at the center of an Elliptical Galaxy

- Radiative coupling between the X-ray emitting AGN and the Hot ( $\sim 1$  keV) ISM via Compton heating: requires the AGN X-rays to be HARD .... are they?





# The X-Ray Background spectrum is hard enough!

