Spectroscopic Study of the Galactic Center X-Rays with Suzaku Katsuji Koyama, Kyoto University

- (1) Origin of 6.7/6.9 keV Lines
 - : Collisional Excitation or Charge Exchange
- (2) Discoveries of New SNR Candidates
- (3) Origin of 6.4 keV Line
 - : X-Ray Reflection or Electron Bremsstrahlung
 - : Time Variability of the 6.4 keV clumps.

Energy Scale Check Using the H-like Lya \rightarrow and Neutral Ka \rightarrow



Origin of 6.7/6.9 keV Line Charge Exchange or Collisional Excitation ?





Plasma Parameters

Ionization Temperature (kTi) Fe Ka H-like/He-like: kTi=6.5 keV +/- 0.1 keV Fe Kb H-like/He-like: kTi=5.1 keV + 1.5 -1.0 keV Ni Ka H-like/He-like : kTi=9.3 keV +1.6 -2.5 keV Electron Temperature (kTe) He-like Fe Kb/Ka : kTe=6.2 keV +3 -1 keV H-like Fe Kb/Ka : kTe > 6.5 keV (lower limit)

(Centroid of He-like K α moves with Ionization temperature due to the satellite lines) The Center Energy of Ka (He–like) : kTi= $2.5 \sim 6.5$ keV

All the results are consistent with the plasma of kTi ~ kTe=6.5 keV.

2. Discovery of New SNR Candidates



3. Discovery of 6.4 keV clumps Origin of the 6.4 keV clumps Is this Inner shell Ionization by Electrons or X-rays ?





All

show Ka, Kb, and K-edge absorption have equivalent width of 1.1 - 2.1 keV have K-edge absorption of 1.8 - 9.6 x 10²³ cm⁻² >> 1 x 10²³cm⁻² (the interstellar absorption to the GC)

Thus X-ray ionization is more likely.

We further observed large time variability





Since physical size of this region is nearly 10 pc, such a large flux change within a few year is impossible by any charged particle.

Only possible scenario of this time variability is due to a irradiation of variable X-rays (X-ray Reflection Nebula)

More than a few hundred years ago, Sgr A* had been very active in X-rays; it was 10⁶ times brighter than present at ~300 years ago, and decayed to less than a half after ~5 years. The X-rays hit the Sgr B clouds after ~300-years travel. The clouds reemitted the 6.4 keV photons. Like a time delayedecho, the echo is now just arriving at the Earth, when Sgr A* is falling into a quiescent state.

Conclusion of the Galactic Center Diffuse X-rays

(1) Origin of 6.7/6.9 keV Lines High Temperature Plasma in CIE

(2) We Discovered New SNR Candidates

(3) Origin of the 6.4 keV Line
X-Ray Reflection
The 6.4 keV clumps near Sgr B2 are time
Variable reflecting an Outburst of Sg A*.