# Spatial Distribution of the Galactic Diffuse X-Rays and the Spectral/Timing Study of the 6.4-keV Clumps

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**Talk by T. Tsuru
Posters B40, 44, 45**

6.4 keV (Neutral Fe)

6.7 keV (He-like Fe)

8--11 keV
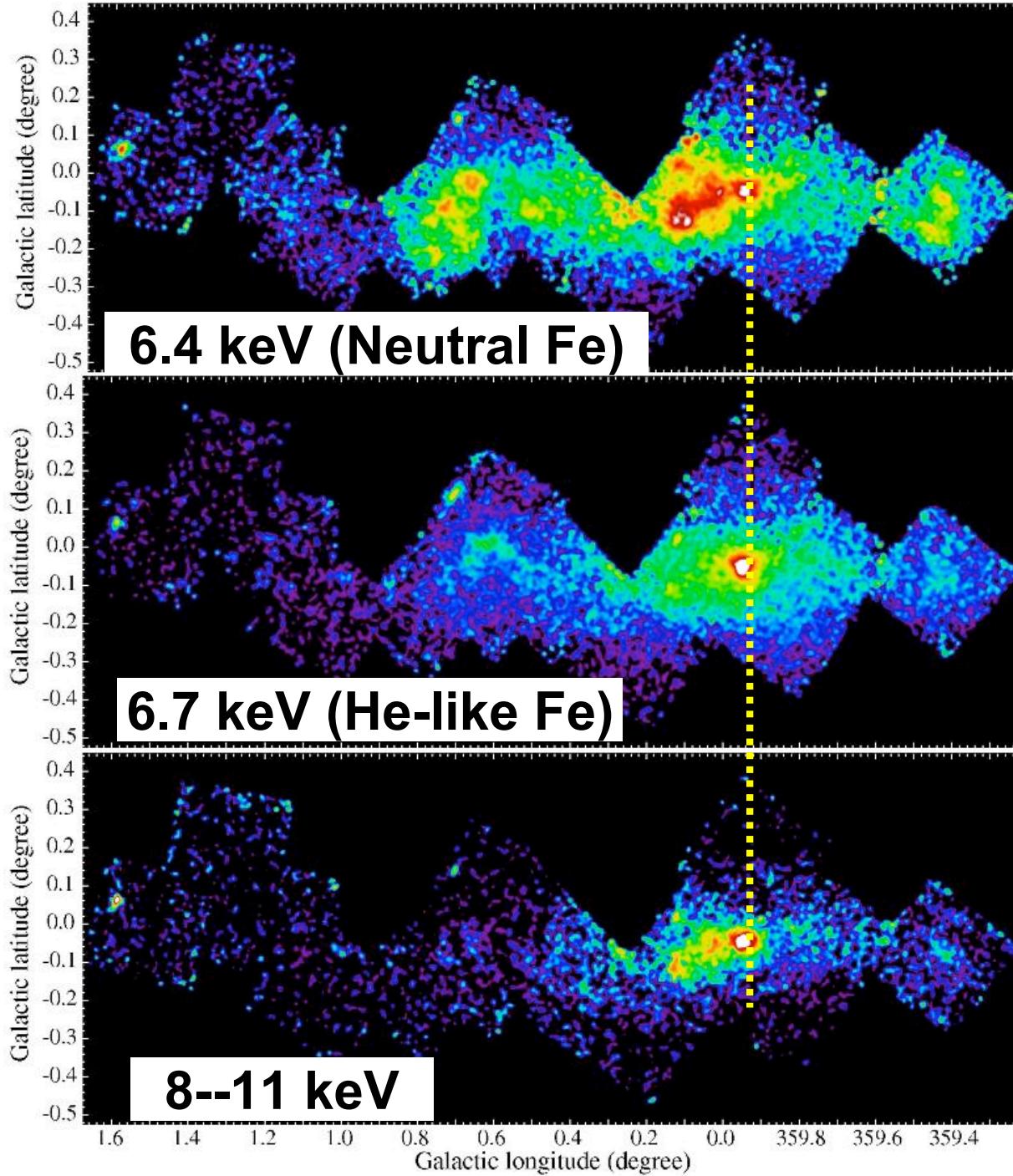
Suzaku X-ray Maps along the Galactic Center and Ridge (GC, GR)

Origin of the 6.4 (Neutral Fe) 6.7 (He-like Fe) 6.96 (H-like Fe) - keV lines and Continuum flux

**Diffuse ? or Integrated point sources ?**

The Galactic Center X-Rays (GCX) map near Sgr A*

East-West asymmetry of the Flux and Spectrum

GC
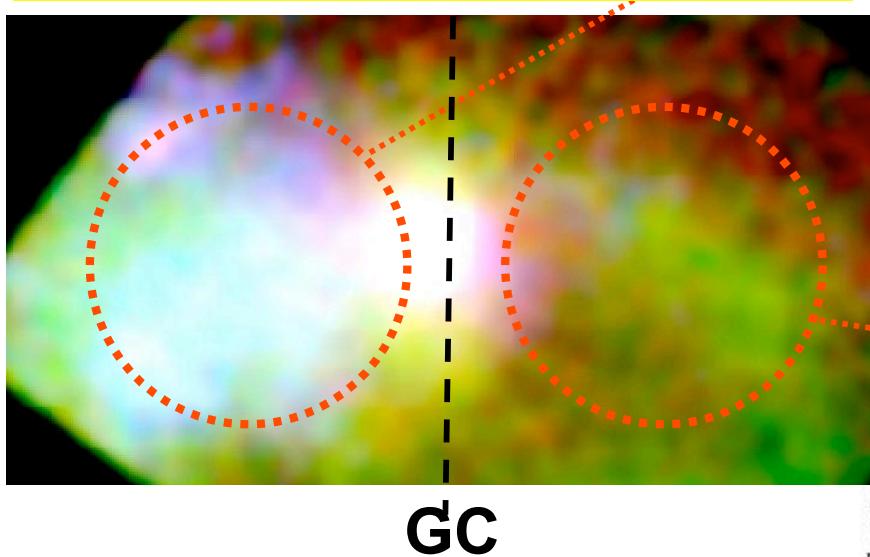
Red: 6.7 keV (He-like Fe)
Blue:6.4 keV (Neutral Fe)
Green: 2.45 keV(He-like S)

data and folded model
gc_src1_fi_noSacalreg_g900.pi

East

Counts s⁻¹ keV⁻¹

χ

Energy (keV)

data and folded model
gc_src2_fi_sym_LSAEa_calreg_grp500.pi

West

Counts s⁻¹ keV⁻¹

χ

Energy (keV)
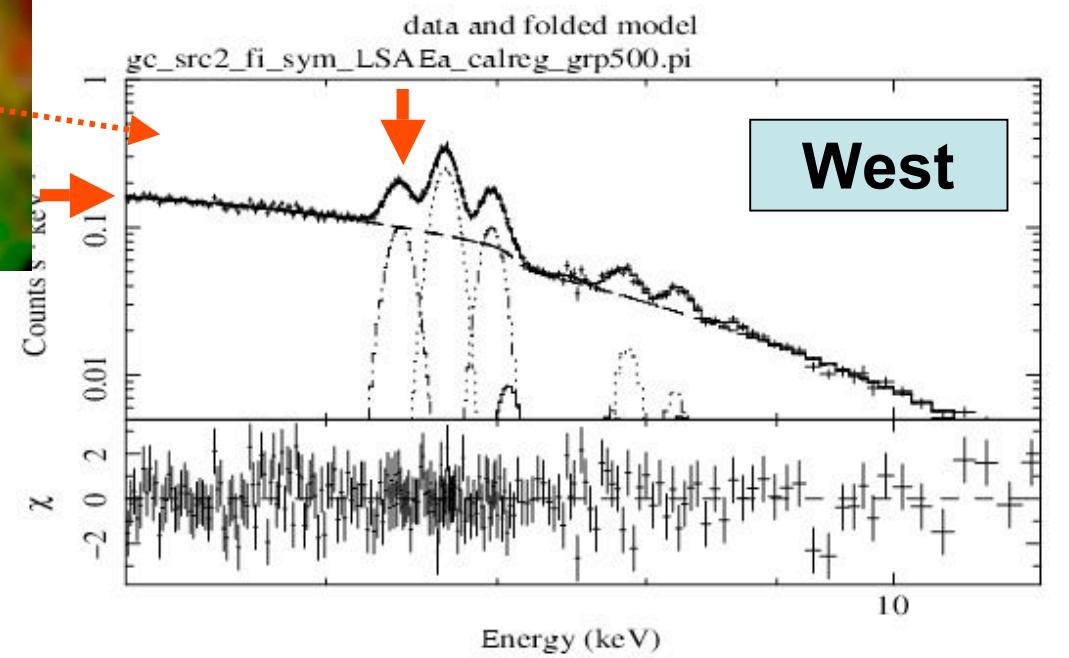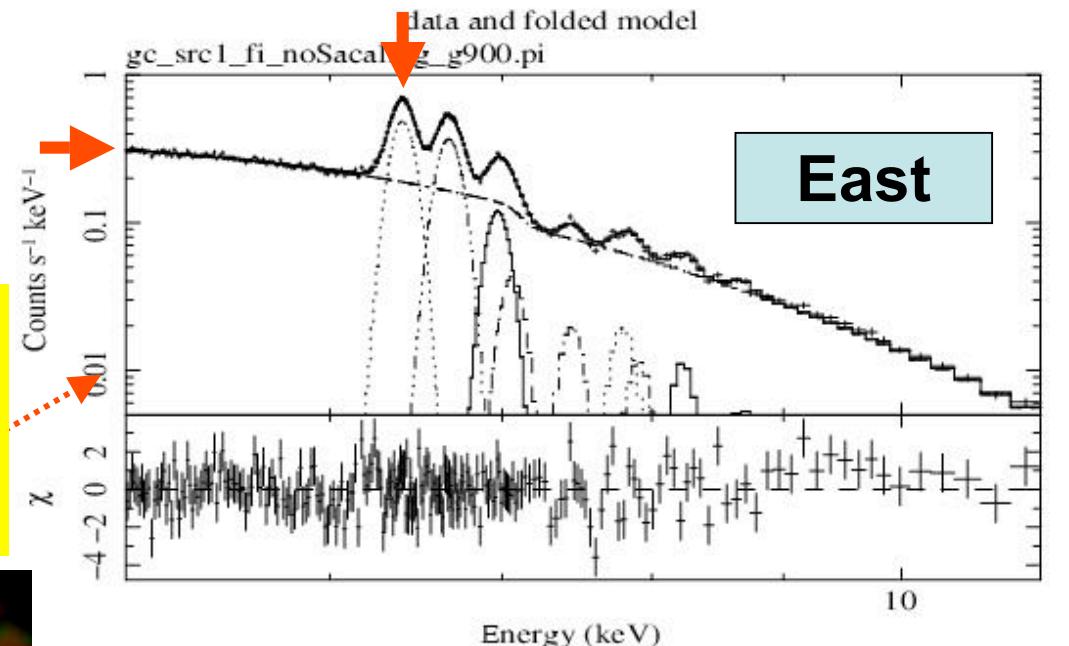
The 6.7 keV line flux *vs* Integrated point source flux (Chandra deep exposure) Near GC (|*l*| < 0.3 deg)

l-distribution

b-distribution

Sgr A*

Sgr A*

10 x 6.7 keV line (*EW*=0.5 keV)

Point source Flux (4.8-8 keV)

10^{-6} photons s^{-1}cm^{-2}arcmin^{-2}

Galactic longitude (degree)

Galactic latitude (degree)

Black: East
Red: West

6.7keV lines

6.96/6.7 keV

Black: East
Red: West

distance from SgrA* (degree)
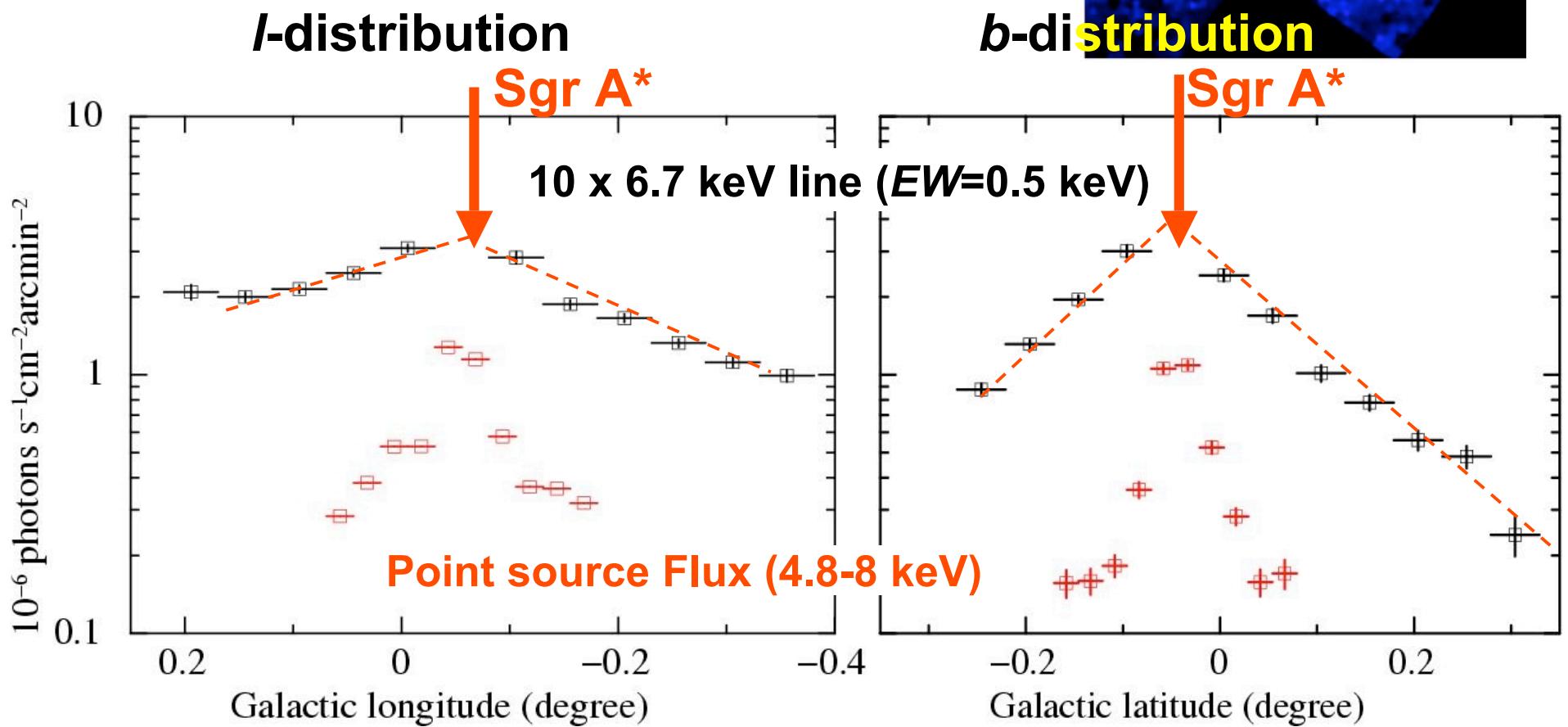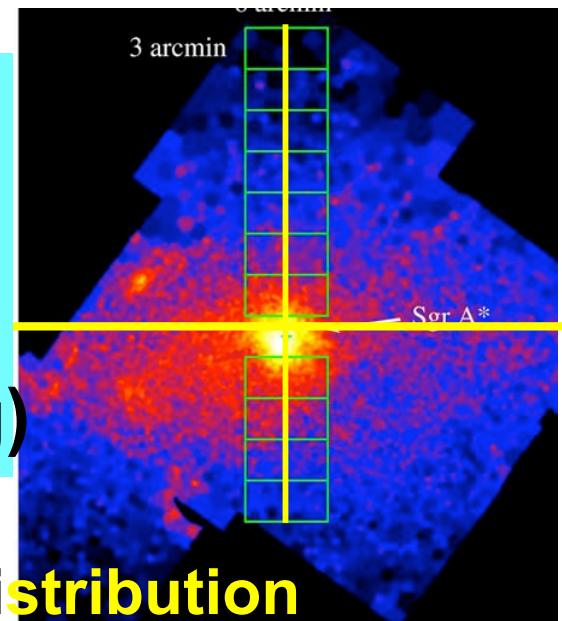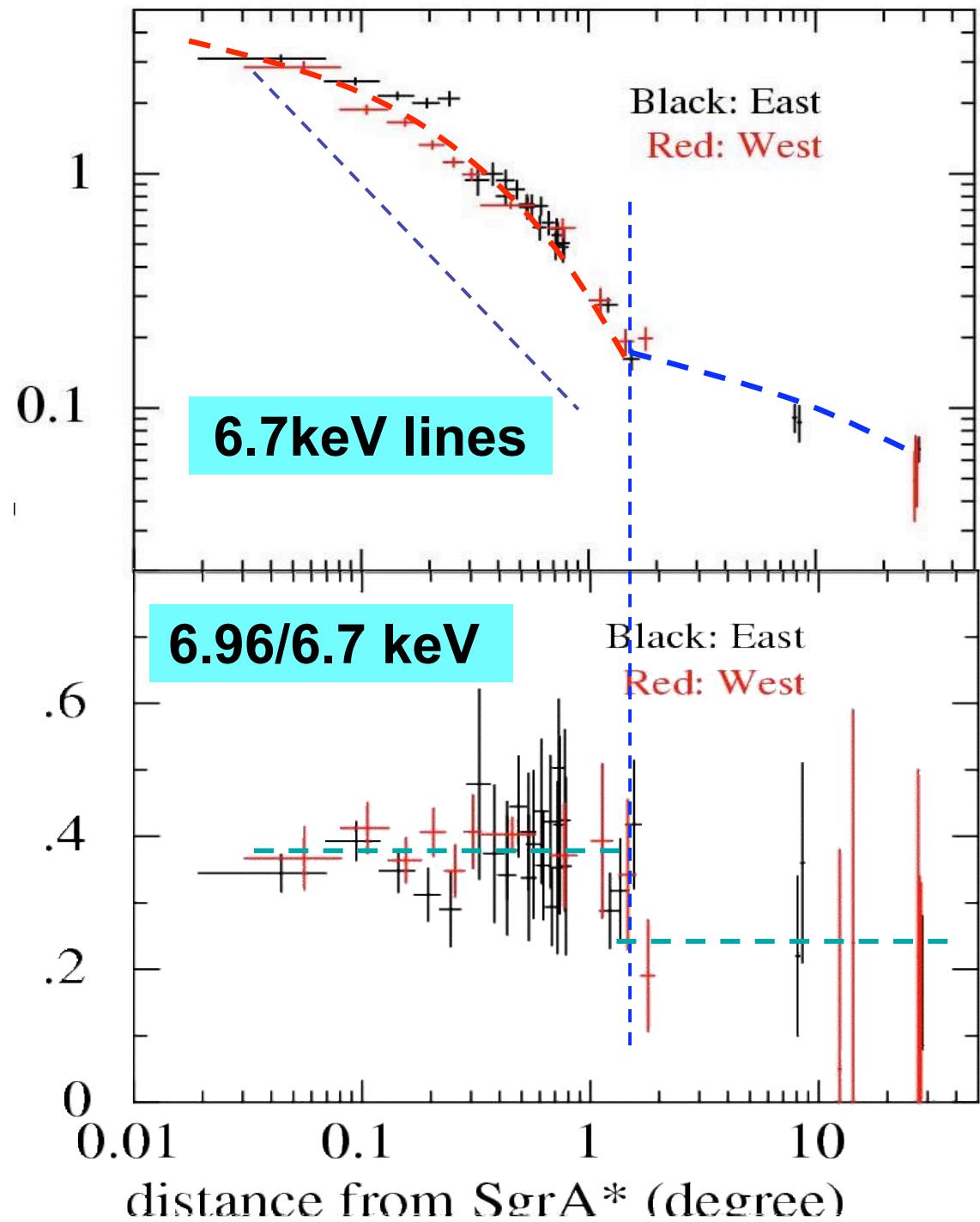
The 6.7 and 6.96 keV lines in GC and GR

6.7 keV line :
Exponential
HWHM ~ 0.2 deg

Point-sources:
power-law
index = 0.9
(Infrared star numbers,
Chandra point sources)

Temperature
$F_{6.96}/F_{6.7}$ ~0.3 --0.4 (GC)
~ 0.2--0.3 (GR)
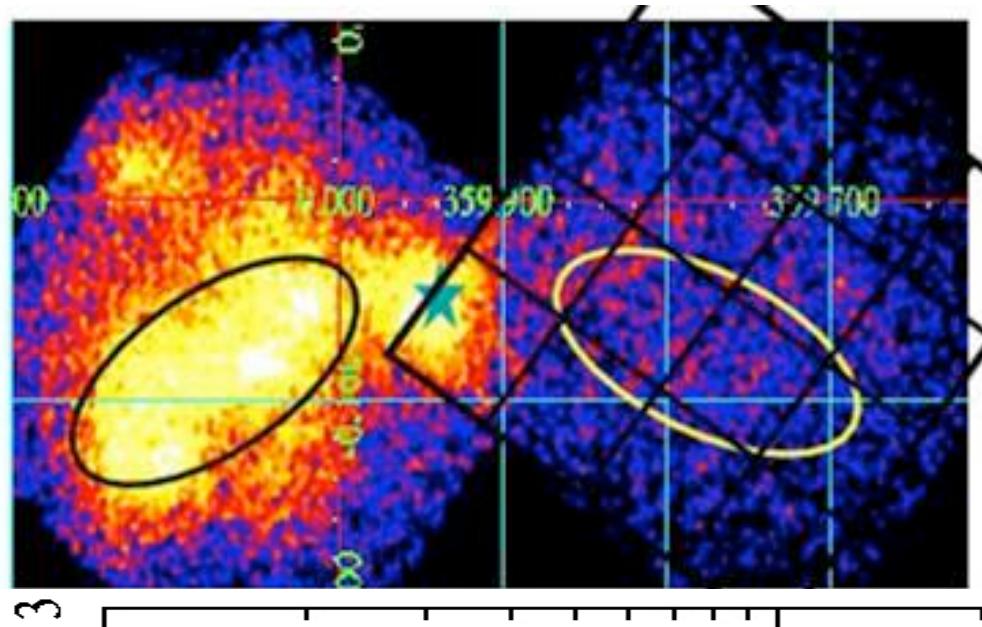
Made 2 x 16 spectra and fit with a model of Power-law + Gaussian lines.

Gamma, Fluxes (*F*) and Equivalent width (*EW*)

F_{5-10} : 5-10 keV band

$F_{6.4}$, $EW_{6.4}$: 6.4 keV line

$F_{6.7}$, $EW_{6.7}$: 6.7 keV line

$F_{6.4}/F_{6.7}$ vs *Gamma*
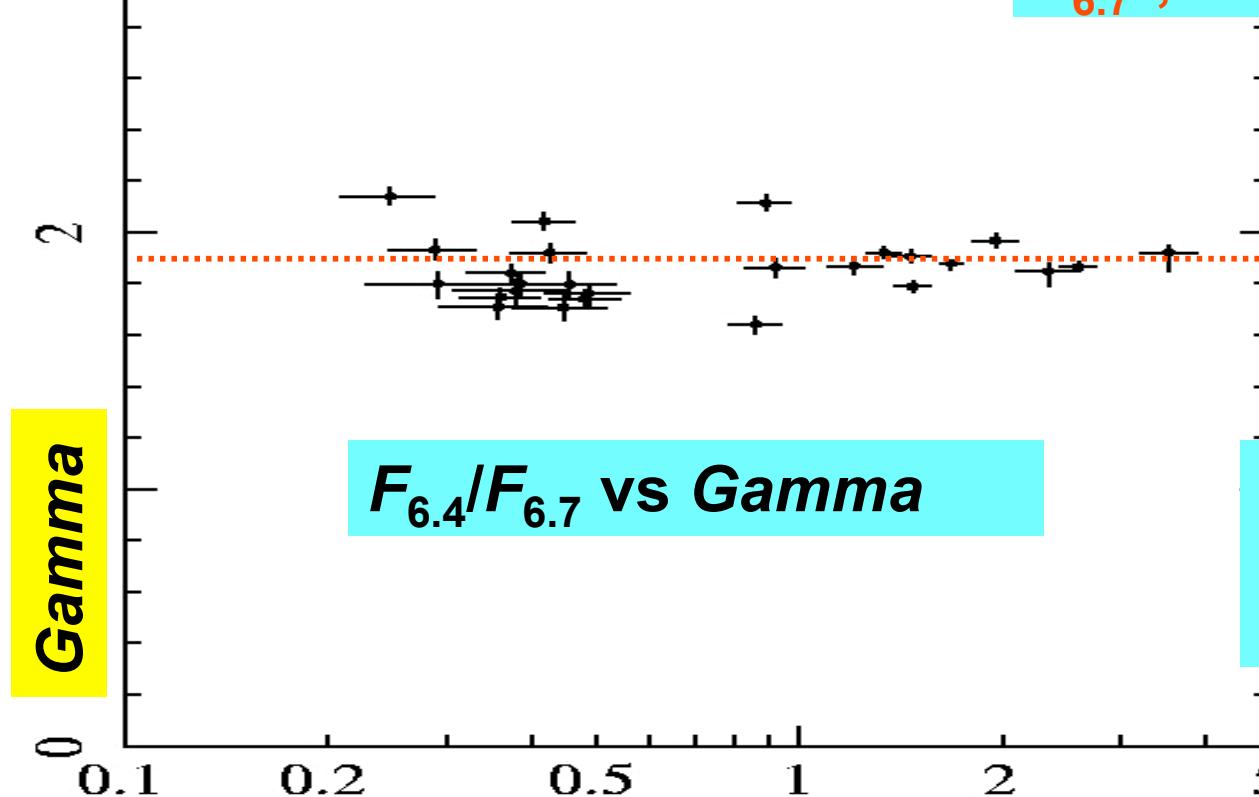
*Gamma* is constant (~1.9) (independent of $F_{6.4}/F_{6.7}$)

Keep this fact in your mind

$F_{6.4}/F_{6.7}$

$EW_{6.7}$+ 0.57 $EW_{6.4}$ = Constant

$100F_{6.7}$

$10\ F_{6.4}$

$F_{6.7}$ + 0.57 $F_{6.4}$

$F_{5\text{-}10}$

line flux(ph s^{-1} cm^{-2} arcmin^{-2})

flux (5−10 keV)(ergs s^{-1} cm^{-2} arcmin

6.7 keV EW (eV)
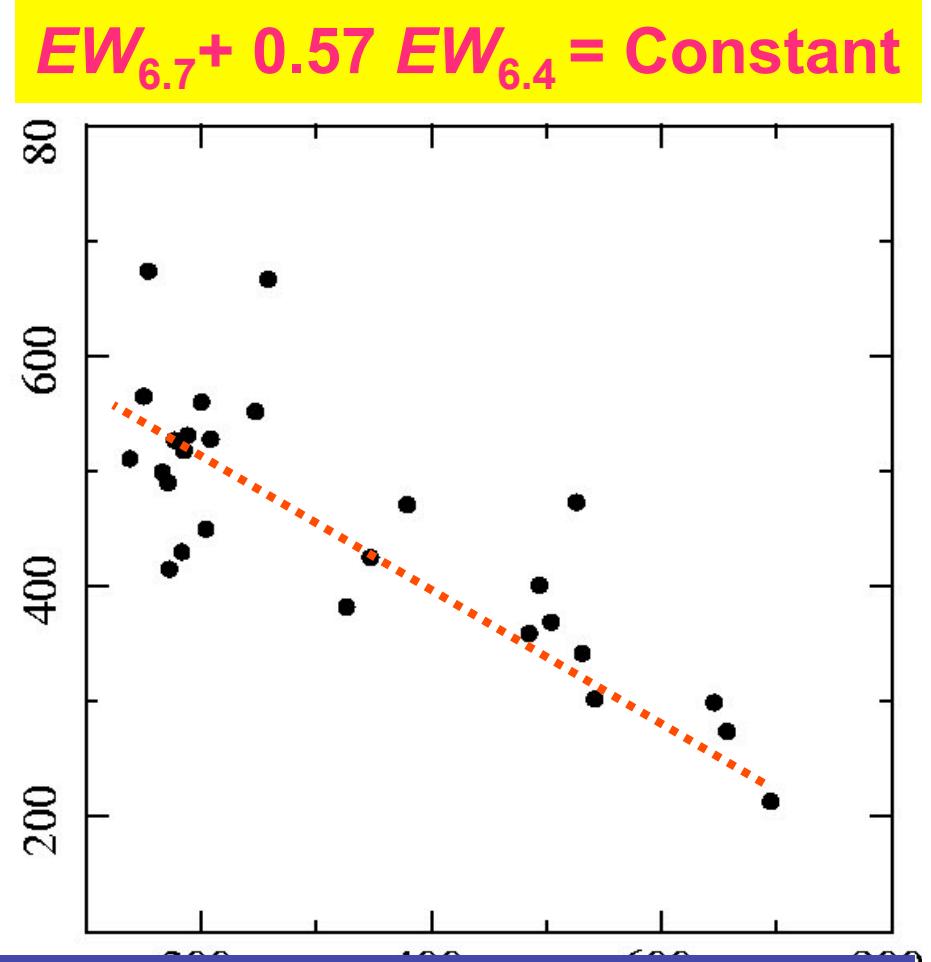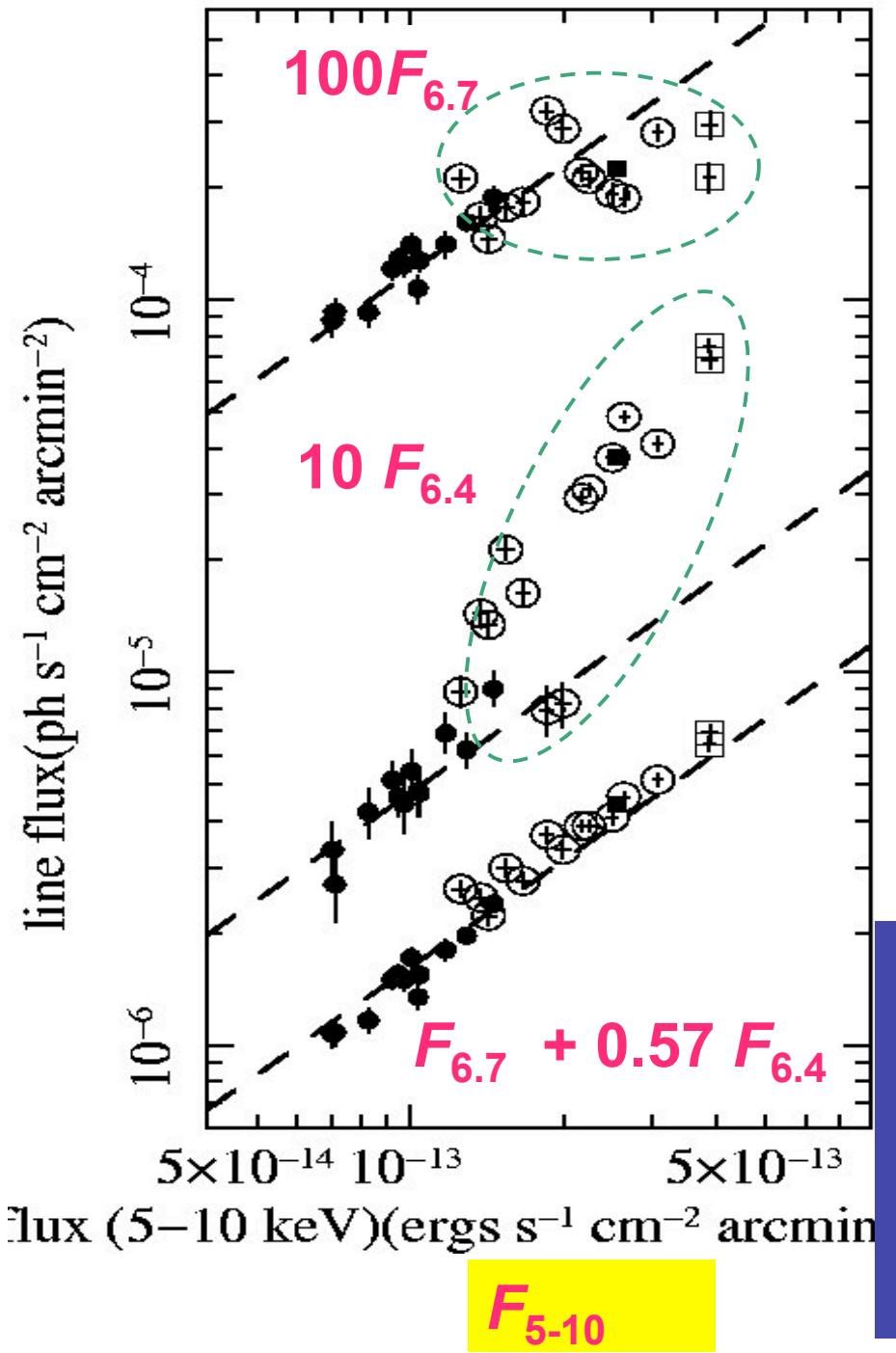
Phenomenologically, about 2/3 (~1/1.57) of the 5-10 keV flux is associated to the 6.7 keV line and the other 1/3 (~0.57/1.57) is associated to the 6.4 keV line.

F_{5-10} ~ 2* 6.7 keV line + 1*6.4 keV line

Gamma ~1.9

(independent of $F_{6.4}/F_{6.7}$)

kT=6.5 keV
gamma= 1.4

6.5 keV plasma (*gamma*= 2.4)

(2x2.4+0.9)/3 = 1.9

6.7 Cont (*gamma*= 1.9)

Point (*gamma*= 0.9)

6.4 Cont (*gamma*= 1.9)
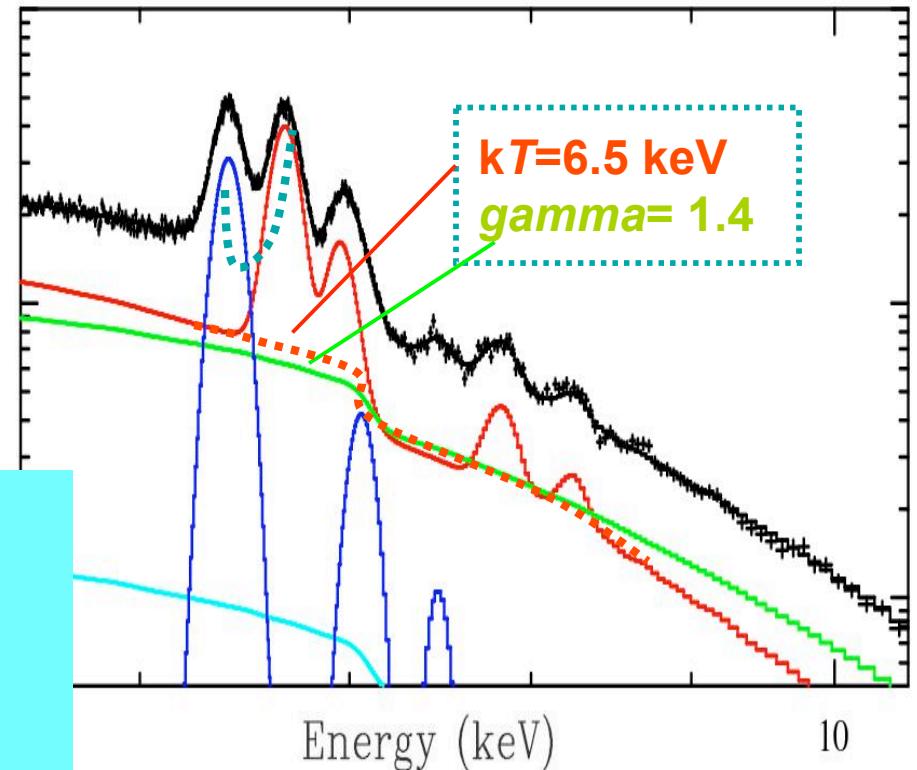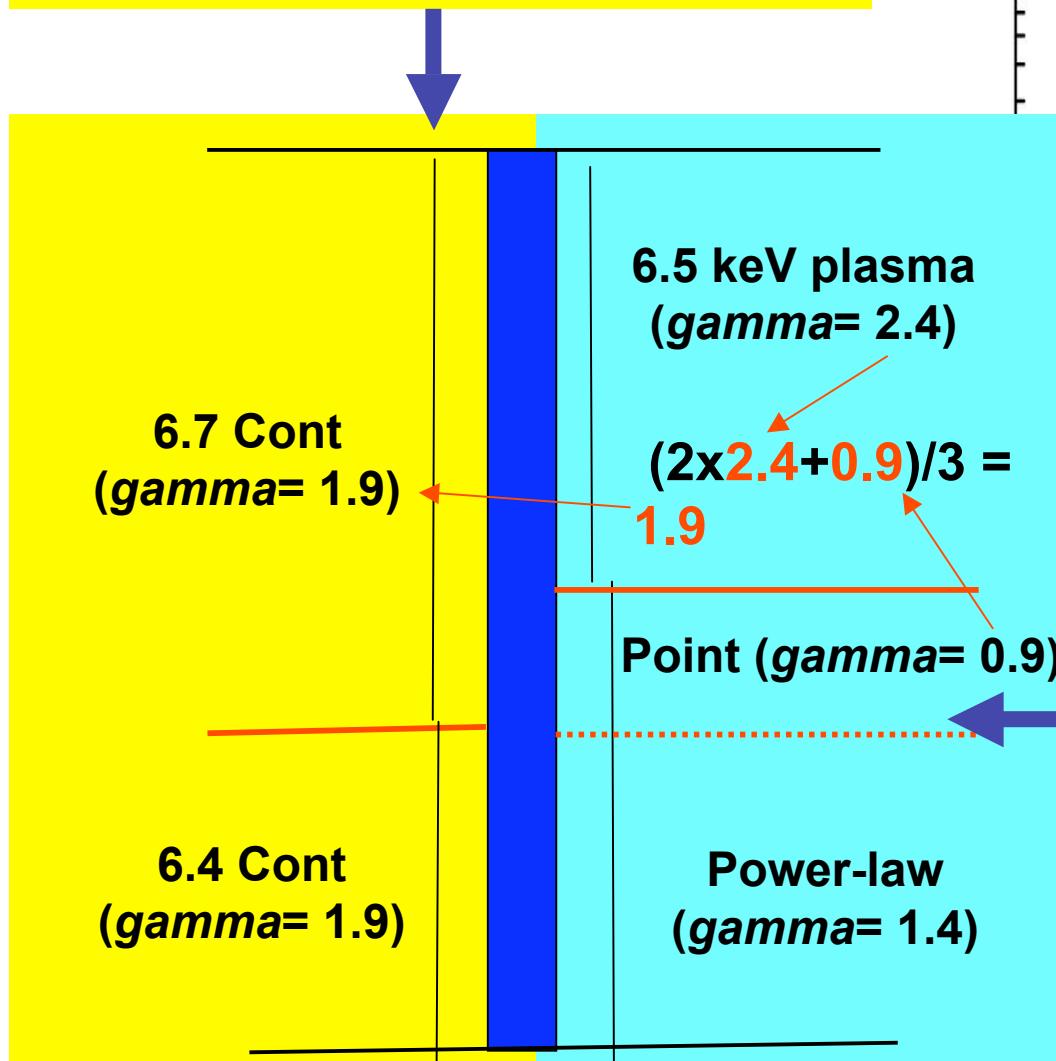
Power-law (*gamma*= 1.4)

6.5 keV Plasma (*gamma* ~ 2.4) = Power law (*gamma* ~ 1.4)

$F_{6.4}$ ~ $F_{6.7}$

Energy (keV)   10

Chandra (Muno *et al.*2004)

6.7keV

diffuse

point source

< 20% of GCX
Gamma=0.9

1/6

6.4keV
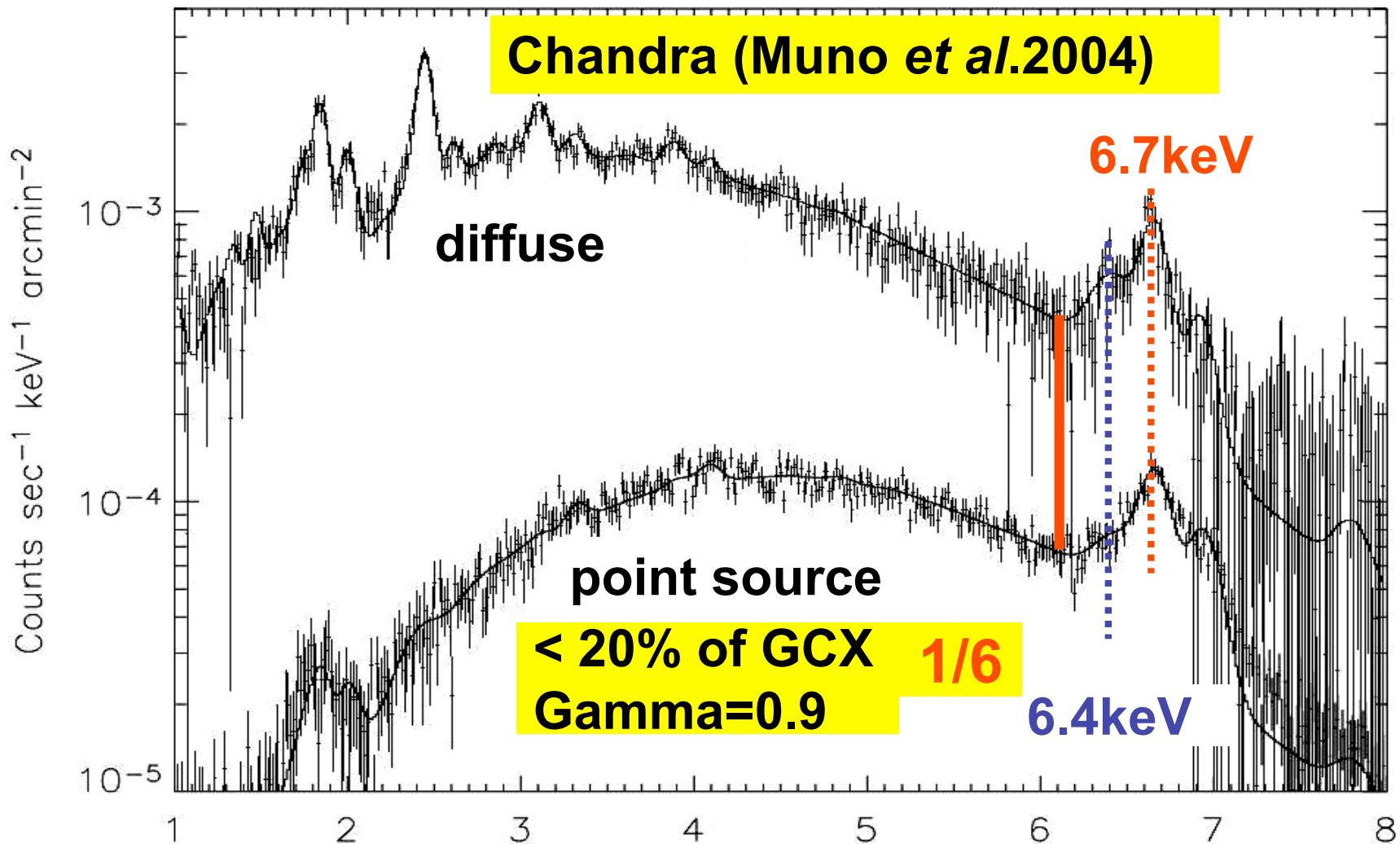
Point Source Contribution ~ 1/6 of total (Minimum)
Strong 6.7 keV line, Gamma=0.9

Point source spectrum has an $EW_{6.7}$ ~ 0.4 keV,
and $EW_{6.4}$ ~ 0.1 keV.

EW$_{6.7}$

EW$_{6.4}$

Magnetic CVs

6.7 keV EW (eV)

6.4 keV EW (eV)
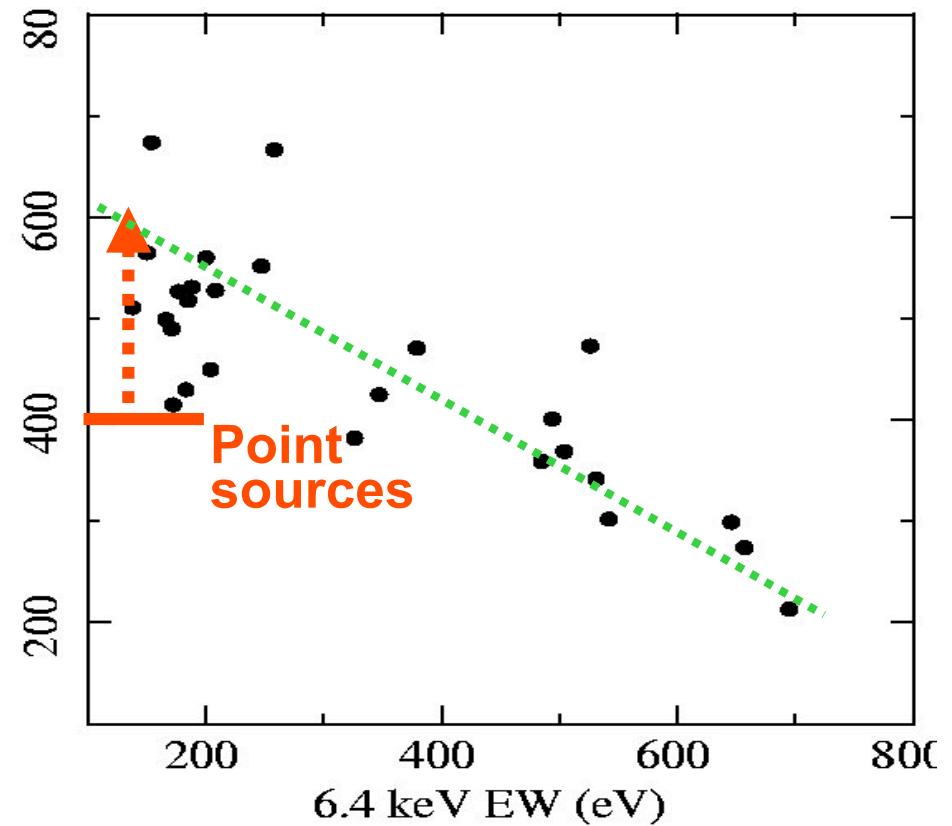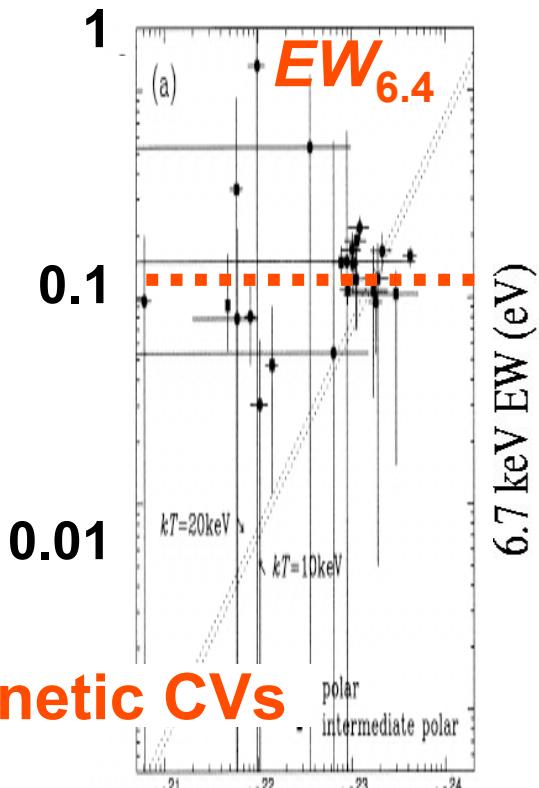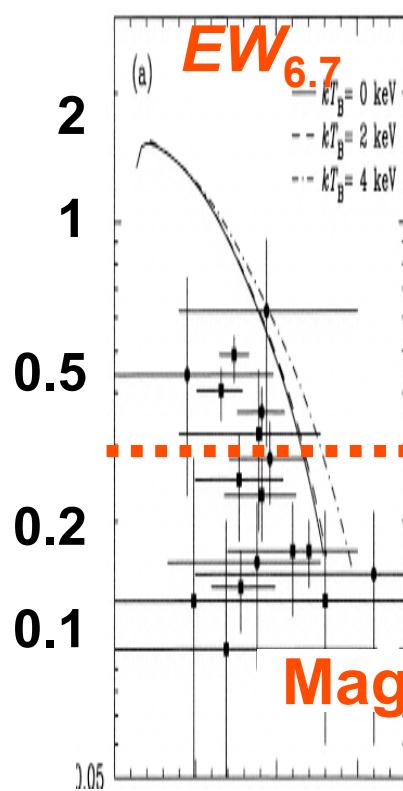
Point sources

Point source spectrum (CV) has, EW$_{6.4}$ ~ 0.1-- 0.2 keV and EW$_{6.7}$ ~ 0.3-- 0.4 keV

(Ezuka et al. 2002)

Point source spectrum (GC) has EW$_{6.4}$ ~ 0.1 keV, and EW$_{6.7}$ ~ 0.4 keV.

(Muno et al. 2004)

Point source spectrum must have Gamma ~1.9 inconsistent with ~0.9 (Chandra, Muno et al.)

6.4 keV Line is time variable.

A Clump near Sgr A*
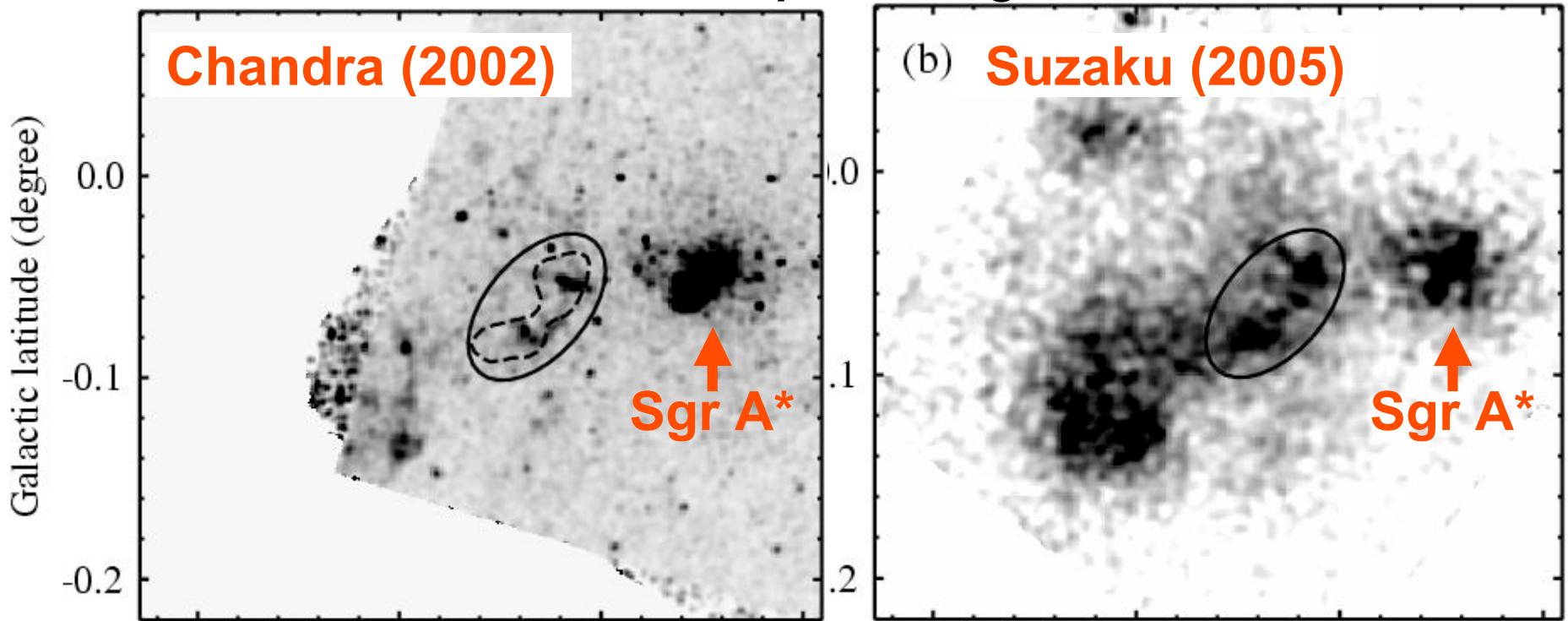
|	Chandra (2002)	Suzaku (2005)
6.4 keV line	$7.83_{-0.14}^{+0.14}$	$6.89_{-0.14}^{+0.12}$ *

$(10^{-5}$ photons s^{-1}cm$^{-2})$

* 4.7 sigma variability   (1.5 sigma for the 6.7 keV line)

The Sgr B2 Cloud

Half-decay life
of the 6.4 keV flux
~15 ys
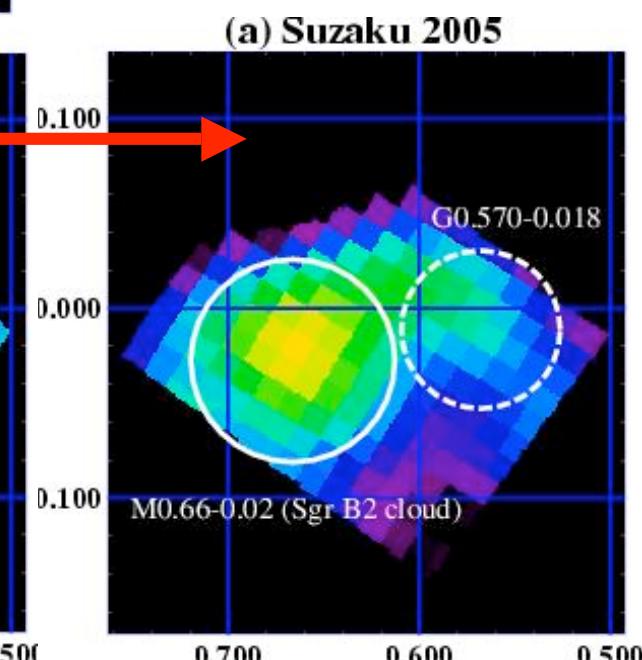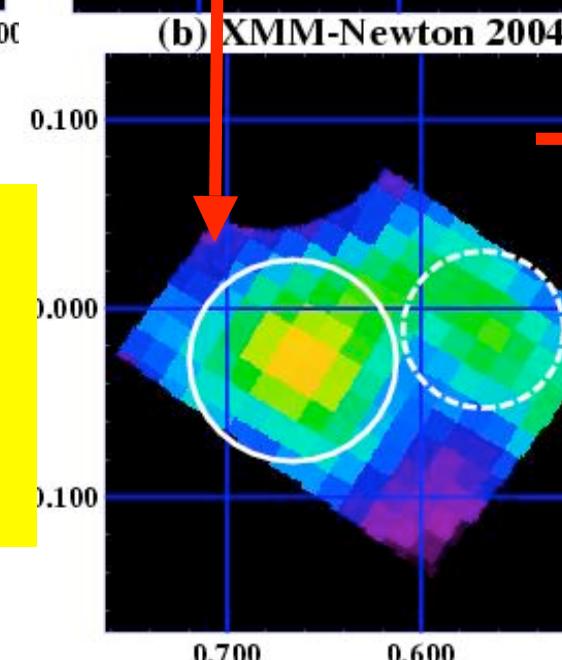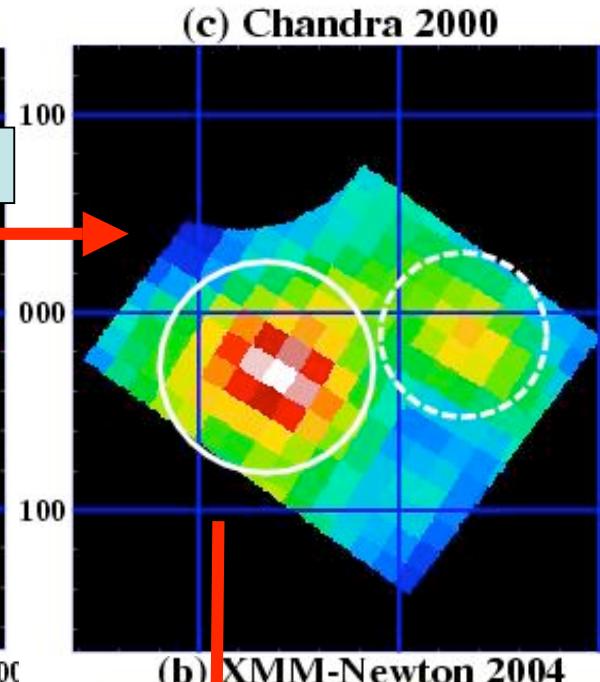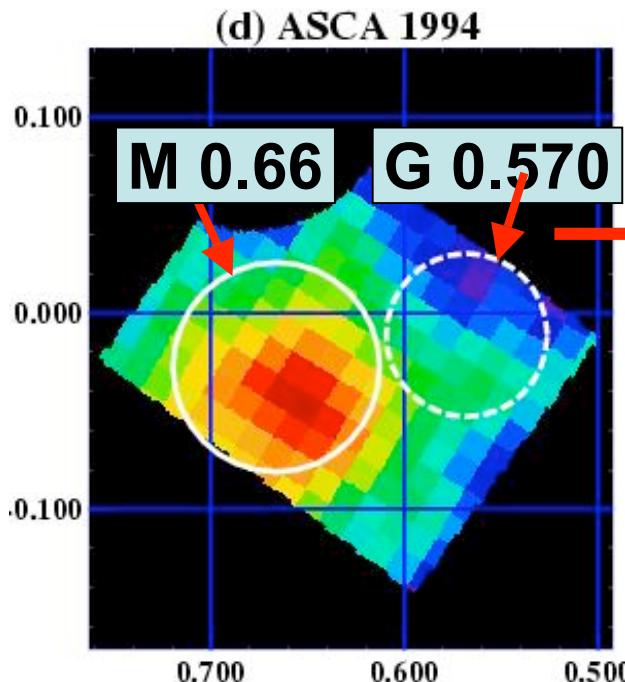
~10pc

This flux
change can not
be explained
by point sources

(d) ASCA 1994

M 0.66   G 0.570

(c) Chandra 2000

(b) XMM-Newton 2004

(a) Suzaku 2005

G0.570-0.018

M0.66-0.02 (Sgr B2 cloud)

Conclusions of the analysis of spatially divided X-ray spectra;

(1) Integrated flux of point sources contributes ~1/6 at least, but less than 2/3 of the total Galactic center X-rays (GCX).

(2) Major fraction of the GCX is diffuse .

(3) Plasma temperature of the GC is probably higher than that of the GR.

(4) 6.4 keV line clumps are time variable, hence the origin is not point sources .