

# Suzaku wide-band observations of black-hole binaries and AGNs : continuum and Fe-K lines



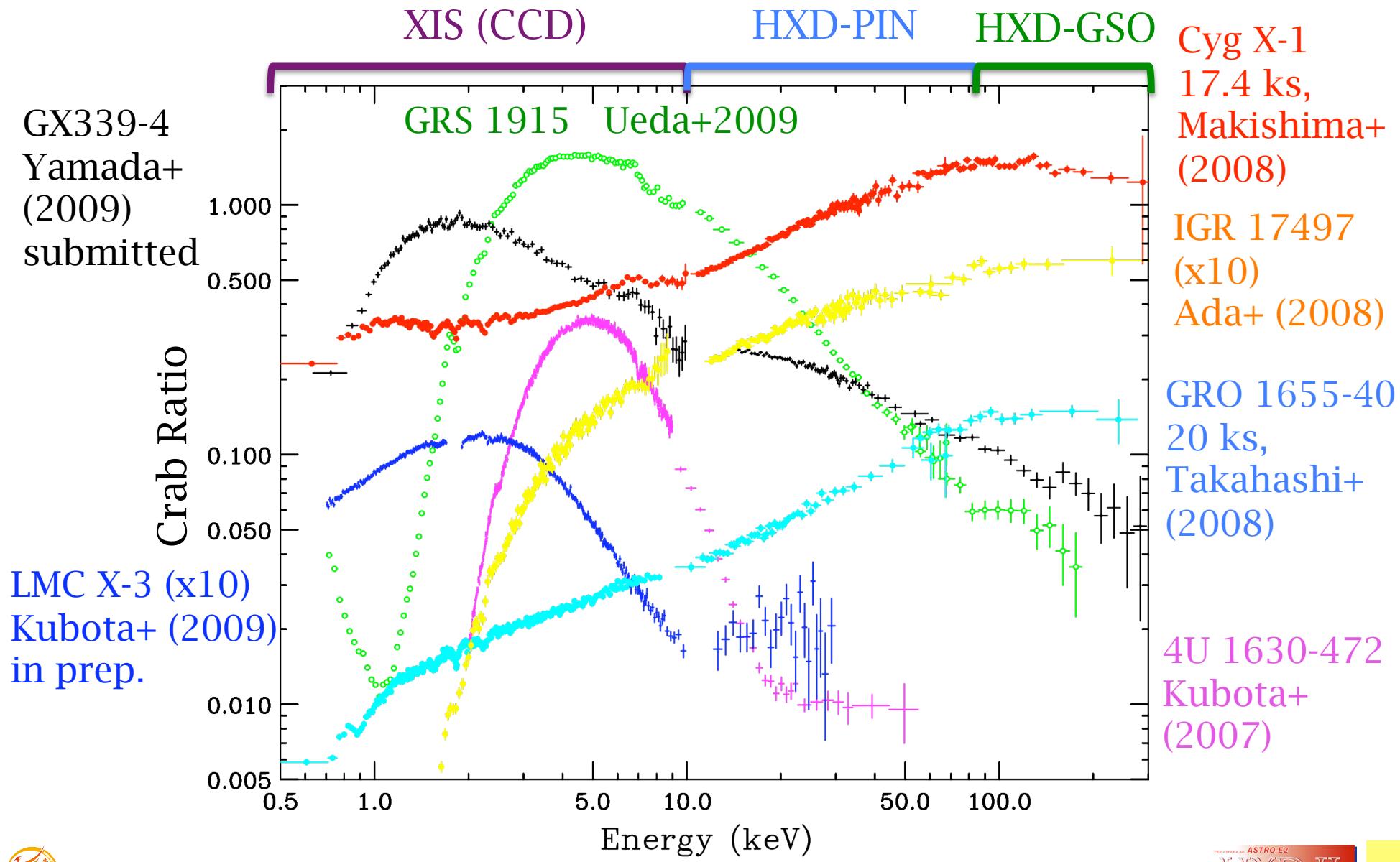
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Y. Ueda<sup>(5)</sup>, and C. Done<sup>(7)</sup>

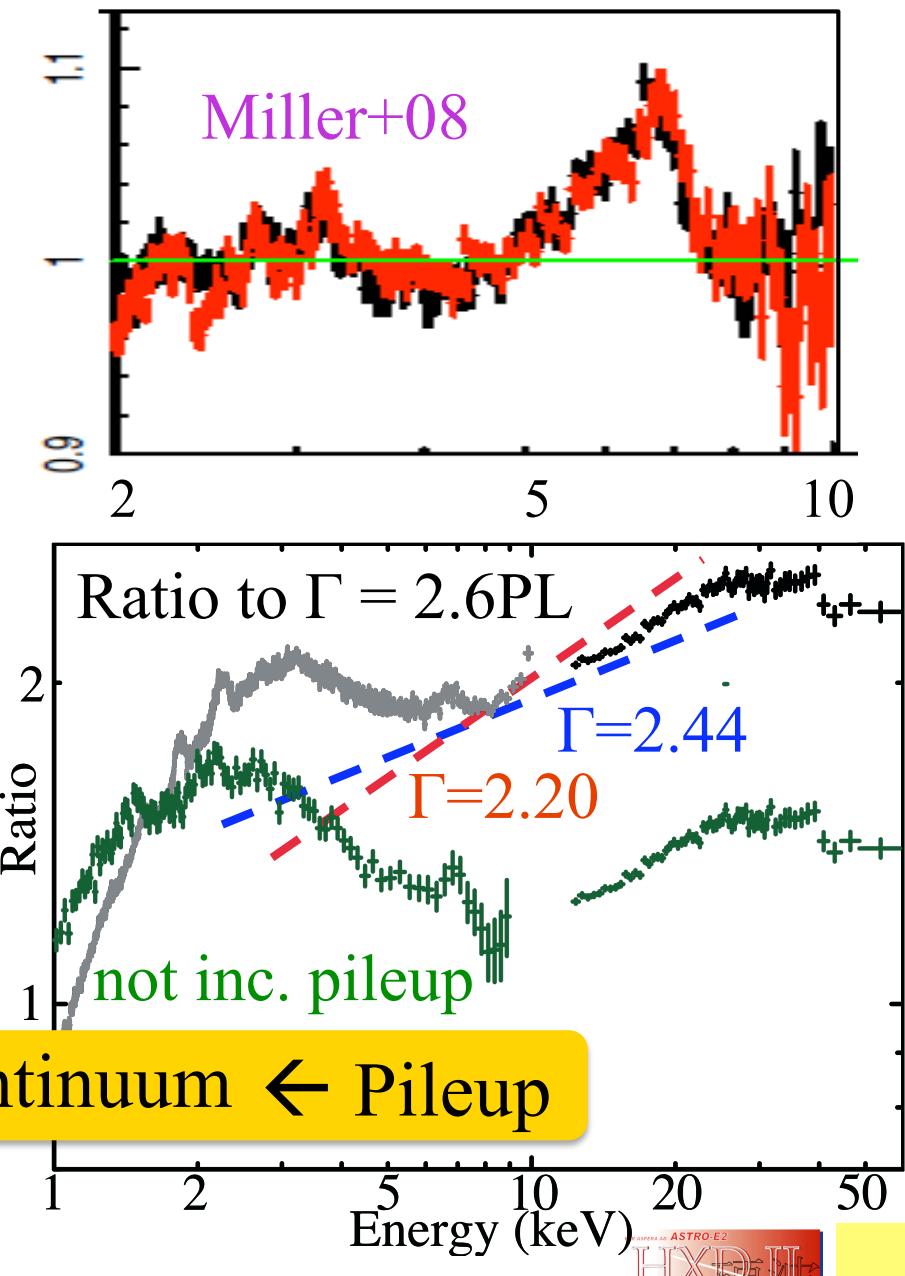
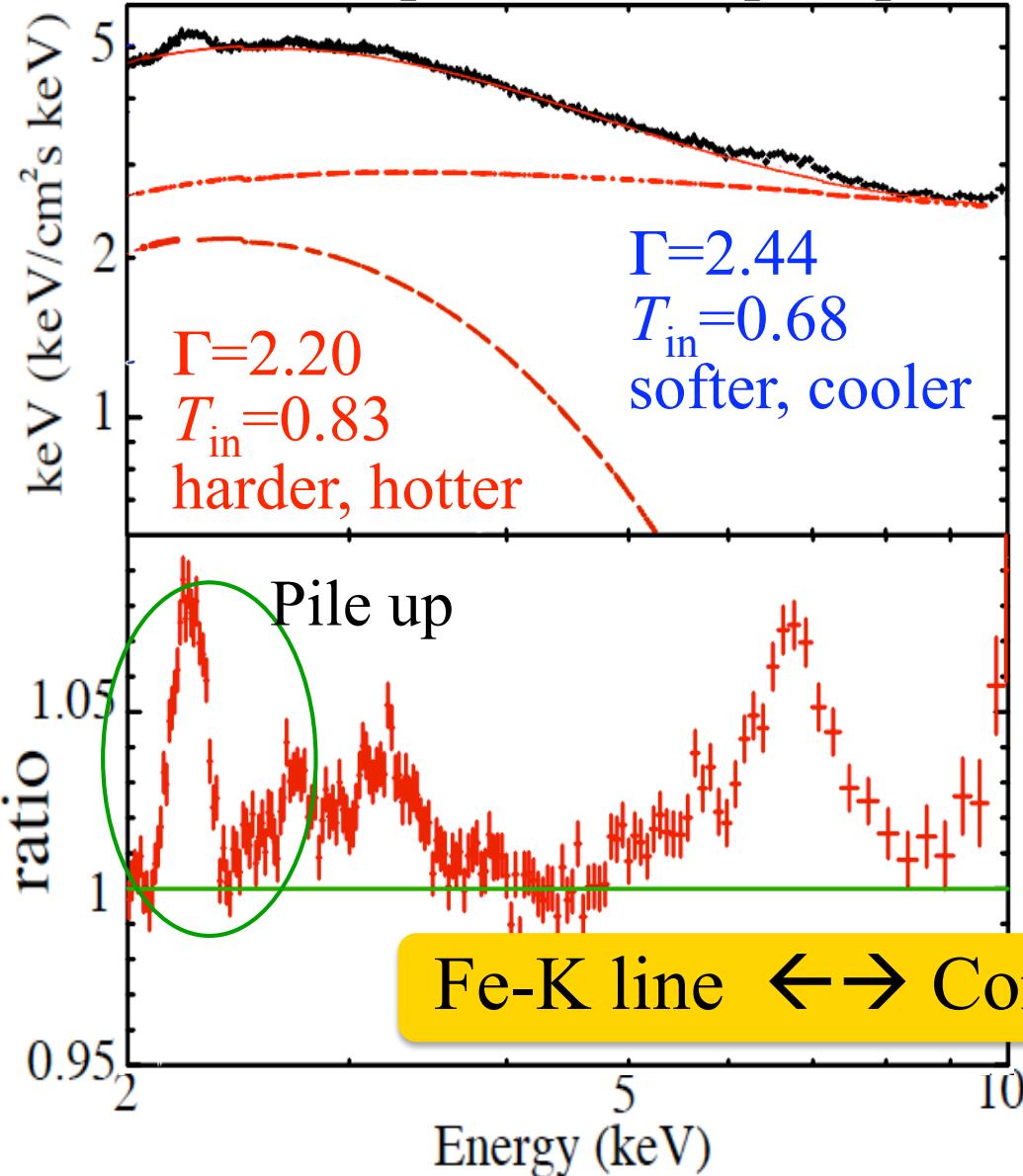
- 1) The University of Tokyo 2)RIKEN, 3) Hiroshima University 4) ISAS/JAXA,  
5) Kyoto University, 6) Shibaura Institute of Technology, 7) University of Durham

# Beautiful Suzaku wide-band spectra



# GX 339-4 (VHS) with Suzaku

XIS spectrum inc. pileup



<http://www.astro.isas.ac.jp/suzaku/analysis/xis/>

[Top](#) > [Suzaku](#) > [Data Analysis](#) > XIS

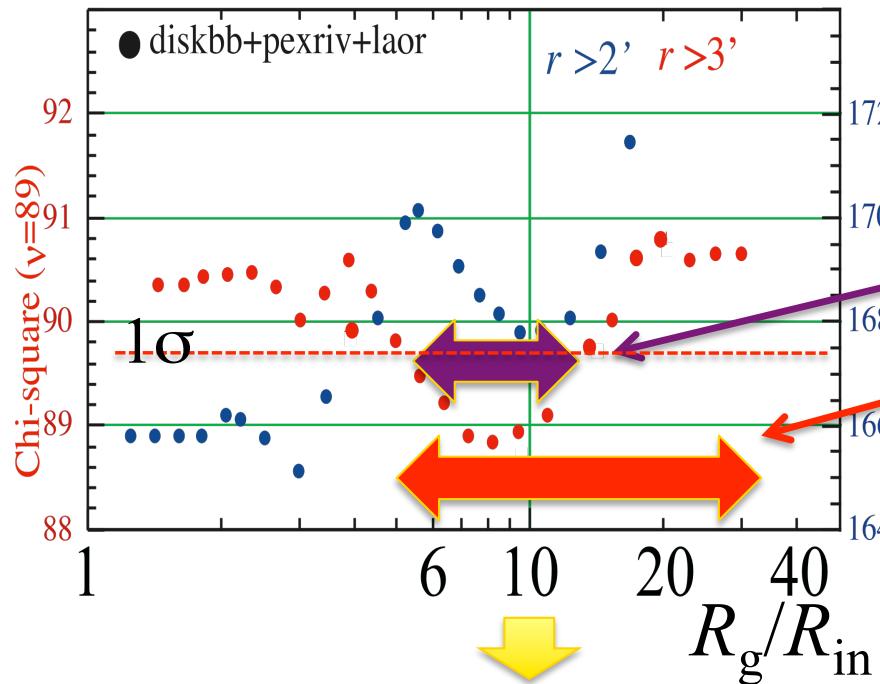
## Information on XIS Data Analysis

- 
- [How to check the significance of pileup](#) (2009-07-12)
  - [Energy scale of XIS taken with a Window mode](#) (2009-06-04)
  - [Problem on GTI of the burst option](#) (2008-12-11)
  - [Problem in the XIS1 NXB database](#) (2008-09-10)
  - [Contamination thickness of XIS0](#) (2007-12-18)
  - [Notes on V2.0/2.1 processed XIS Data](#) (2007-11-01, updated 2007-12-07)
  - [XIS data affected by the erroneous dark frame](#) (2007-09-20)
  - [XISSLIMARFGEN: Tips for Reducing Run Time](#) (GSFC)
  - [Tips for Farster Spectral Fits of XIS Data](#) (GSFC)
  - [Non X-ray Background estimation](#)
  - [Updated Gain Calibration for SCI-on Data](#) (GSFC)



# GX 339-4 (VHS) with *Suzaku*

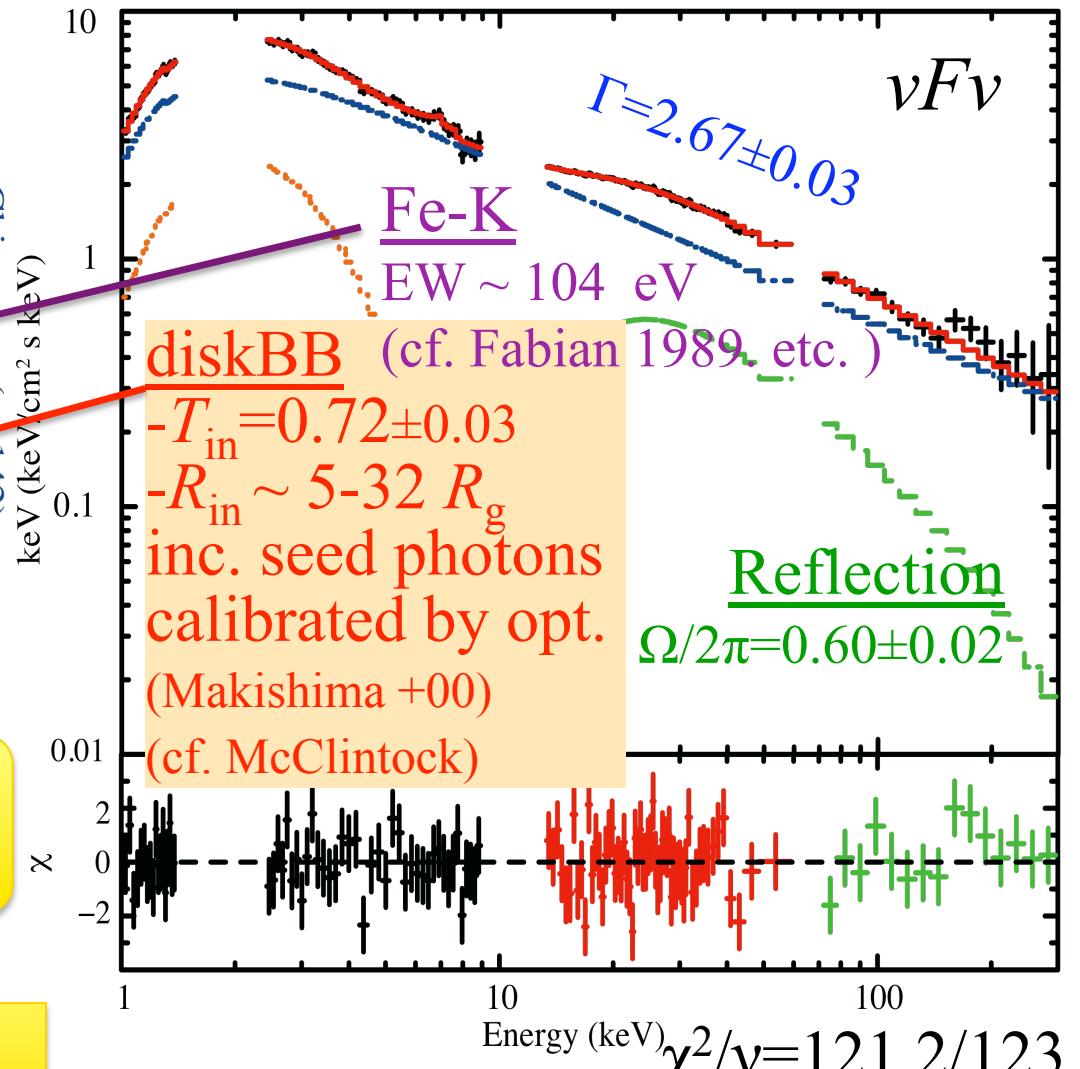
Re-analysis using  $r > 3'$  XIS data which are nearly free from the pile up and TLM saturation; S. Yamada+09., *ApJL*, submitted



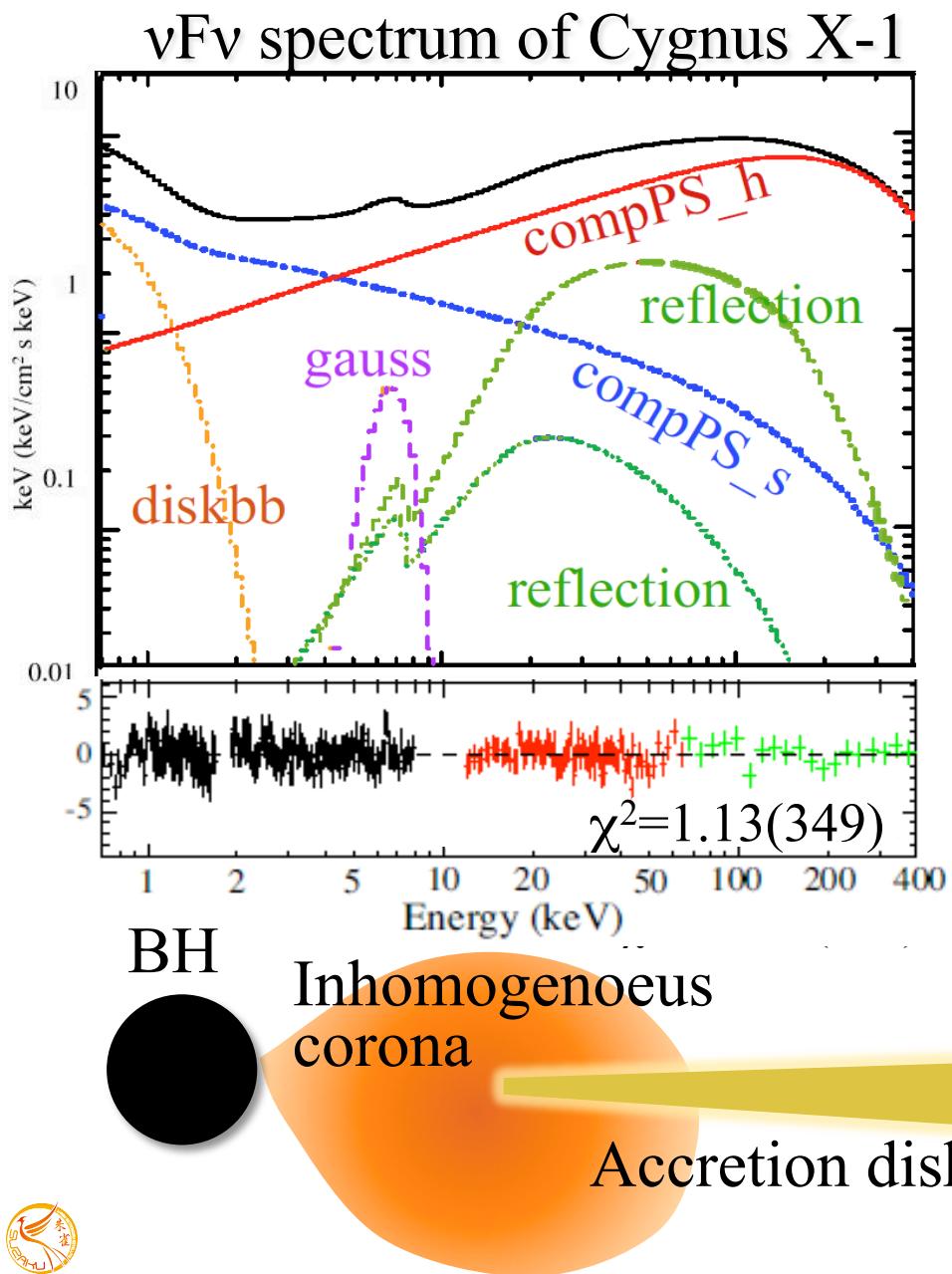
The *Suzaku* data prefer a truncated disk at  $> \sim 6 R_g$ .



$R_{\text{in}} \sim 5.6 R_g$  during H/S state  
(Makishima+ 1986)



# Suzaku result of Cyg X-1 (K.Makishima ++ 2008)

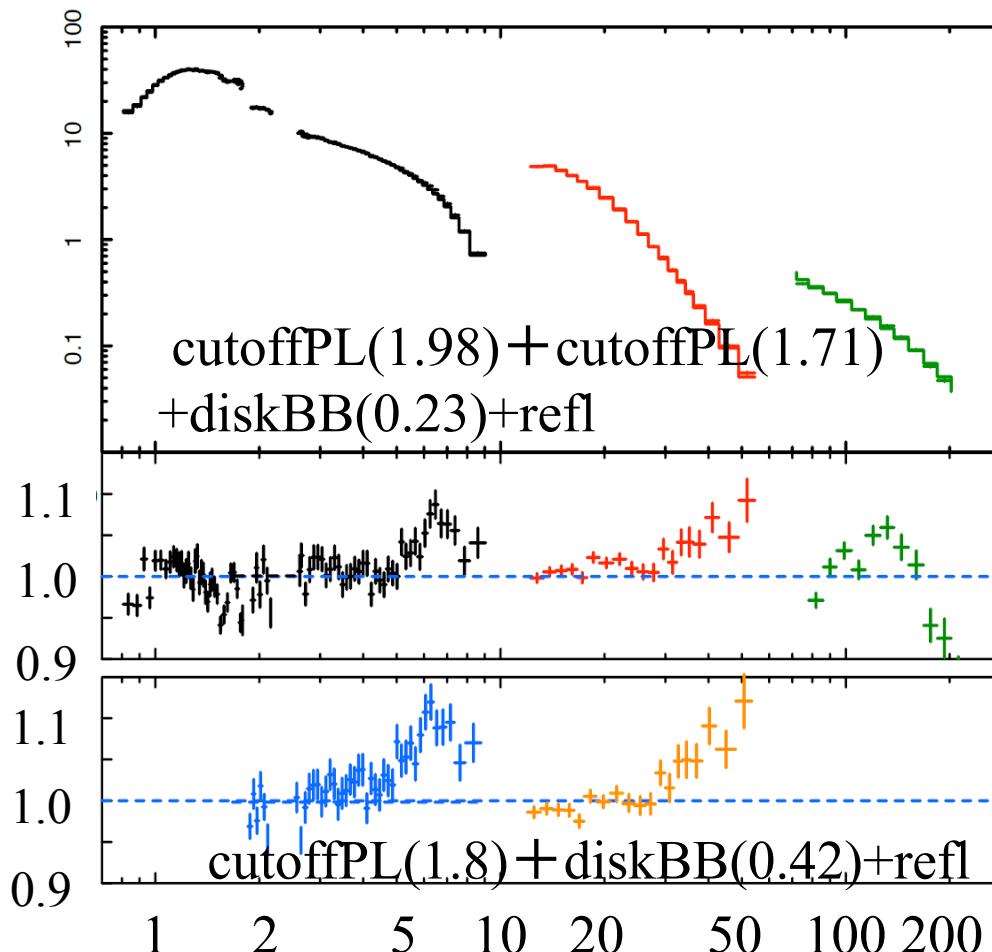


- Two Compton continua  
 $\tau \sim 1.5$  and  $\tau \sim 0.4$   
 $T_e \sim 100 \text{ keV}$  (common)  
 $R_{\text{seed}} \sim 210 \text{ km}$  (2 comp. sum)
- Directly visible disk emission  
 $T_{\text{in}} \sim 0.2 \text{ keV}$ ,  $R_{\text{in}} \sim 250 \text{ km}$   
→ In total,  $R_{\text{in}}/R_g \sim 15$

The disk is truncated at  $\sim 15 R_g$

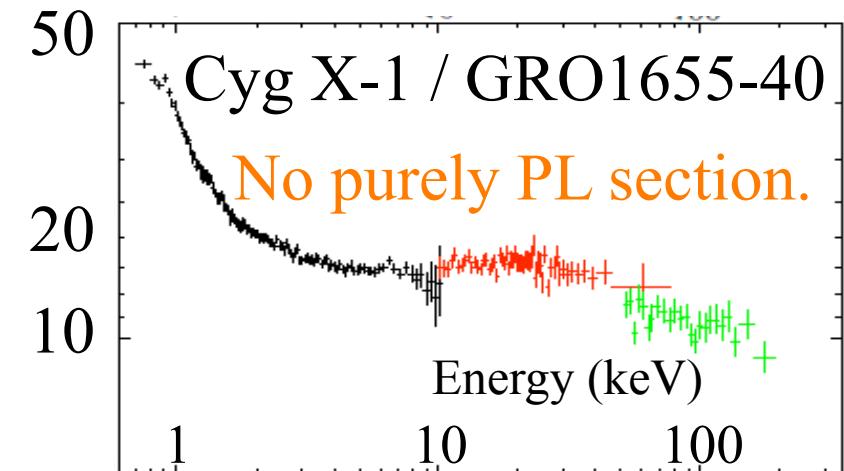
- Mildly broadened Fe-K line  
@ 6.3 keV, EW 290 eV,  
 $\sigma \sim 1 \text{ keV} \rightarrow R_{\text{in}}/R_g \sim 12$
- Reflection  $\Omega/2\pi \sim 0.4$

# Curved Continua Modeling of Cyg X-1

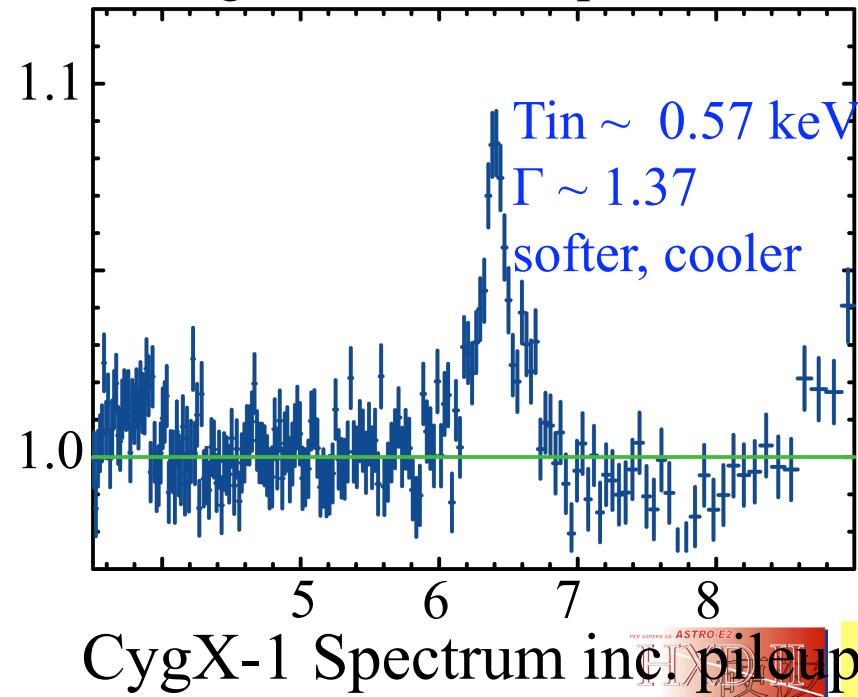


Incorrect modeling by a single PL causes an artificial Fe-K line.

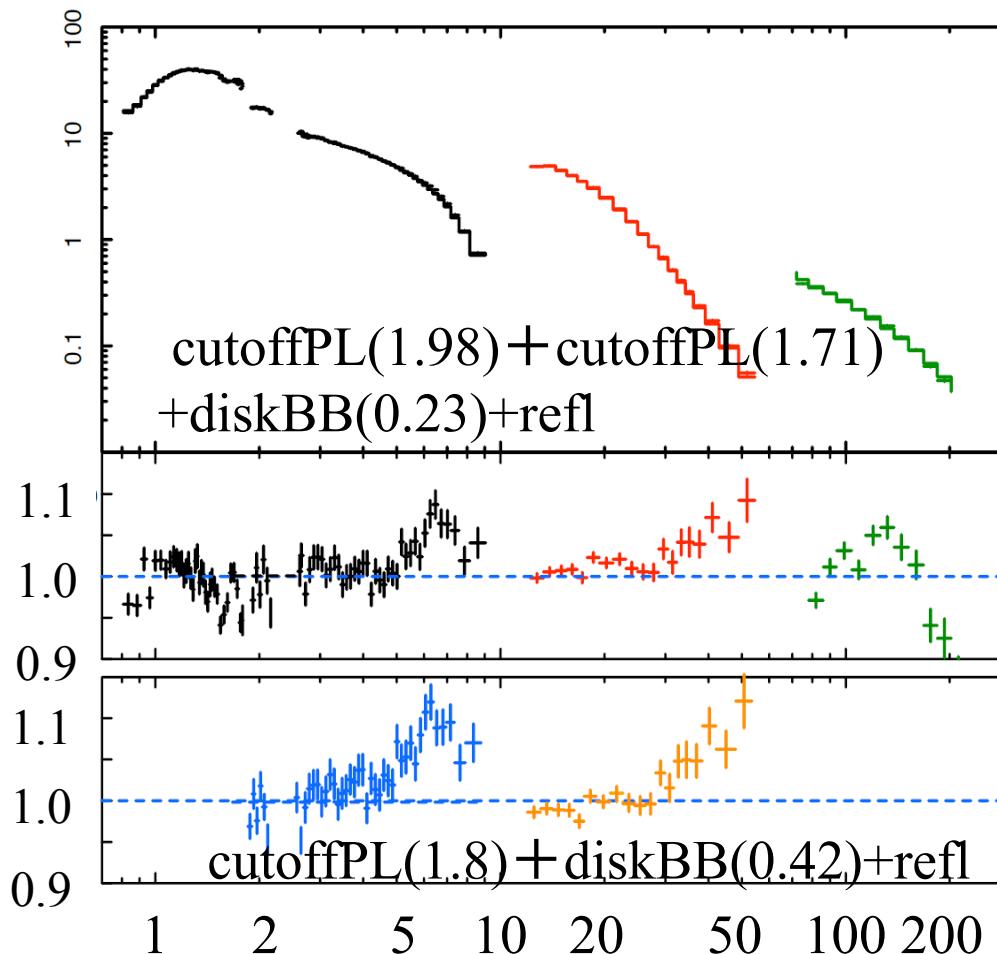
So does fitting except for 4-7 keV



Fitting with diskbb + powerlaw

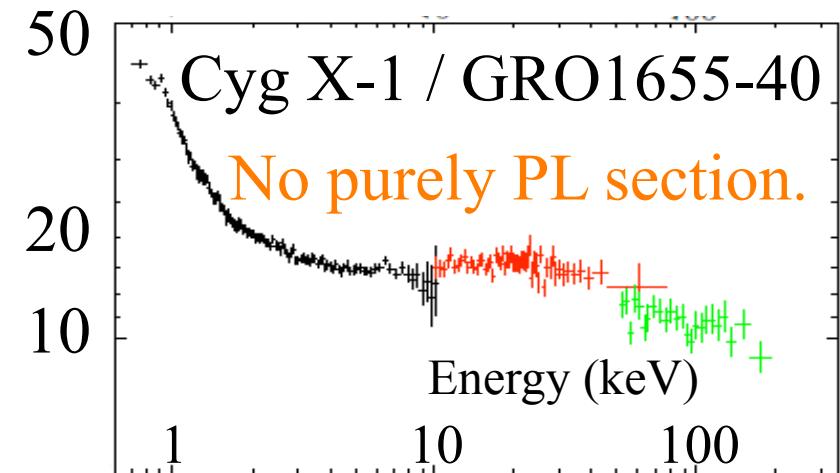


# Curved Continua Modeling of Cyg X-1

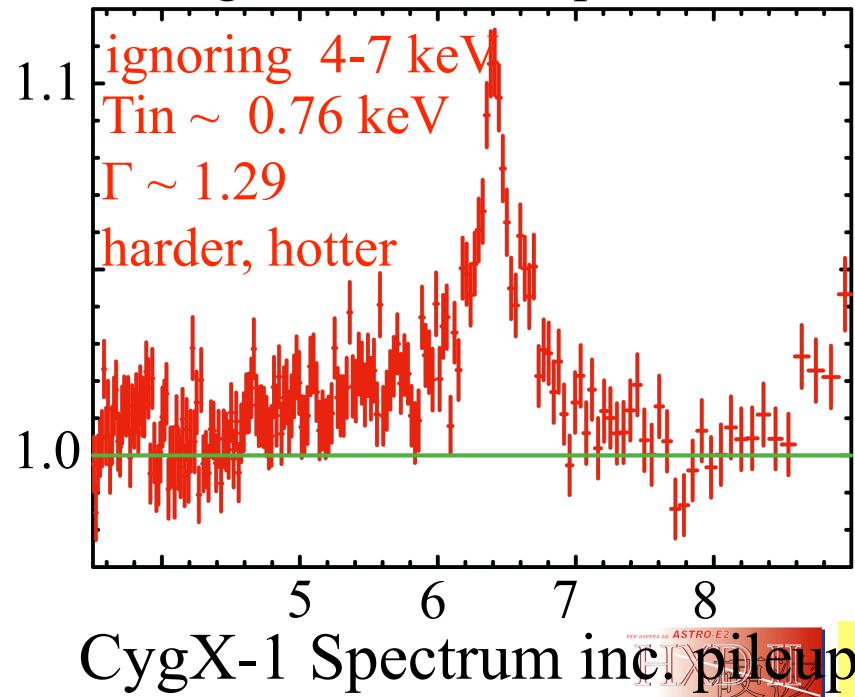


Incorrect modeling by a single PL causes an artificial Fe-K line.

So does fitting except for 4-7 keV

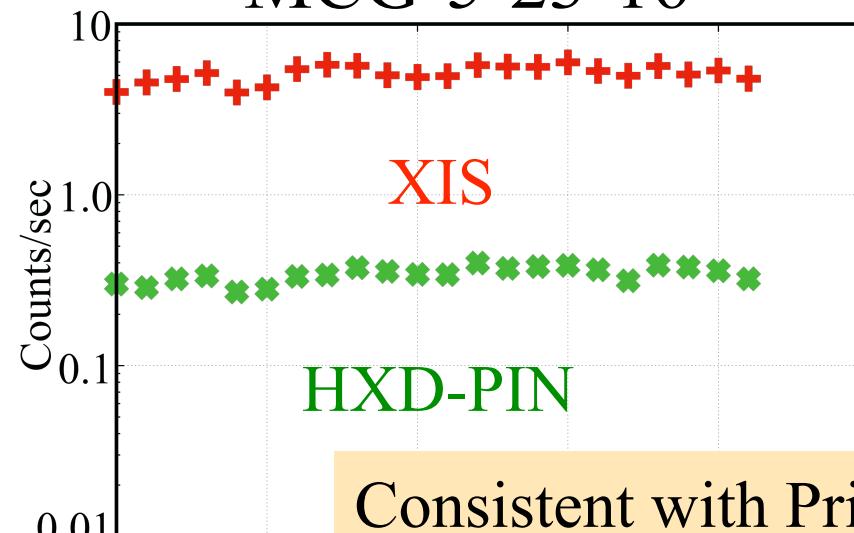


Fitting with diskbb + powerlaw

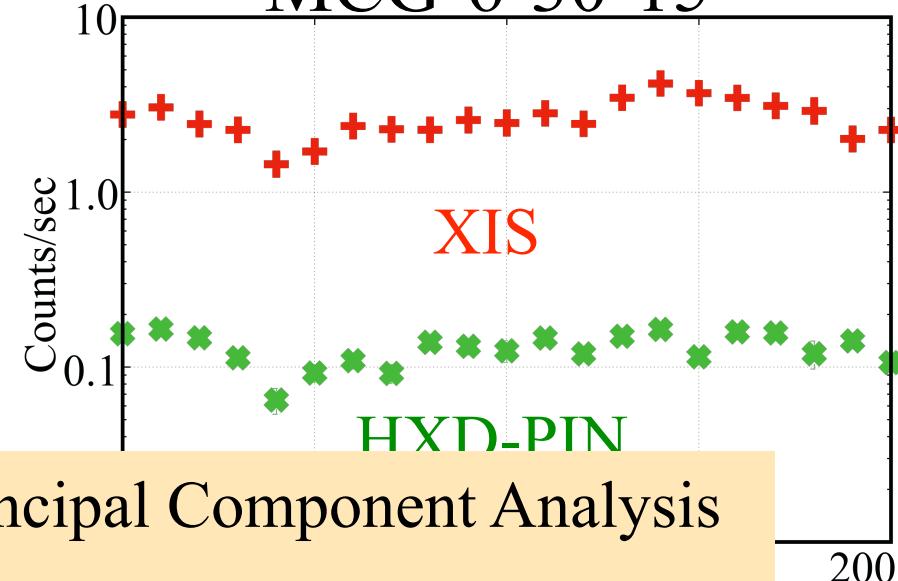


# Hard X-ray variability in Seyferts

MCG-5-23-16

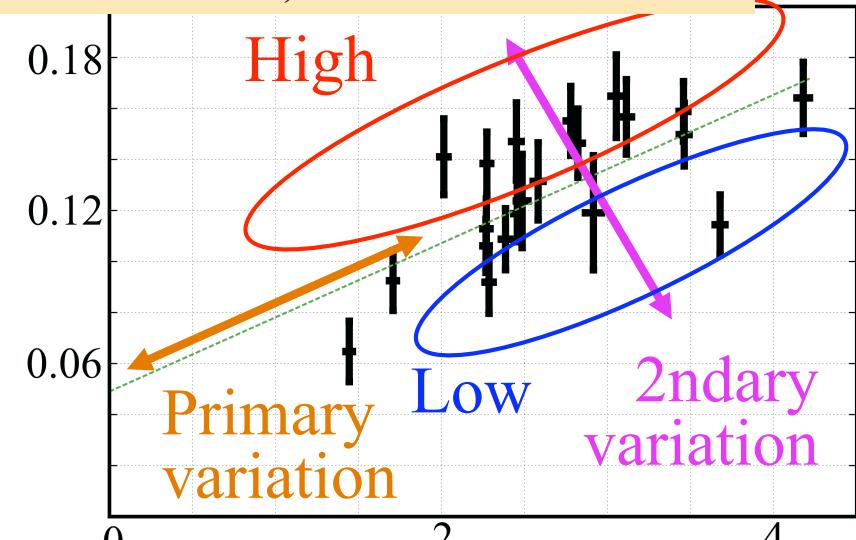
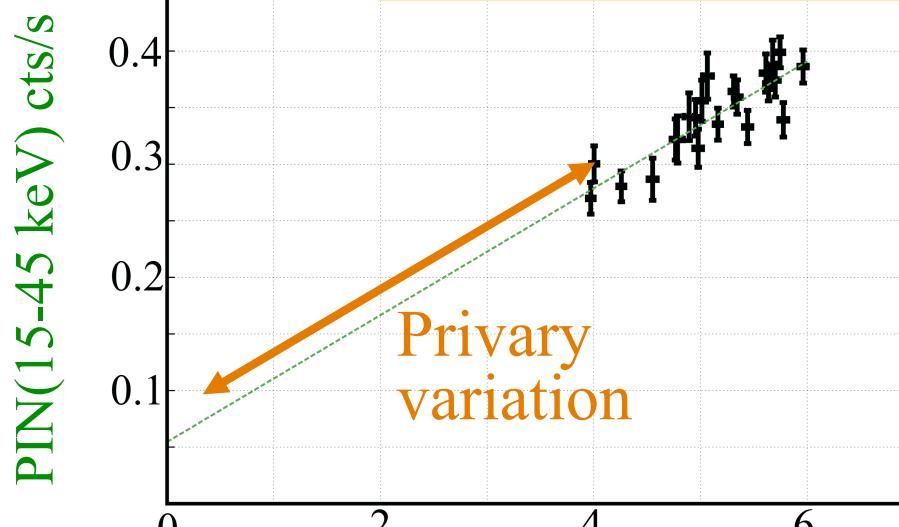


MCG-6-30-15



Consistent with Principal Component Analysis

(Noda+ 2009 in prep, cf. L. Miller+ 2008)

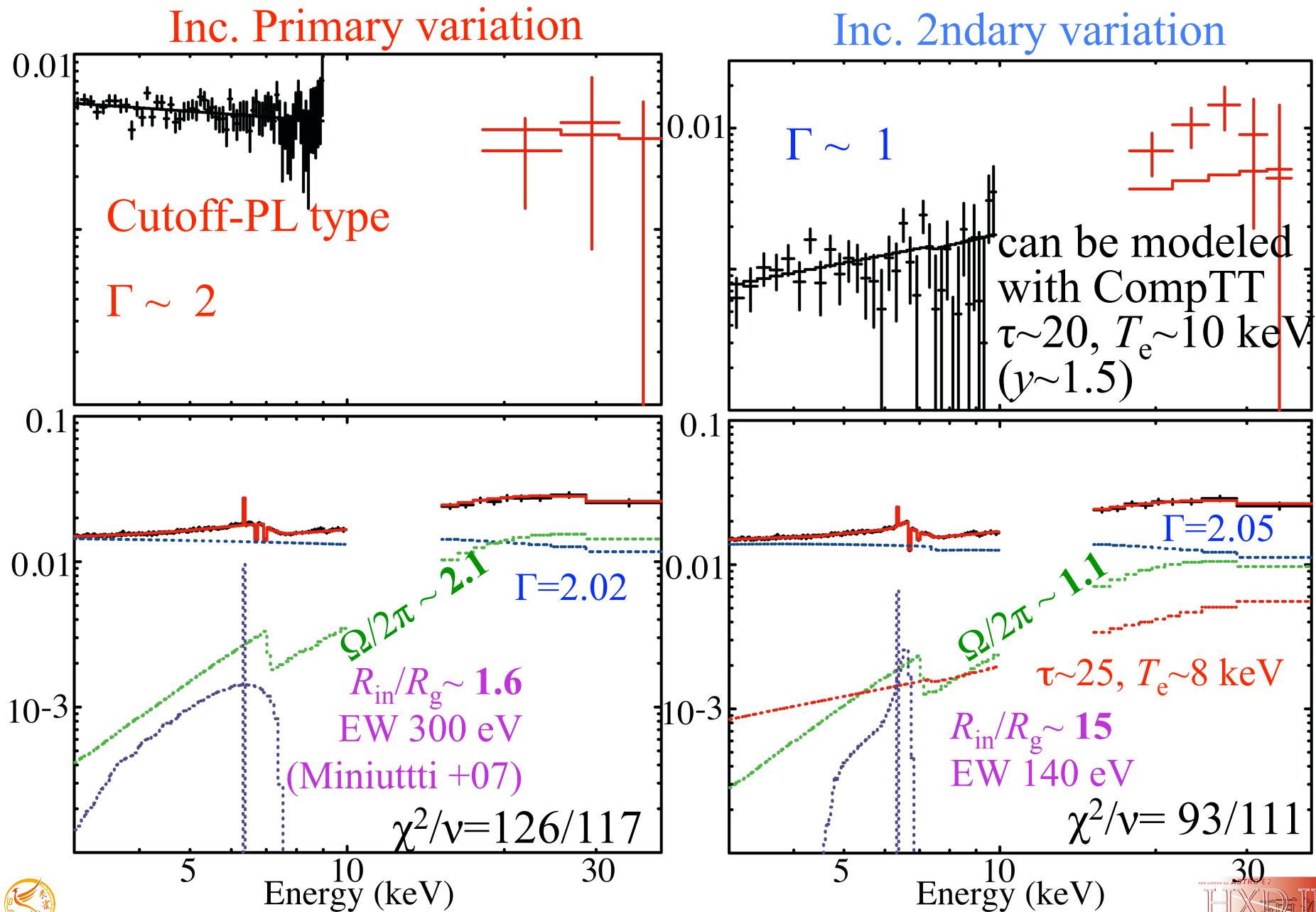


XIS(3-10 keV) cts/s

3 / 16 objects



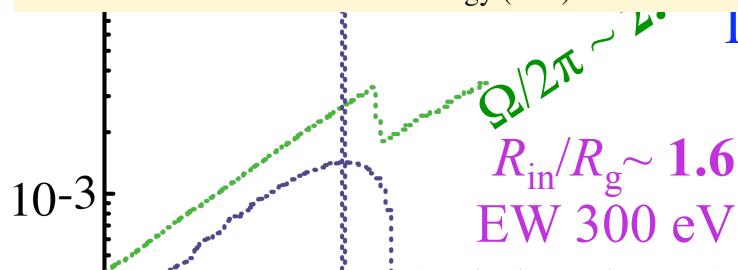
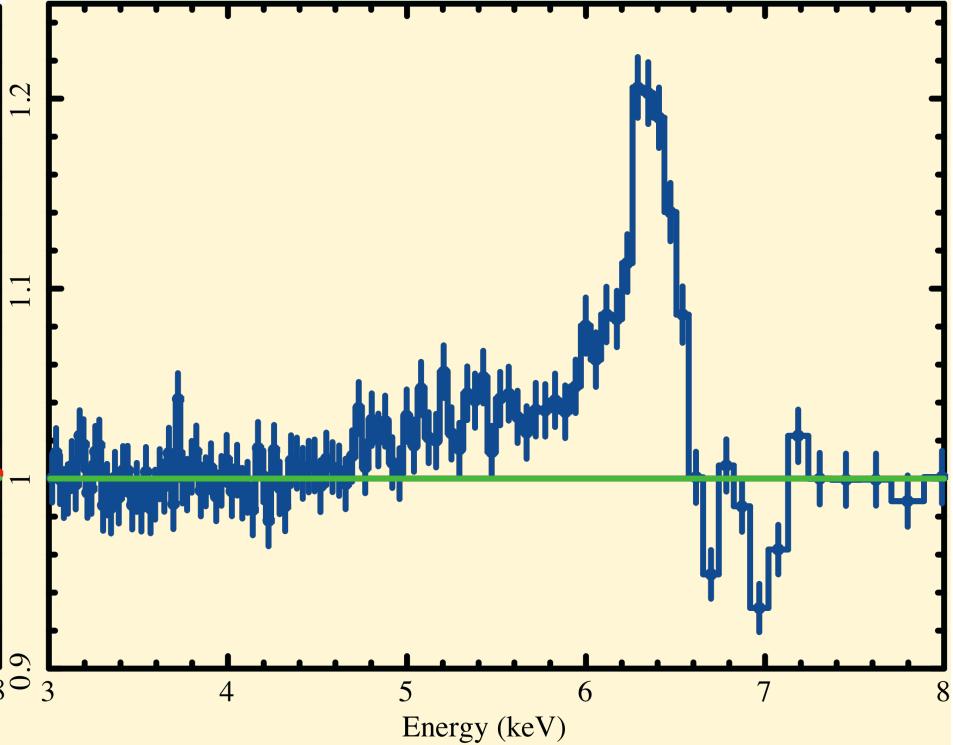
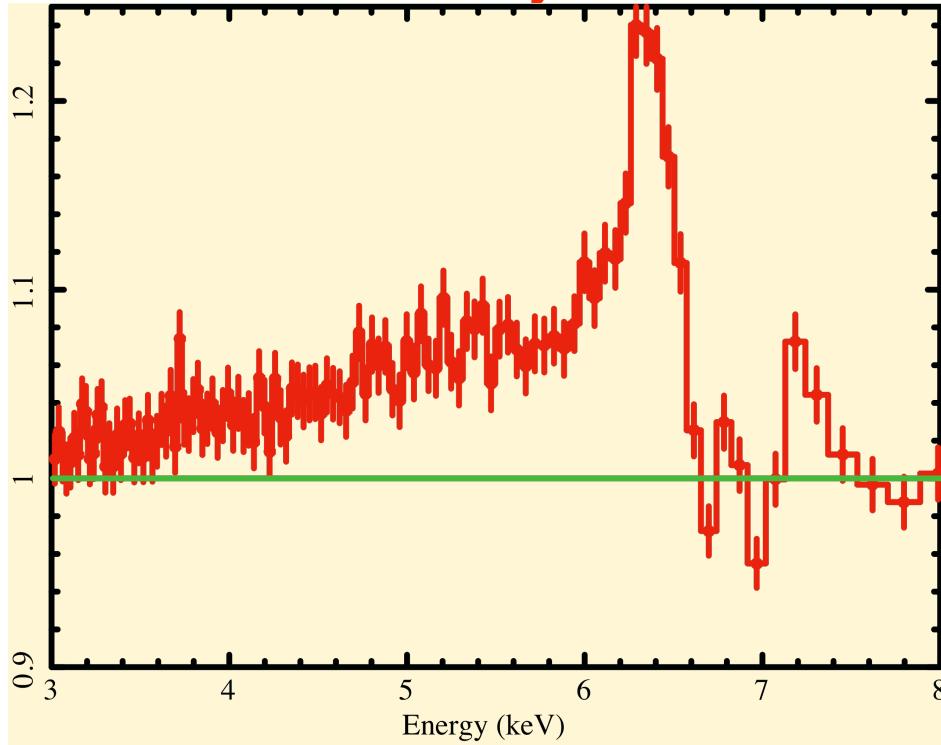
# Re-analysis of MCG -6-30-15 with *Suzaku*



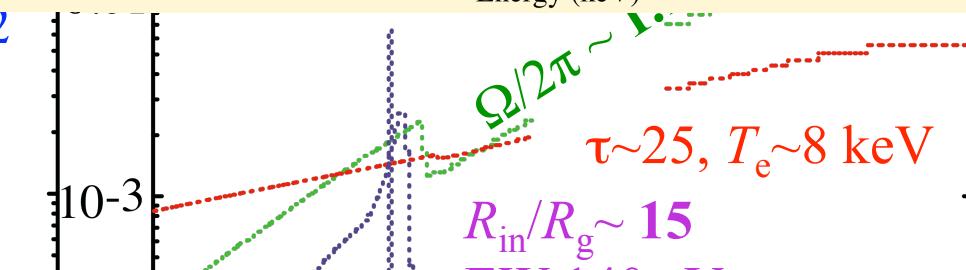
# Re-analysis of MCG -6-30-15 with *Suzaku*

Inc. Primary variation

Inc. 2ndary variation



P 7.86 warmabsorber  
Piotr Zycki +



P 8.14 calibration uncertainty  
IACHEC, Steve Semboy +,  
Nakazawa' invited talk



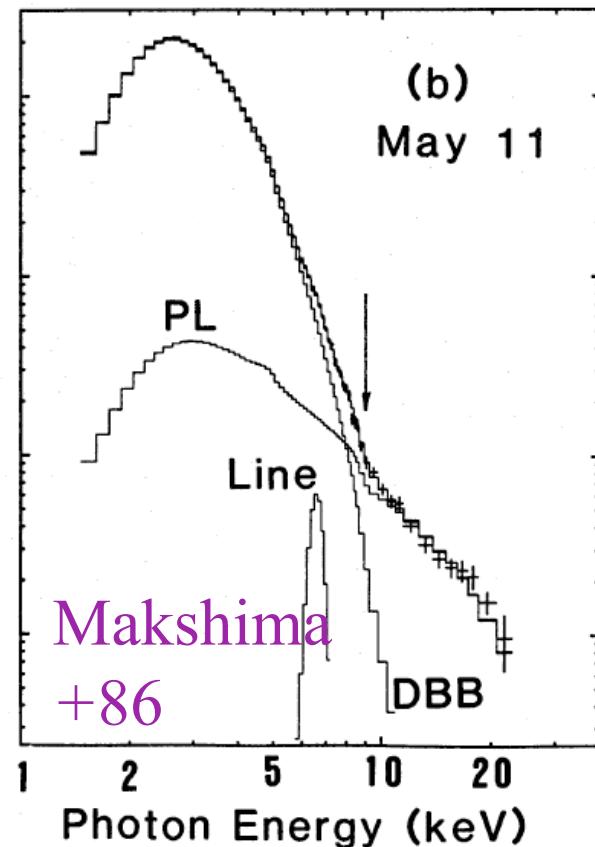
# Summary

- ◆ “Broad Fe-K lines” can easily arise artificially from improper modeling of the wide-band continuum and indirectly from pileup.
- ◆ At least *Suzaku* spectra of GX 339-4 and Cyg X-1 do not prefer extremely broad Fe-K lines that are indicative of extreme Kerr metric.
- ◆ The *Suzaku* spectra of MCG-6-30-15 can be explained without invoking the broad Fe-K line, if we allow the presence of a hard spectral component that mimics the reflection.
- ◆ More x2 co-operation between theoreticians and observationalists would be a key milestone for establishing spin measurement and the success of *ASTRO-H* (T. Takahashi Fri.) *and beyond...*

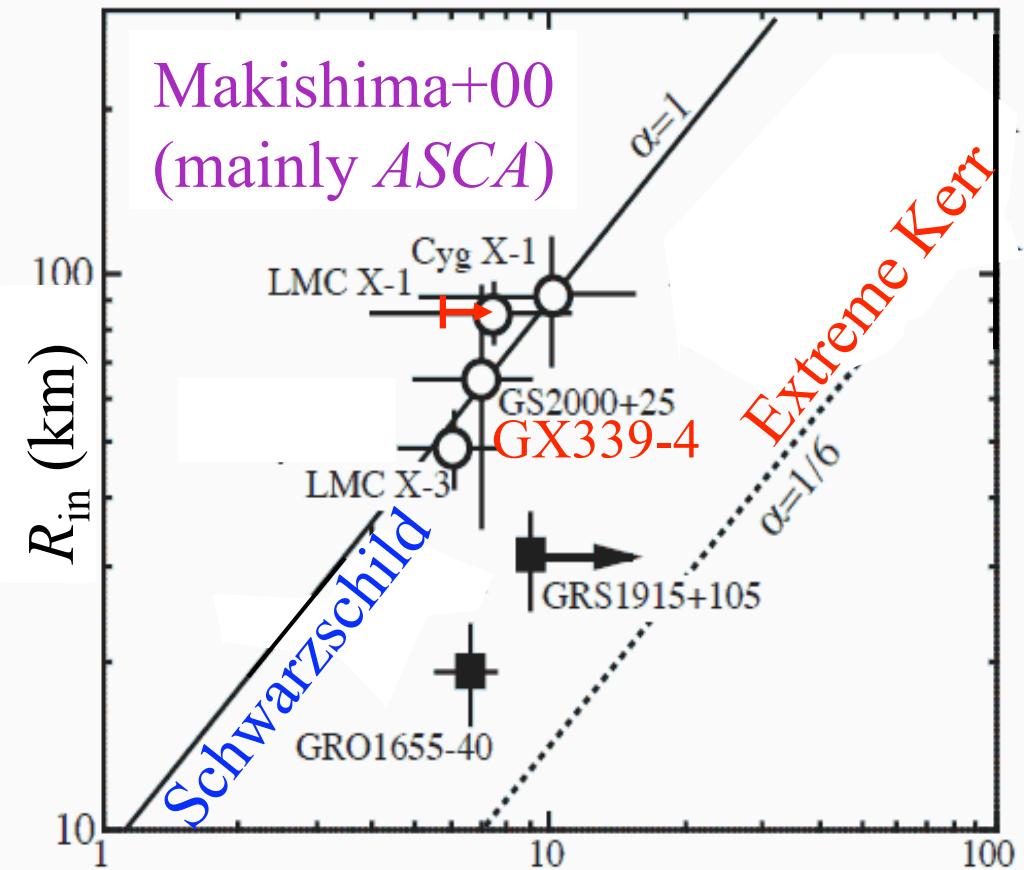


# GX 339-4 (High/Soft) with *Tenma*

Beautiful disk emission revealed with Tenma



Calibration of X-ray measured  $R_{\text{in}}$



$$R_{\text{in}}/R_g = (5.5 \pm 0.5) d_8/m_7$$

