Relativistic Fe K α line detection in the Suzaku spectra of IC 4329A

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(Very simple) physical idea



Previous work

Broad iron lines are expected to be a widespread feature in the bright AGN

• Nandra et al. 2007

30% no relativistic line

• de La Calle Pérez et al. 2010

20% no relativistic line

Bhayani & Nandra 2011

Relativistic effects can explain

Still in some sources relativistic component is missing

Source and data

• IC 4329A is the second brightest Seyfert I, after NGC 4151, with a flux of:

$$F \sim 2 \times 10^{-10} erg \ s^{-1} cm^{-2}$$

Five Suzaku observations in 2007 on August 1, 6, 11, 16, 20 with an exposure of ~26 ks each.
Total exposure of ~130 ks.

Data/Model Ratio

Strong narrow line

Model: zwabs*pexrav

Data/Model Ratio

Model: zwabs*pexrav

Data Analysis

Gauss	702113010	702113020	702113030	702113040	702113050
Γ	1.81 ± 0.04	1.90 ± 0.03	1.77 ± 0.03	1.82 ± 0.04	1.73 ± 0.06
R	0.78 ± 0.23	1.18 ± 0.24	0.79 ± 0.20	0.96 ± 0.25	1.56 ± 0.48
$Norm \cdot 10^{-2}$	3.11 ± 0.14	4.12 ± 0.16	3.26 ± 0.13	3.18 ± 0.14	1.72 ± 0.12
$E_{K\alpha}$	6.39 ± 0.02	6.40 ± 0.01	6.38 ± 0.02	6.40 ± 0.02	6.40 ± 0.02
$F_{K\alpha} \cdot 10^{-5}$	6.24 ± 0.94	5.81 ± 0.92	7.40 ± 0.99	7.54 ± 1.00	5.58 ± 0.83
EW	52 ± 8	42 ± 7	55 ± 7	62 ± 8	68 ± 10
χ^2	959.81/891	1117.19/1104	993.38/999	921.63/869	626.51/606

E_{cutoff}= 180 keV

consistent with Brenneman et al. 2013

Model: zwabs*(pexrav+zgauss)

Spectral Variability

Spectral Variability

R consistent with a narrow line?

Spectral Variability

R consistent with a narrow line?

Broad component?

Data/Model Ratio

Significance between $2-4\sigma$ for single observation

Model: zwabs*(pexrav+zgauss)

Data/model Ratio

$\sim 5.5\sigma$ significance

Model: zwabs*(pexrav+zgauss)

Pexmon model

- Fe Kα (6.4 keV)
- Fe Kβ (7.06 keV) flux
 I I.3% of Kα
- Ni Kα (7.47 keV) flux 5% of Kα
- Compton Reflection (pexrav)
- Fe Kα Compton shoulder

Nandra et al. 2007

Data Analysis

Pex	702113010	702113020	702113030	702113040	702113050
Γ	1.82 ± 0.03	1.85 ± 0.02	1.78 ± 0.03	1.83 ± 0.03	1.71 ± 0.04
$Norm \cdot 10^{-2}$	3.15 ± 0.12	3.97 ± 0.12	3.31 ± 0.11	3.25 ± 0.12	1.69 ± 0.08
R_{Narr}	0.38 ± 0.07	0.32 ± 0.06	0.36 ± 0.06	0.44 ± 0.07	0.46 ± 0.09
R_{Broad}	0.29 ± 0.13	0.23 ± 0.11	0.26 ± 0.12	0.36 ± 0.14	0.47 ± 0.18
χ^2	942.25/891	1124.08/1104	987.78/999	899.82/869	610.57/606

 E_{cutoff} = 180 keV θ_{disc} = 35°

Model: zwabs*(cutoffpl+pexmon+kdblur2*pexmon)

Data/model Ratio

Model: zwabs*(cutoffpl+pexmon+kdblur2*pexmon)

Data/model Ratio

Model: zwabs*(cutoffpl+pexmon+kdblur2*pexmon)

Relativistic + Fe XXVI

Evidence for a Fe XXVI narrow emission line (6.94 keV)

Observation	Gaussian	Reflection	$\Delta\chi^2$
702113010	950.20/890	933.88/890	16.32
702113020	1097.46/1103	1100.35/1103	-2.89
702113030	993.35/998	987.78/998	5.57
702113040	921.33/868	899.79/868	21.54
702113050	616.26/605	600.41/605	15.85

Gaussian: zwabs*(pexrav+zgauss+zgauss) Reflection: zwabs*(cutoffpl+pexmon+kdblur2*pexmon+zgauss)

Summary

Missing relativistic component in AGN?

- Brightest Seyfert: IC 4329A
- Narrow component in single short observation
- Relativistic component in the combined spectra with high significance
- Data consistent with the narrow and the broad iron line components tracking the Compton Hump.

Very high signal-to-noise ratio is required to disentangle relativistic line components in AGN