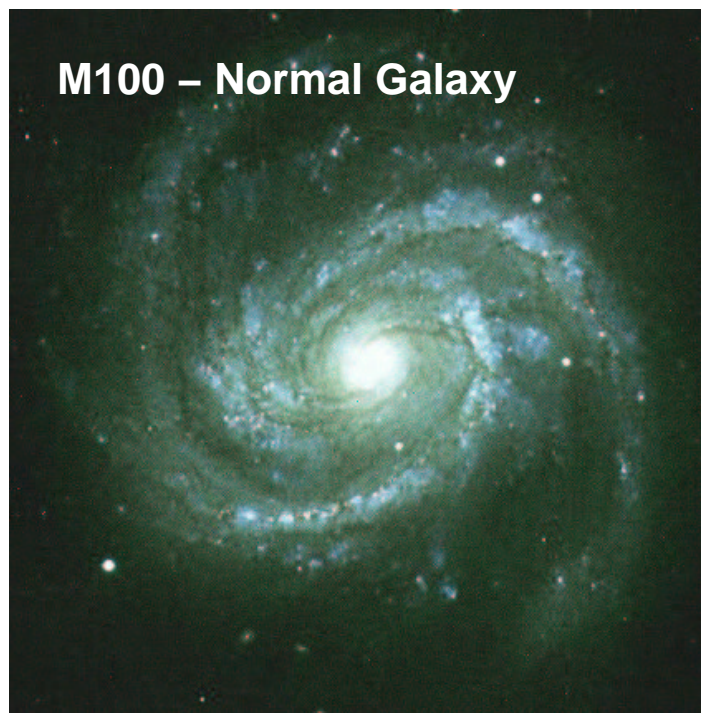
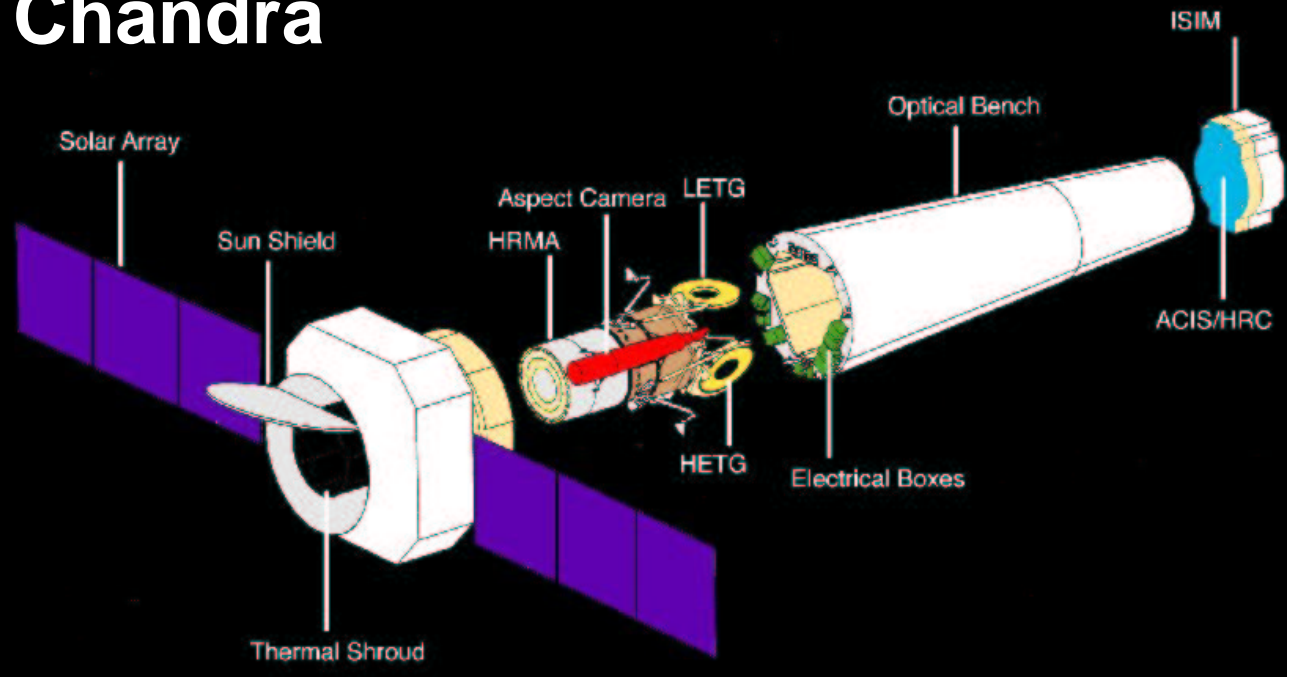


X-raying Active Galaxies: Exploring the Environments of Supermassive Black Holes

Niel Brandt (Penn State)

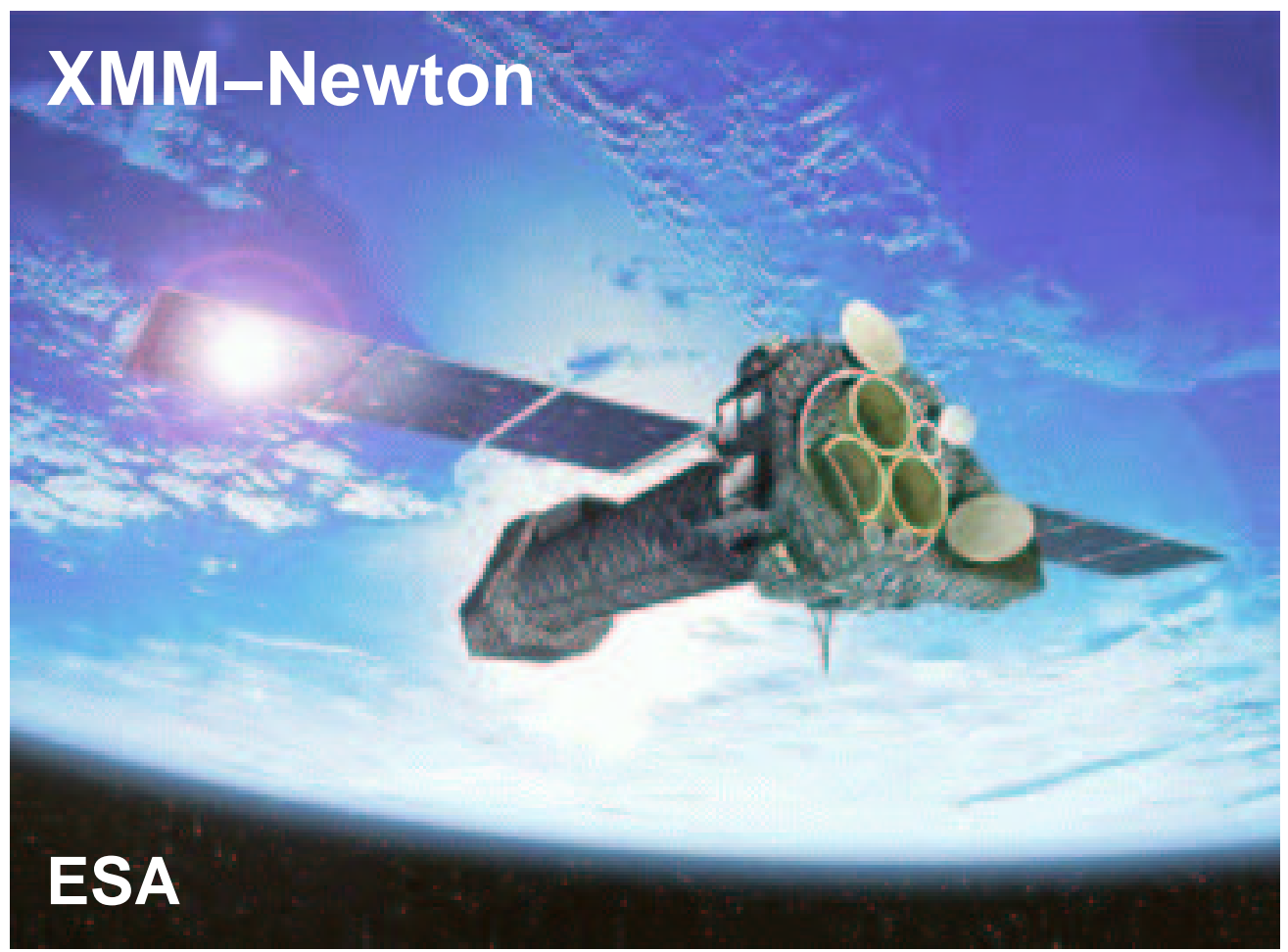


Chandra



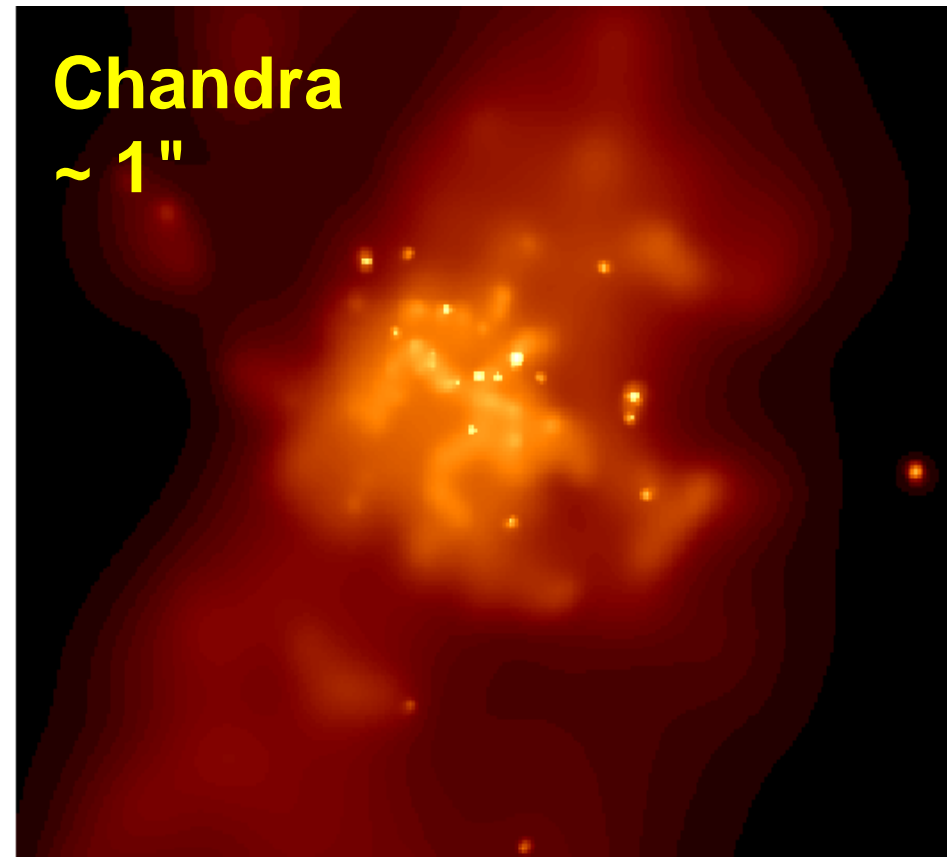
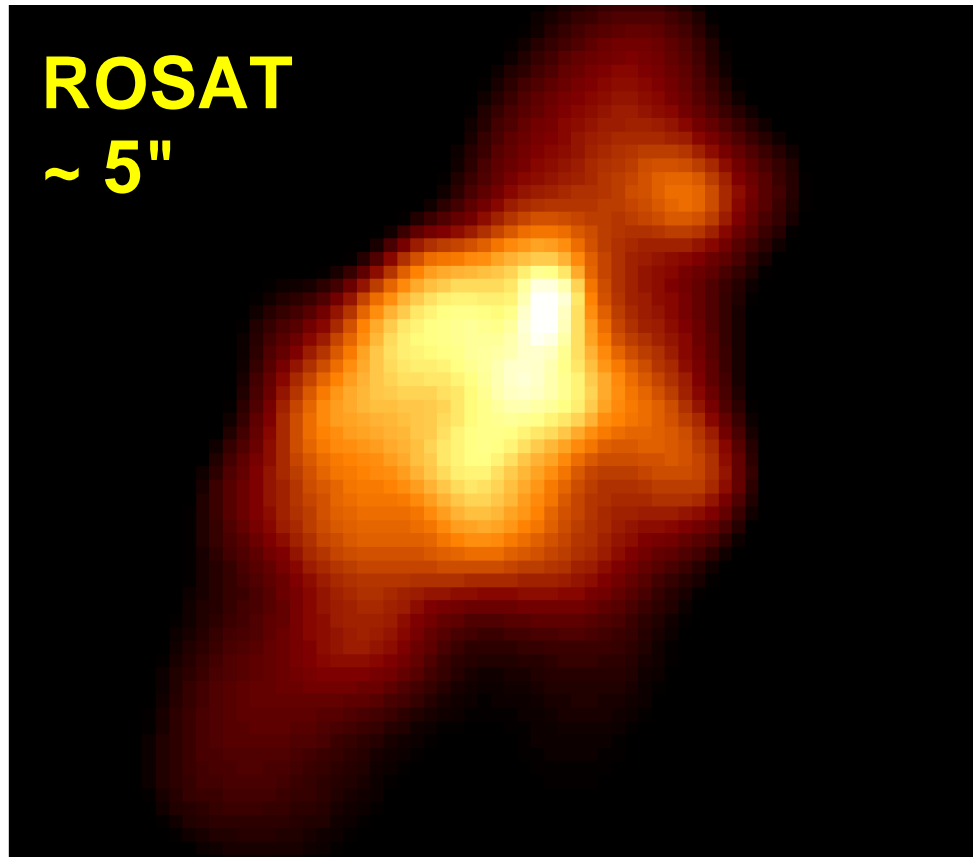
NASA

XMM-Newton

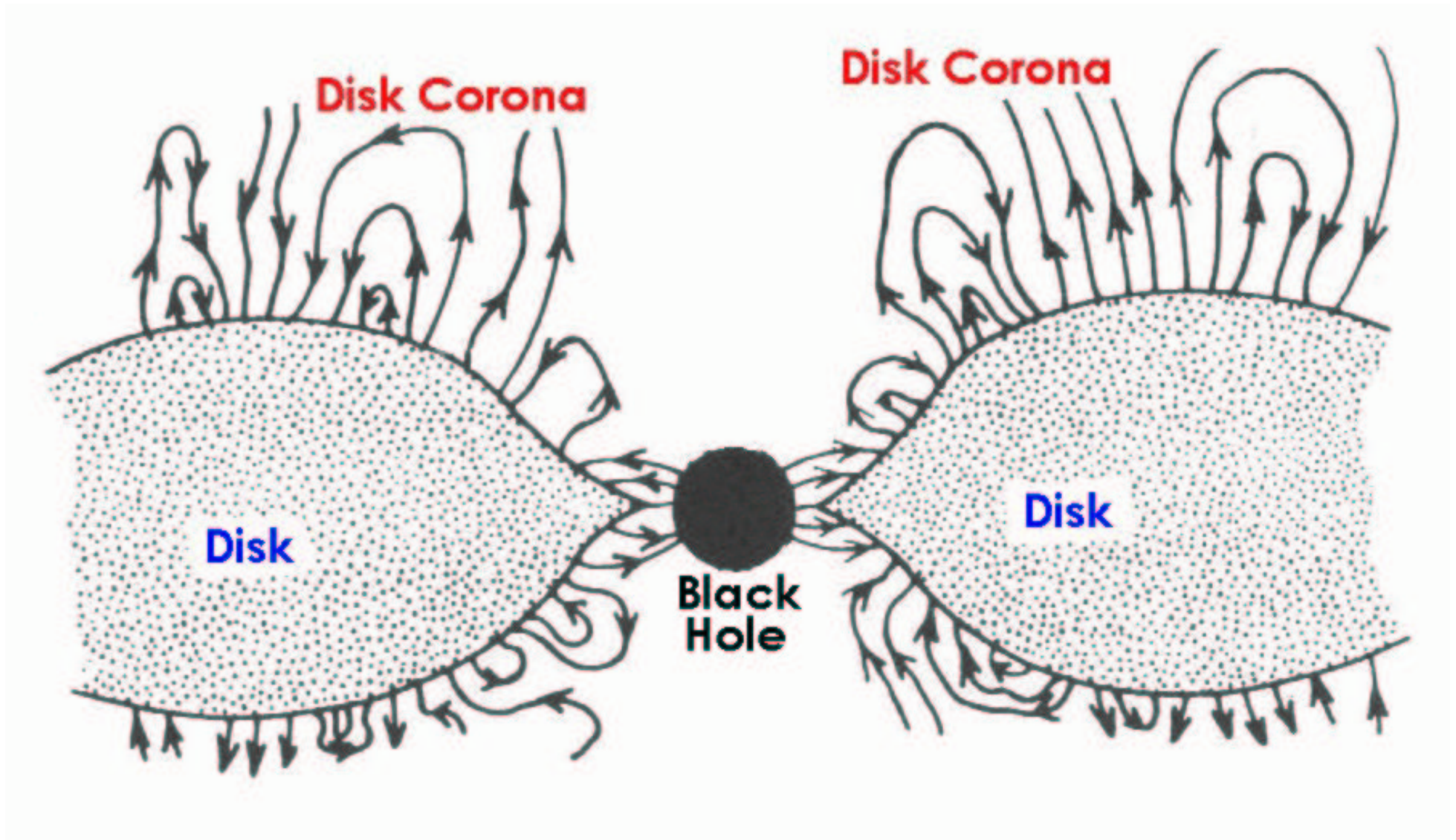


ESA

The Importance of Spatial Resolution: The Center of M82

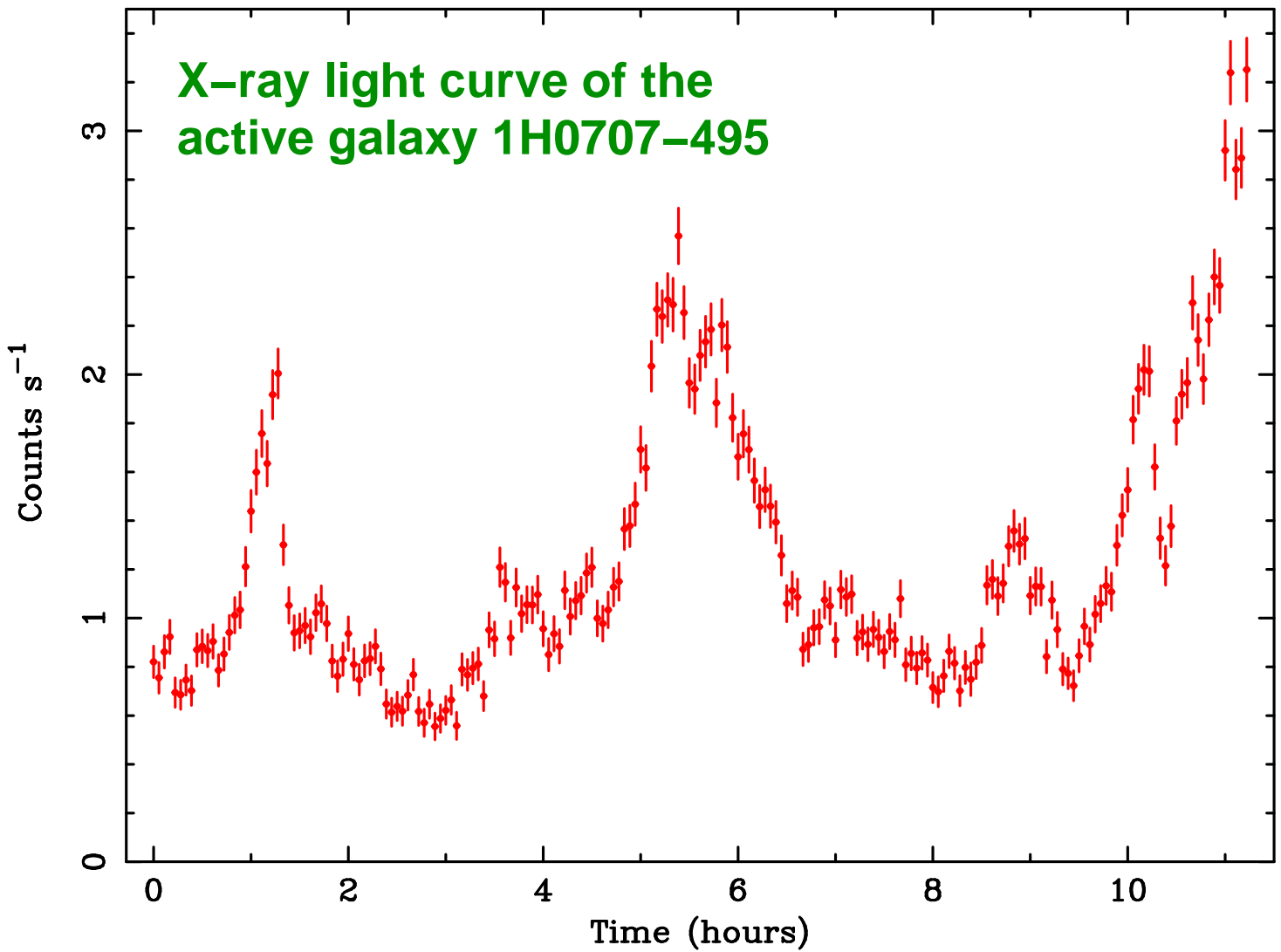


Nuclear Region of an Active Galaxy

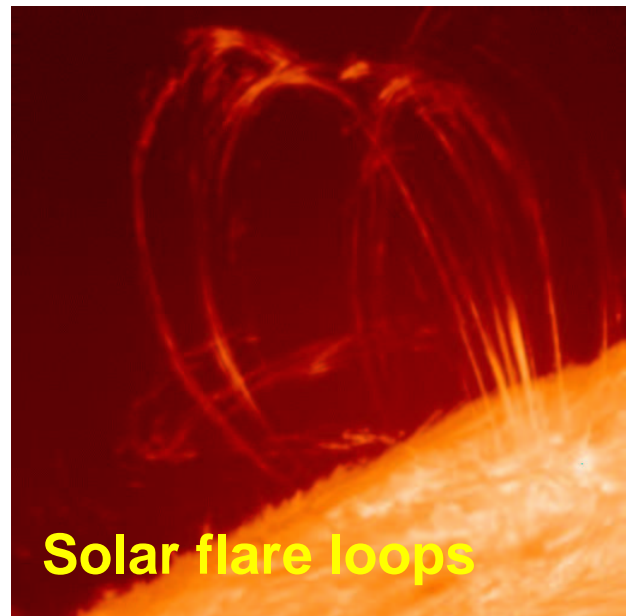
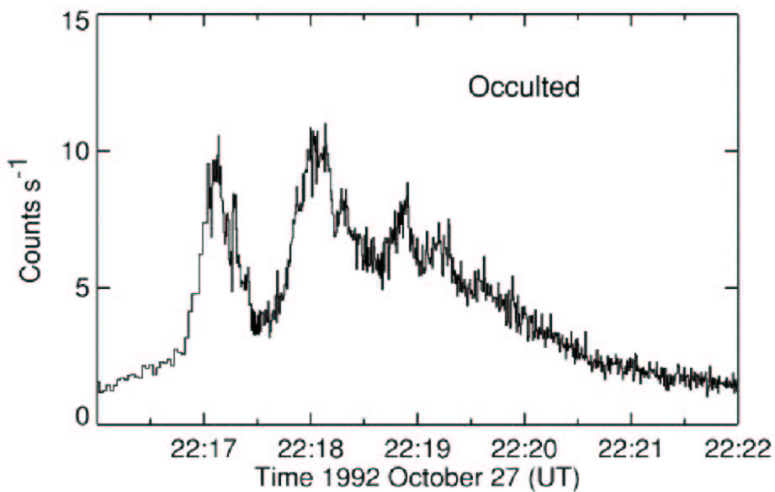


10^{13} cm scale ~ light minutes

Rapid X-ray Variability of Active Galaxies

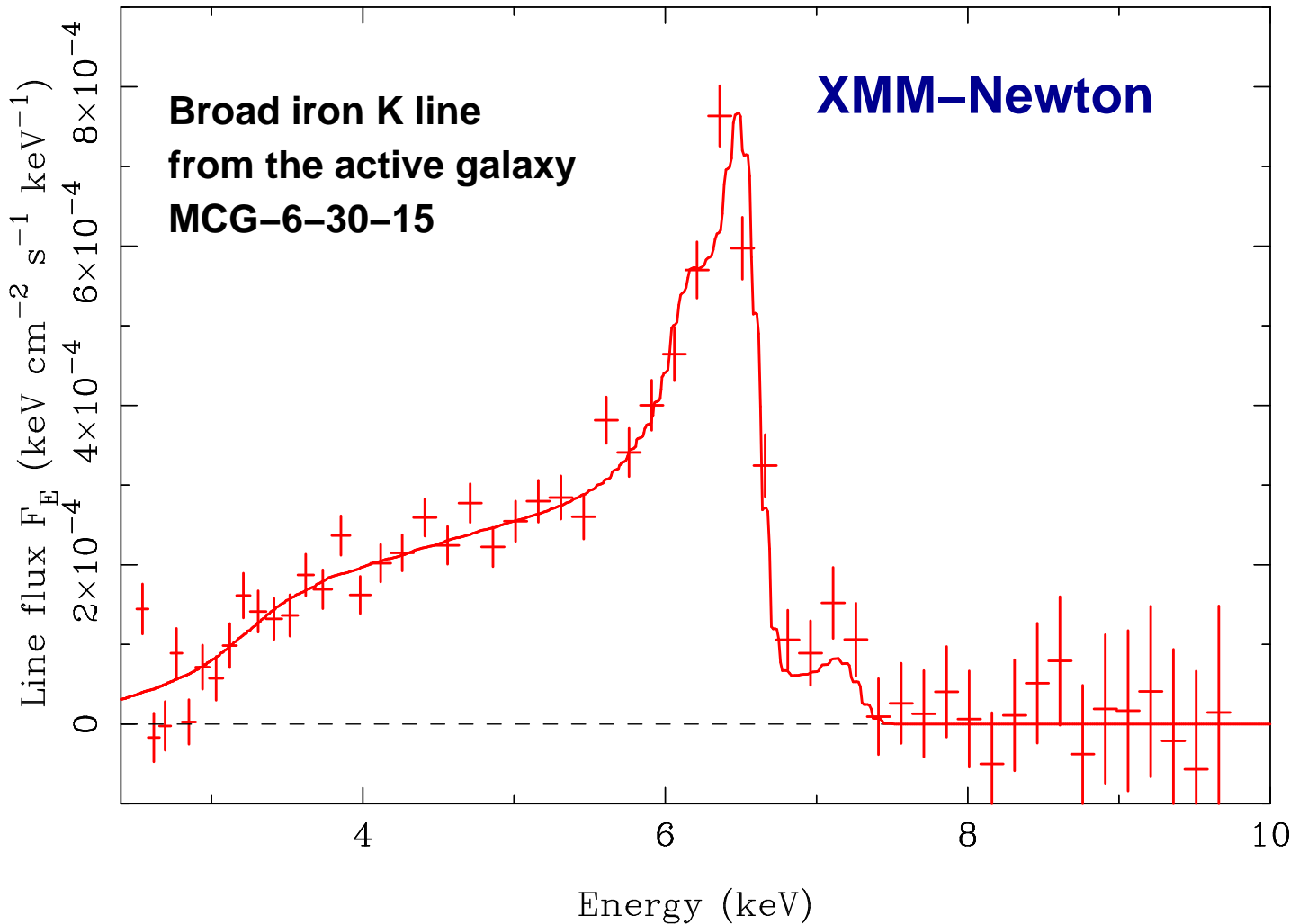
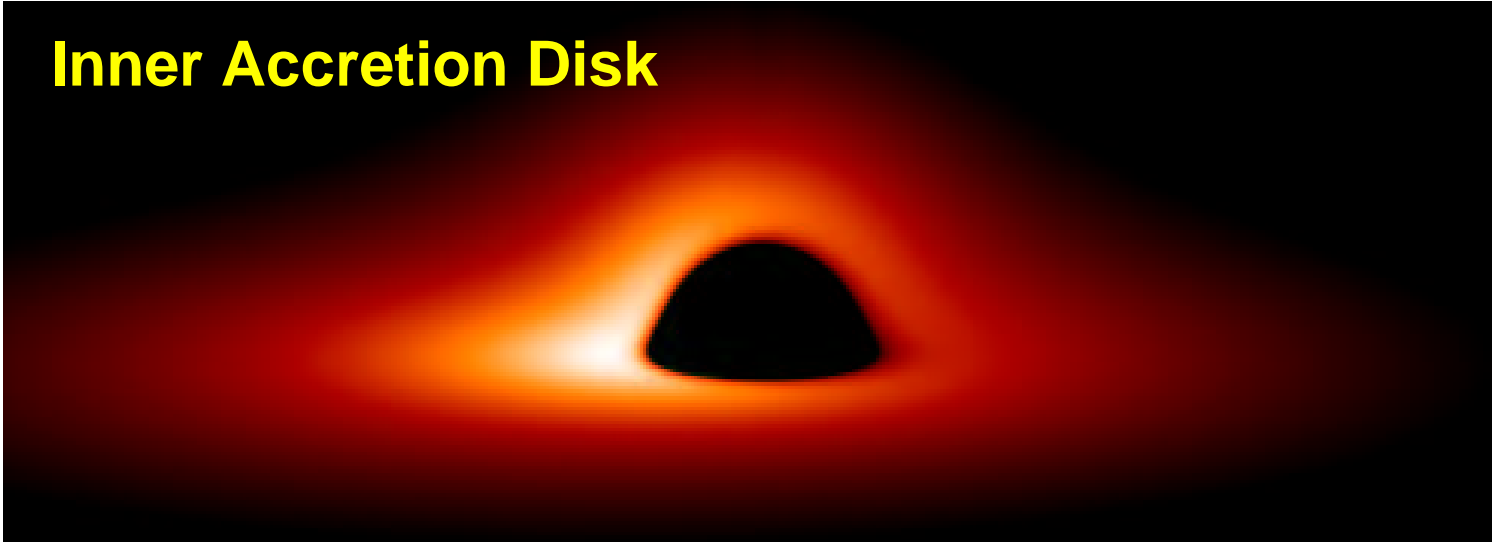


Solar flare light curve

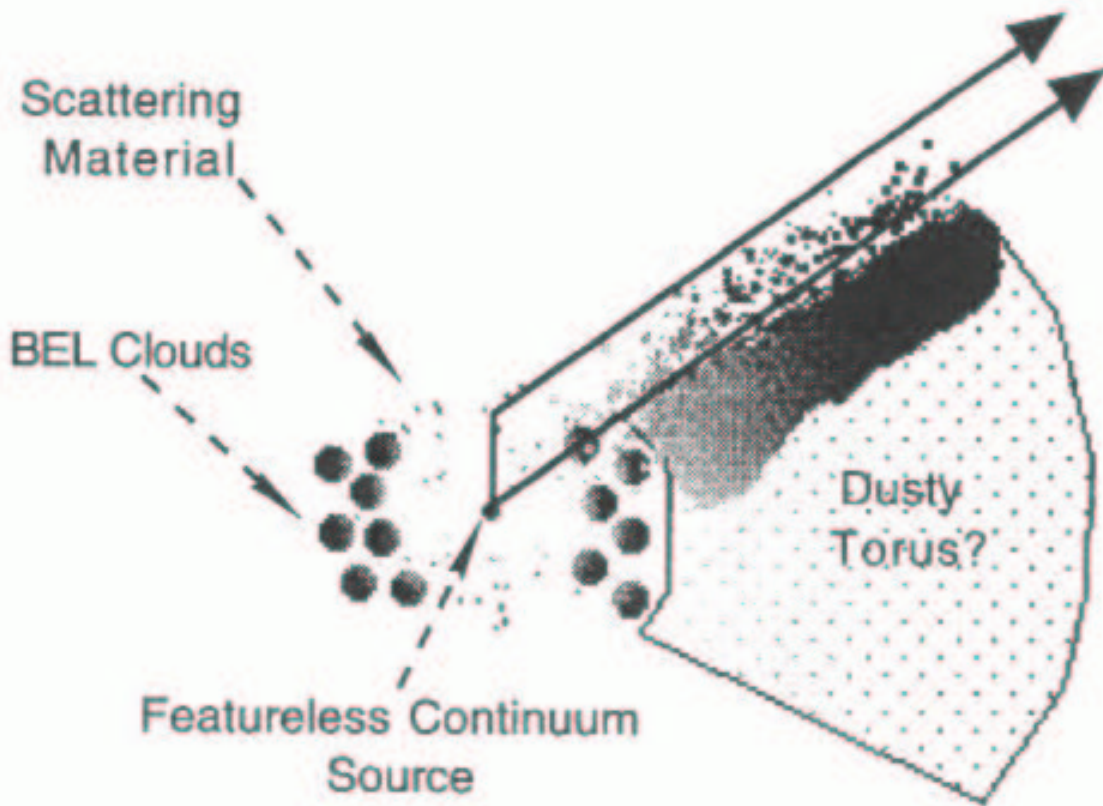


X-rays from the Inner Accretion Disk

Inner Accretion Disk



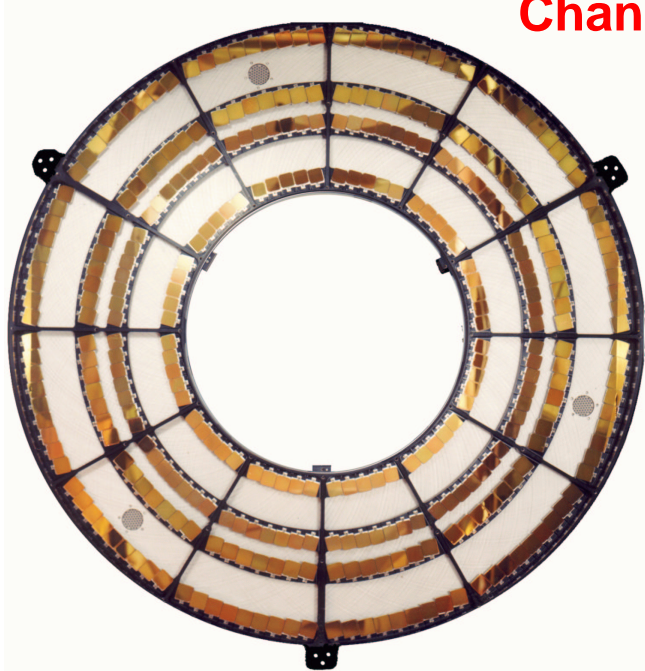
X-raying an Active Galaxy Wind



10^{17} cm
scale
~ light weeks

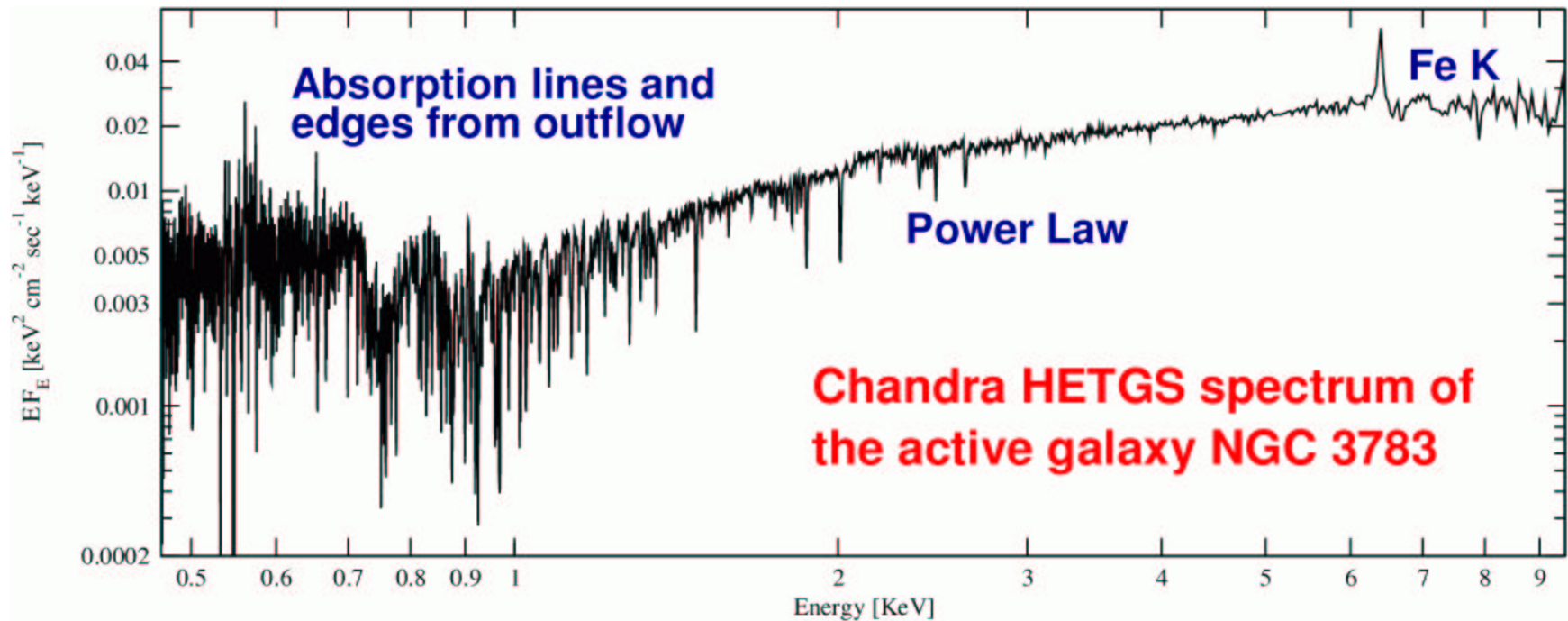
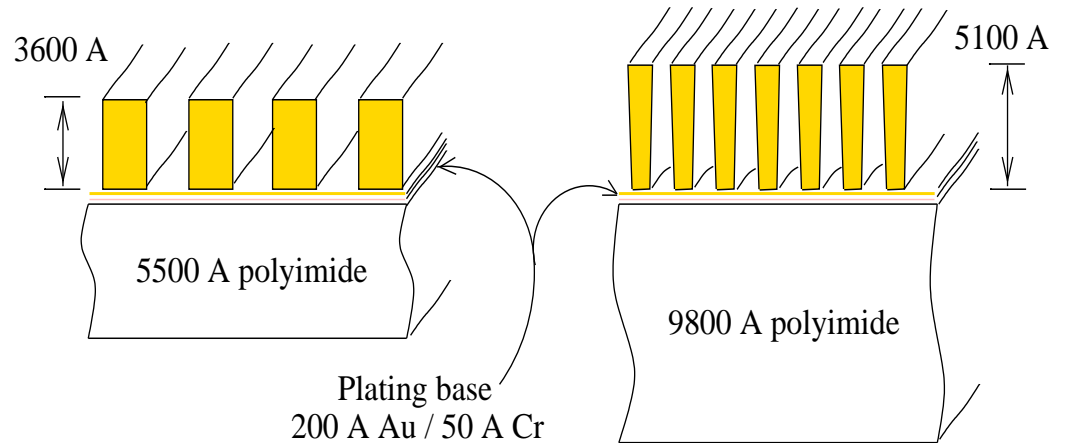
Chandra Grating Spectrum of the Wind from NGC 3783

Chandra HETGS

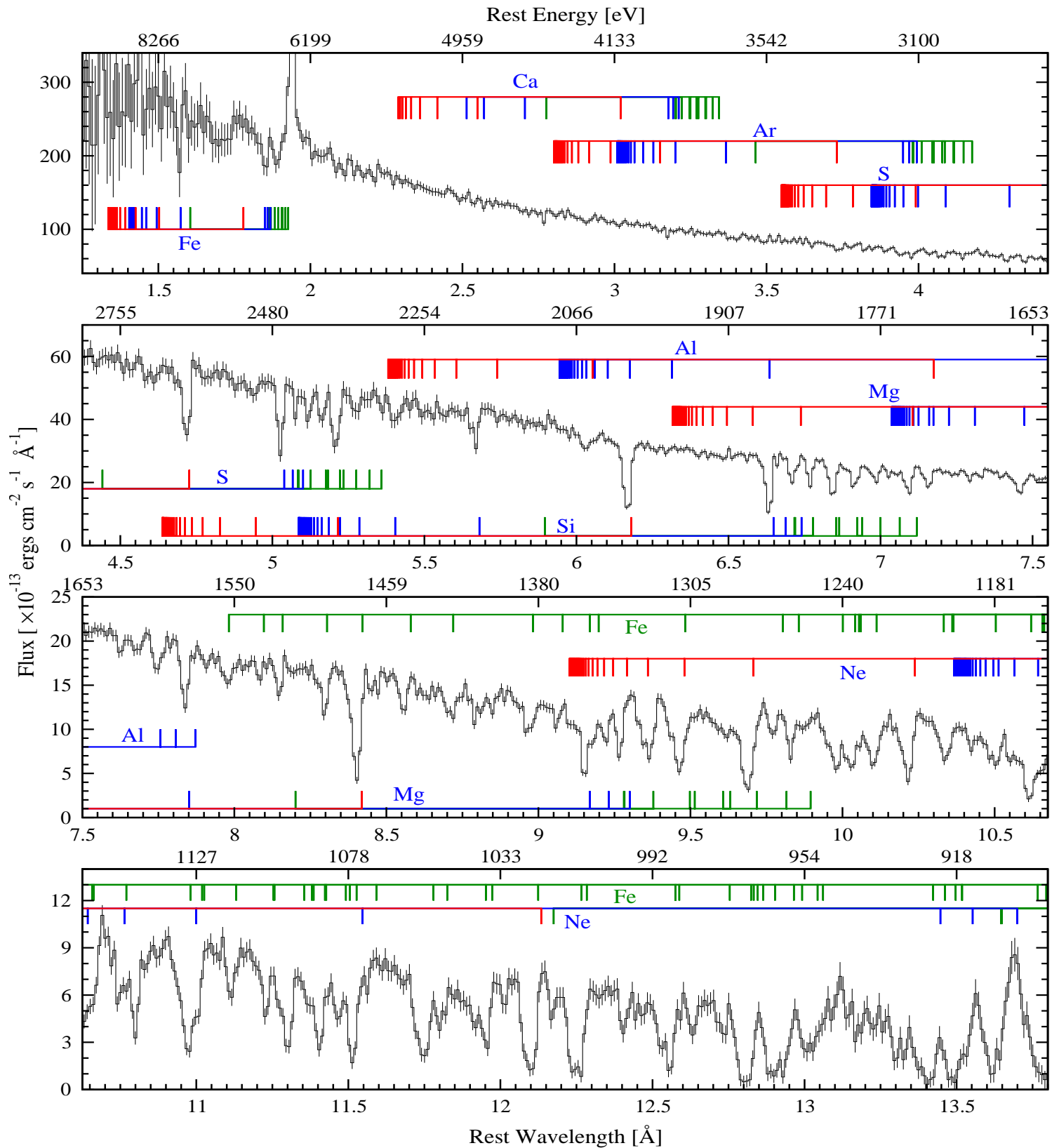


MEG

HEG



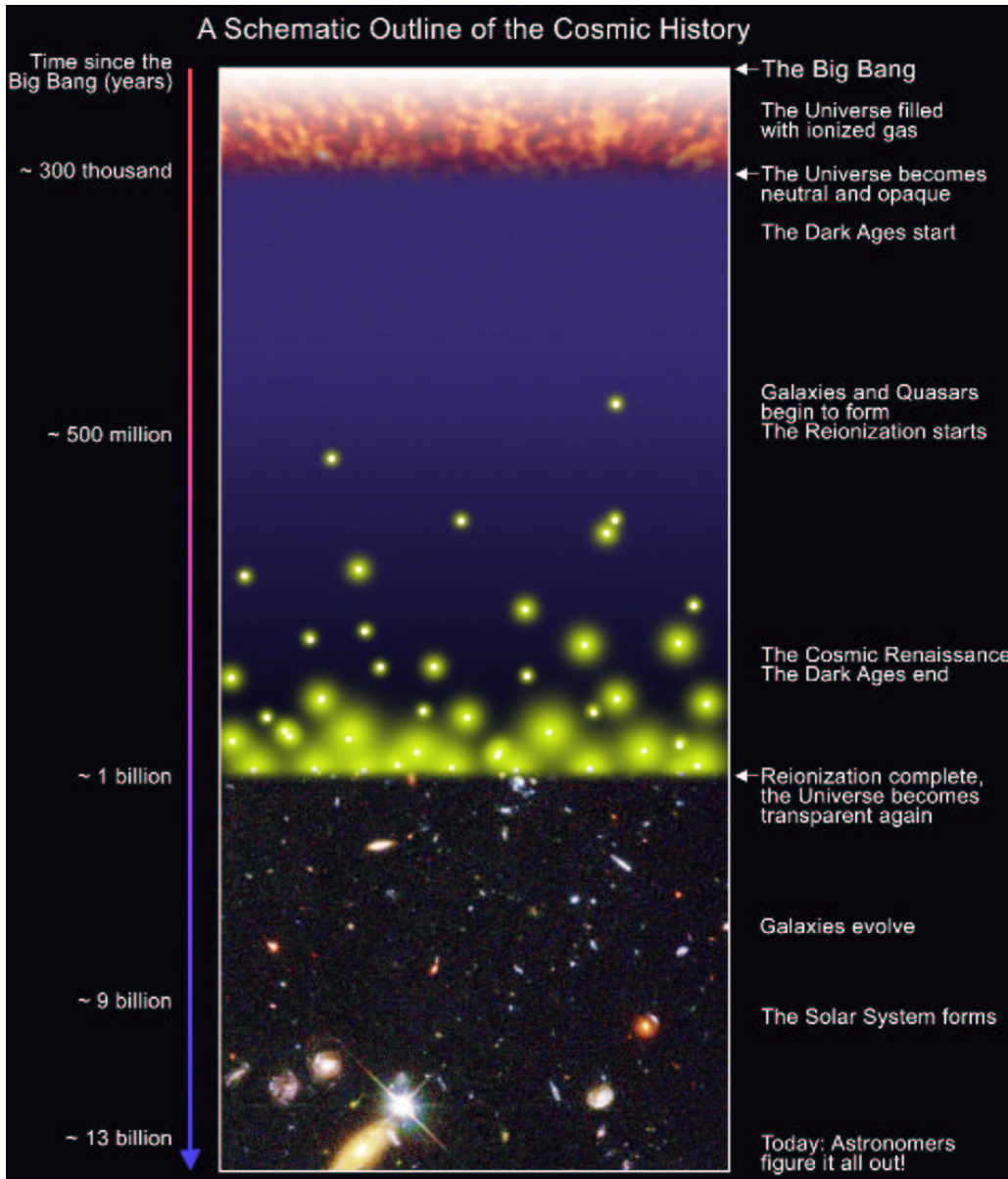
NGC 3783 Spectral Details



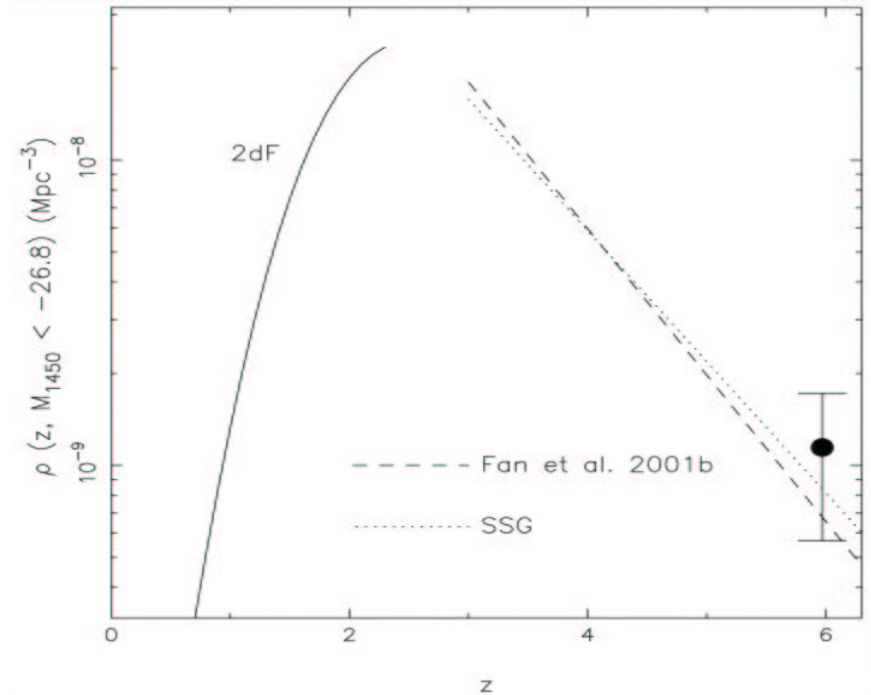
Note the Moseley sequence

Wind kinetic power > Photon power !

Active Galaxies at the Highest Redshifts



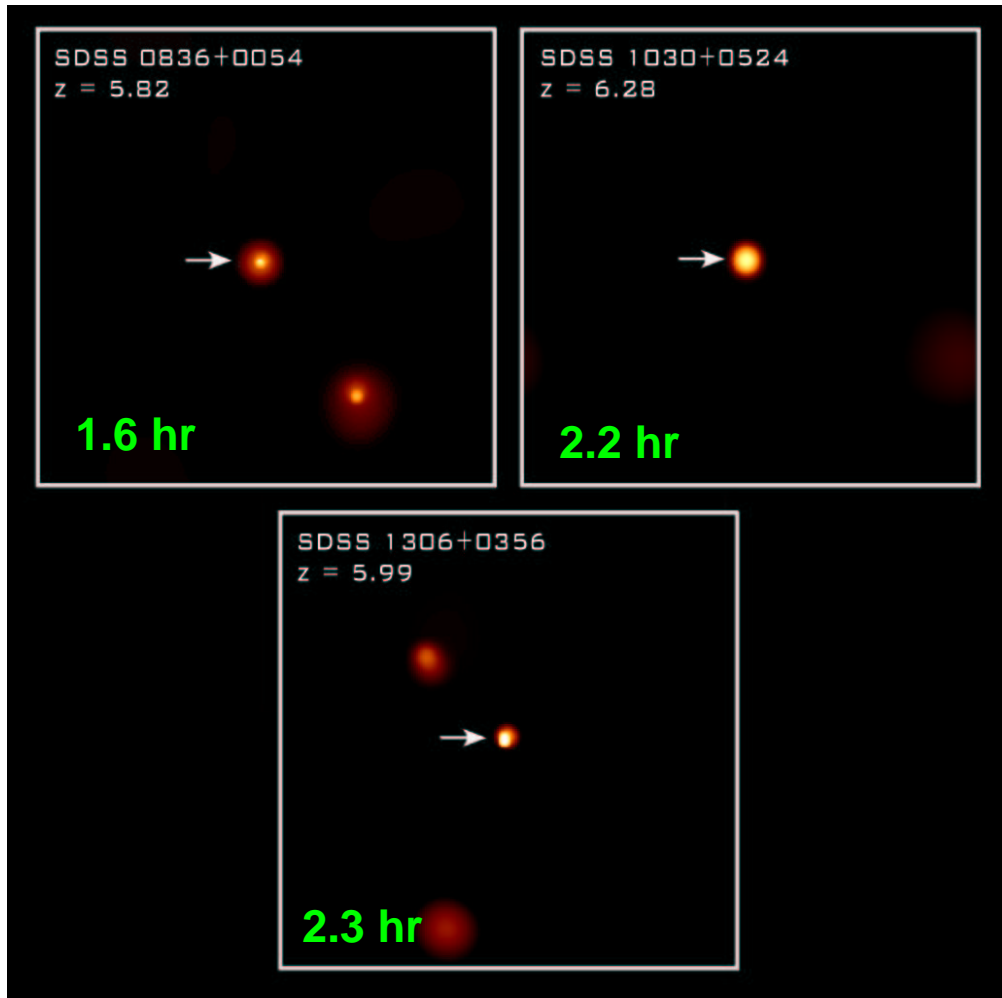
Evolution in the space density of luminous quasars from $z = 0-6$



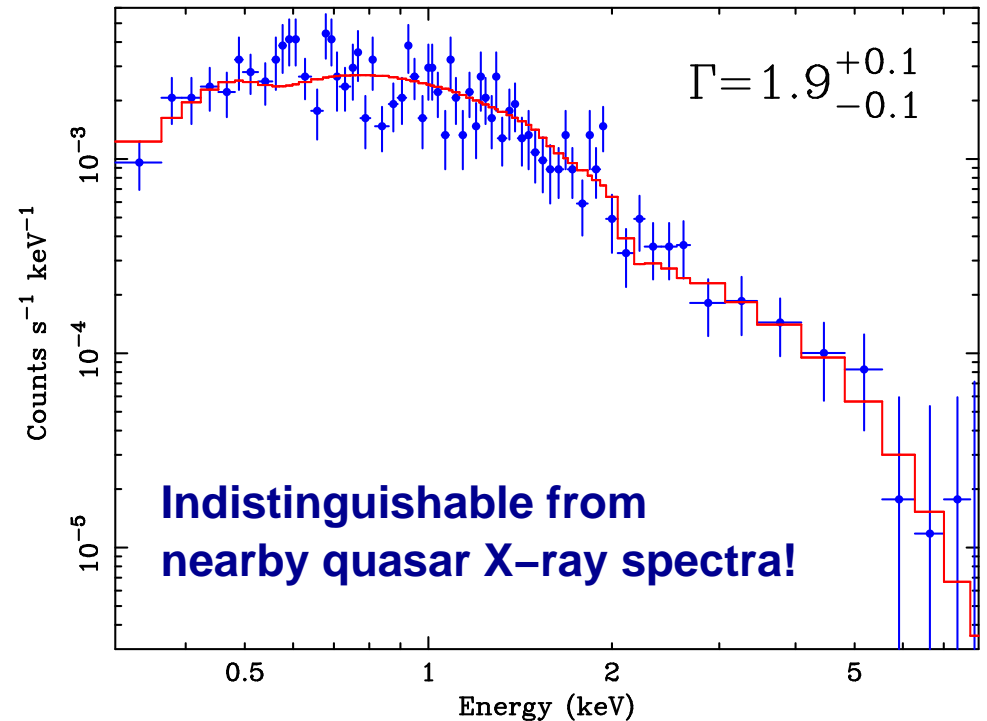
Sloan Digital Sky Survey



X-rays from the First Supermassive Black Holes



Combined Chandra X-ray spectrum of 46 quasars at $z > 4$



Quasar numbers evolve, individual quasars don't.
Black hole + gas = Same thing, every time!

The Chandra Deep Field–North

Chandra ACIS–I
1.95 Ms over 2.3 yr

Red: 0.5–2 keV

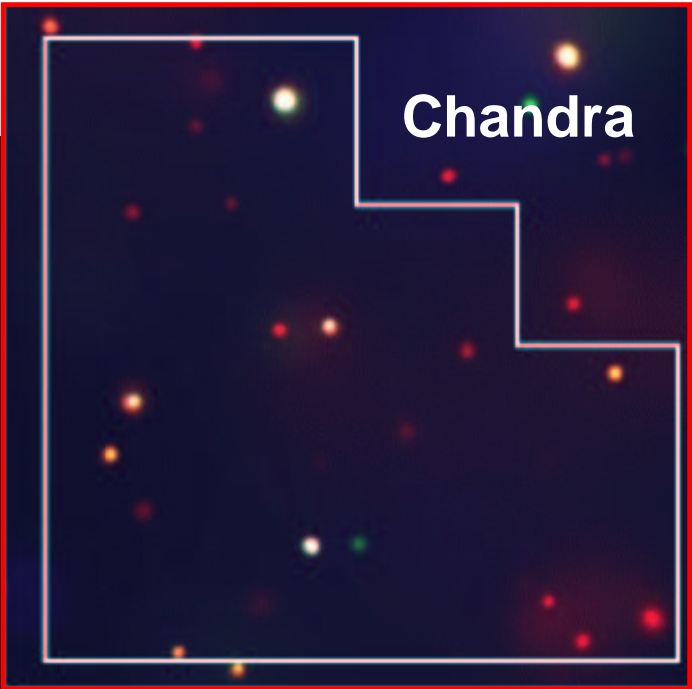
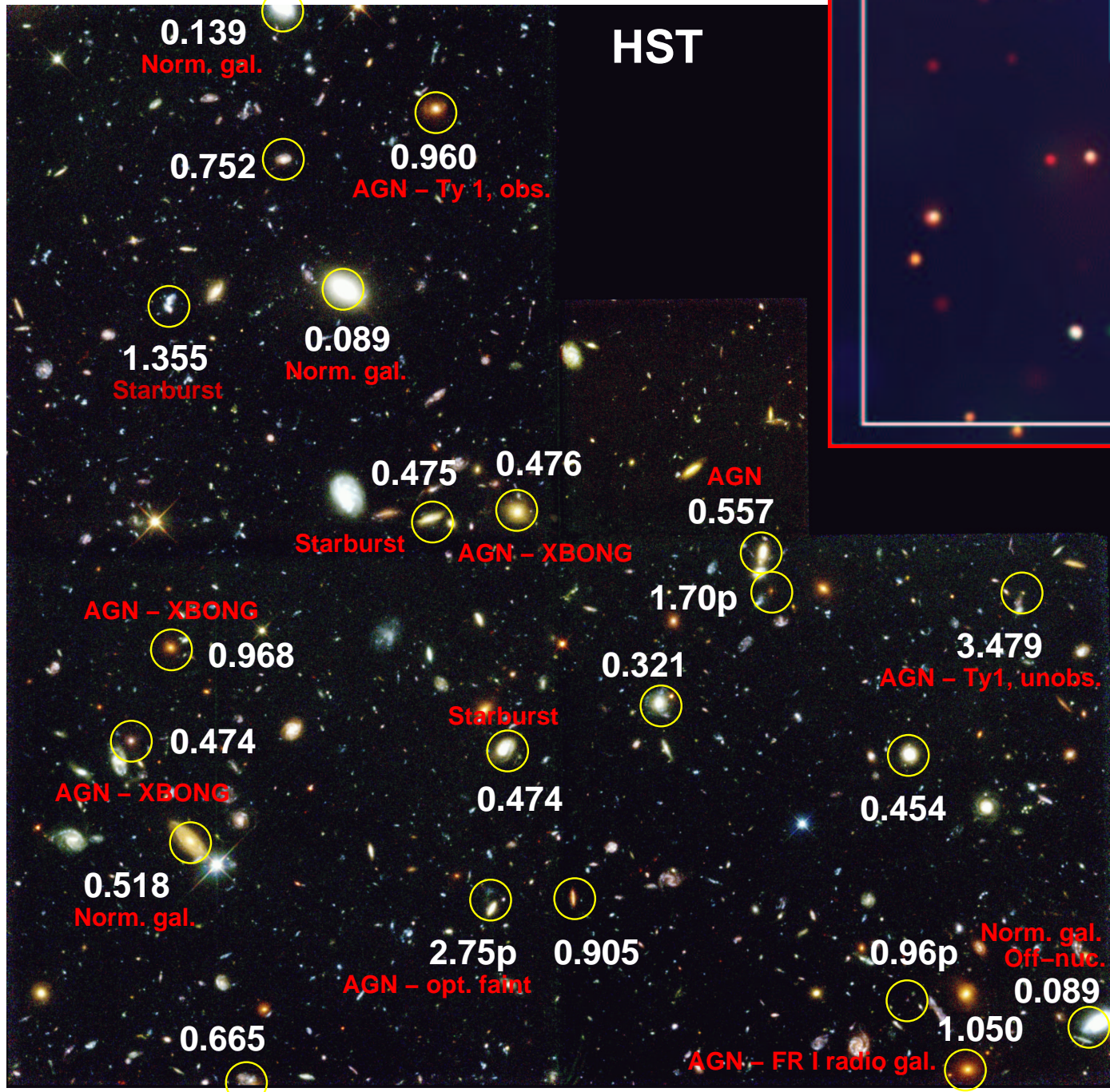
Green: 2–4 keV

Blue: 4–8 keV

448 arcmin²
(~ 60% Moon)

~ 582 point sources
~ 6–7 extended sources

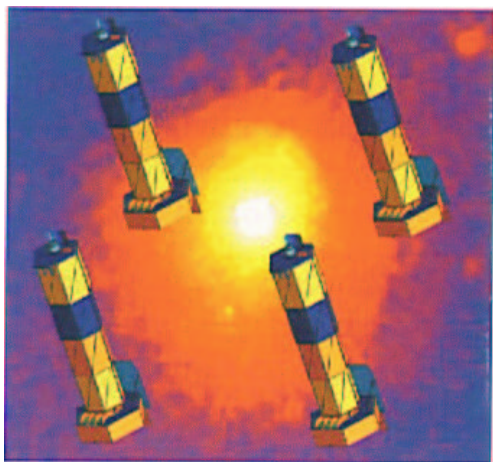
50–250 times the sensitivity of pre–Chandra surveys!



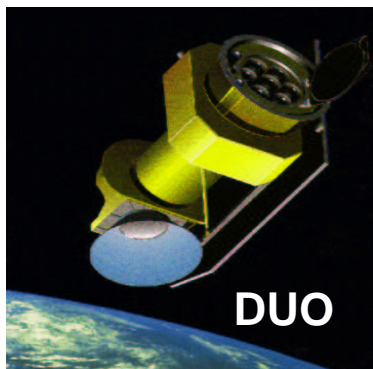
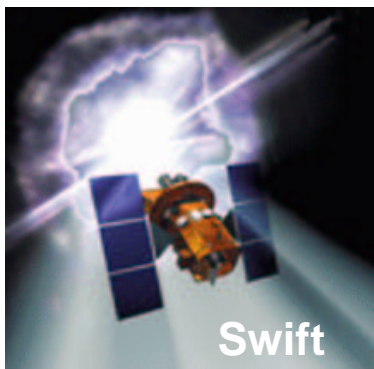
**Active galaxies
more numerous
and varied than
previously thought.**

Some Future Prospects and Upcoming Missions

Constellation-X



Small-to-Medium Missions



Long-Term, Large Missions

