ABSTRACT BOOK

VARIABLE AND BROAD IRON LINES AROUND BLACK HOLES

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Edited by

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Chapter 1

Introduction

Introduction (Invited)

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(Abstract not available)

Chapter 2

Understanding the innermost flows around BH

General Relativity effects and line emission (Invited)

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General relativity strongly affects the properties of lines emitted in the vicinity of the Black Hole in AGN and GBHC. In this talk, GR effects on the line profiles from the inner regions of the accretion disc will be reviewed, as well as the effects on the primary illuminating radiation. The use of relativistic lines to measure the two parameters which completely characterize the space-time around a non-charged Black Hole, i.e. its mass and spin, will be also discussed.

Power spectra from spotted accretion discs (Poster)

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M. Dovciak, V. Karas, G. Matt

We discuss the effects of change of energy, light-bending and time-delays acting on photons travelling from a black hole accretion disc. These are described in terms of transfer functions, for which we give approximate analytical formulae and compare them with numerical computations. We assume a spotted thin accretion disc around a non-rotating black hole. Approximations are then employed to determine the influence of relativistic effects on X-ray variability power spectra. A simple estimate of power spectra profiles is presented.

Chapter 3

X-ray reflection and spectral variability

Polarization from an orbiting spot (Poster)

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V. Karas, G. Matt

The polarization from a spot orbiting around Schwarzschild and extreme Kerr black holes is studied. The spot is illuminated by X-ray powerlaw emission from the primary source orbiting with Keplerian velocity near above the disc. The accretion disc is supposed to be cold, geometrically thin and optically thick. Overall flux, degree and angle of polarization integrated over the whole orbit as well as their time dependence during the orbit are examined as functions of the observer's inclination angle. The gravitational and Doppler shifts, lensing effect as well as time delays are taken into account.

Fe Kα radiation induced by the impact of relativistic electrons from flares

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The iron Kalpha emitted from accreting black holes is thought to be produced by the reprocessing of hard X-ray radiation illuminating the disk. Mechanisms which could produce this hard X-ray radiation are magnetic reconnection in the disk corona or shocks. Both phenomena produce high energy particles whose contribution is usually ignored. In this work, we analyze how the transfer of mechanical energy from relativistic electrons to the circumnuclear gas (accretion disk, BLR) contributes to the X-ray continuum and the iron Kalpha emission. It is shown that for gas columns comparable to the Thomson depth, the iron Kalpha yield is comparable to that observed provided that the electron energy is above $\sim$ 600 keV and that the total kinetic luminosity of the beam is around log LKIN = 46.6-47.7; this luminosity is comparable to that observed in radio-loud AGNs.

Modeling AGN in the X-ray range: Implications of Magnetic Flares

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B. Czerny, M. Mouchet, V. Karas, M. Dovciak, G. Ponti

Active Galactic Nuclei (AGN) release a significant fraction of their bolometric luminosity in the X-ray band. The shape of the X-ray spectrum is complex and varies rapidly in time as seen in recent observations. Magnetic flares above the accretion disk can account for the extreme variability of AGN. They also explain the observed iron Kalpha fluorescence lines and the spectral imprints of Compton reflection.

We present radiative transfer modeling of the X-ray emission from magnetic flares in AGN. The hard X-ray primary radiation coming from the flare source illuminates the accretion disk, which is supposed to stay in hydrostatic equilibrium. A Compton reflection/reprocessed component coming from the disk surface is computed for different emission directions. The modeling takes into account the variations of the incident radiation across the hot spot underneath the flare source. Time-dependent spectra and lightcurves for orbiting flares at two different distances from a Schwarzschild black hole are computed using a full general relativity ray tracing technique. Rms-variability spectra for large flare distributions across the disk are also modeled and compared to observed X-ray data of the Seyfert-1 galaxy MCG -6-30-15.

Theoretical aspects of relativistic spectral features (Invited)

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The inner parts of accretion flows have been extensively studied by means of X-ray spectroscopy. This talk summarizes several aspects of how the observed spectral features from black-hole accretion discs are influenced by strong gravity. We start with a brief summary of the equations describing light intensity (and polarization) propagation through plasmas in strong gravitational fields. Relativistic effects are often discussed in terms of geometrical optics with photons propagating through empty spacetime – well-suited to interpret various flavours of 'hot spots' on the disc surface (and a patchy corona above it). Theoretical approaches have been developed that can tackle more complicated situations, such as the case of dispersive media. This may be able to address, more accurately, simultaneous observations in mutually remote parts of the electromagnetic spectrum. In the second part of the talk we mention flares and spots as a model for X-ray variability of active galactic nuclei: multiple spots are created on the surface of an accretion disc following the intense irradiation, and the observed signal is modulated by an interplay of relativistic effects. This scheme captures many properties of present observations, but we argue that more complex geometries of the emitting region should be also explored, such as spiral waves propagating across the disc.

Models for the X-ray spectra and variability of luminous accreting black holes

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The X-ray spectra of luminous Seyfert 1 galaxies often appear to be reflection-dominated. In a number of Narrow Line Seyfert 1 (NLS1) galaxies and galactic black holes in the very high state, the variability of the continuum and of the iron line are decoupled, the reflected component being often much less variable than the continuum.

These properties have been interpreted as effects of gravitational light bending. In this framework, we present detailed Monte-Carlo simulations of the reflection continuum in the Kerr metric. These calculations confirm that the spectra and variability behaviour of these sources can be reproduced by the light bending model.

As an alternative to the light bending model, we show that similar observational properties are expected from radiation pressure dominated discs subject to violent clumping instabilities and, as a result, have a highly inhomogeneous two-phase structure. In this model, most of the observed spectral and variability features originate from the complex geometrical structure of the the inner regions of near-Eddington accretion flows and are therefore a signature of accretion physics rather than general relativity.

Light bending models for AGN and Galactic Black Hole Candidates (Invited)

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The observed spectral variability properties of some AGN and GBHC candidates are interpreted in terms of a theoretical model involving strong gravity effects in the immediate vicinity of the central black hole. New results on relativistic reflection and Fe line variability from the XMM-Newton and Suzaku X-ray observatories will also be presented.

Amplification and variability of the X-ray emission due to microlensing

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Here we consider the influence of microlensing to the Fe K-alpha line and X-ray continuum amplification and variation. To investigate the variability of the line and X-ray continuum, we studied the effects of microlensing on quasar X-spectra produced by the crossing of a microlensing pattern across a standard relativistic accretion disk. To describe the disk emission we used a ray tracing method considering both metrics, Schwarzschild and Kerr. We found that the Fe Kα and the continuum may experience significant amplification by a microlensing event (even for microlenses of very small mass - see Popovic et al. 2003, A&A, 398, 975; 2006, ApJ, 637, 620). Moreover, the Fe K-alpha line shape deformation as well as chromatic effects of the X-ray continuum can be caused by microlensing (Popovic & Chartas 2005, MNRAS, 357, 135). These results suggest that monitoring of gravitational lenses in X-ray emission may help us to understand the physics of the innermost part of the relativistic accretion disks. Also, we investigate a contribution of microlensing to the X-ray variability of high-redshifted (unlensed) QSOs, finding that cosmologically distributed deflector may contribute significantly to the X-ray variability of high-redshifted QSOs (z>2). Considering that the upper limit of the optical depth ($\tau \sim 0.1$) corresponds to the case where dark matter forms cosmologically distributed deflectors. Consequently observations of the X-ray variations of unlensed QSOs can be used for the estimation of the dark matter fraction of microlenses (Zakharov, Popovic, Jovanovic 2004, A&A, 420, 881).

Chapter 4

Broad iron lines and reflection in BHC

Relativistic Fe line emission and highly photoionized absorption in GRO J1655-40

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We report on two XMM-Newton and simultaneous INTEGRAL observations of the microquasar GRO J1655-40 during its 2005 outburst. The source was most probably in its high-soft state during both observations. There is evidence for the presence of both a relativistically broadened Fe line providing strong support for the existence of a spinning black hole, and a highly photo-ionized absorber. The photo-ionized absorber is responsible for strong K absorption lines of Fe XXV and Fe XXVI in the EPIC pn spectra and blue-shifted ($v = -480 \pm 185$ km/s) Ne and Fe XXIV features in the RGS spectra. The parameters of the highly-ionized absorber were different during the two observations. A less ionized absorber is present in the second observation, where the 0.5-200 keV luminosity of GRO J1655-40 decreased by around a half.

Observations of broad lines in Galactic Black Hole Candidates (Invited)

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I will review the advances made with XMM-Newton in the study of broad iron lines in stellar mass black holes. The high effective area of the EPIC cameras through and above the Fe K band is essential for revealing the relativistic nature of broad iron lines in stellar-mass black holes. So far, XMM-Newton has revealed relativistic iron lines in XTE J1650-500, GX 339-4, Cygnus X-1, GRO J1655-40, and GRS 1915+105, and other sources. Relativistic lines are not only important for revealing black hole spin, but can be used to reveal the nature of the hard component as well. I will comment on how future line variability studies can probe the innermost relativistic regime and accretion flow geometry around stellar-mass black holes even more deeply than the average line profile.

XMM-Newton detection of relativistic Iron emission in SAX J1711.6–3808

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During XMM-Newton observations on the Galactic X-ray transient SAX J1711.6-3808 when the source was close to the outburst maximum, a relativistic Fe line was detected. The line was broad and red-wards skewed, indicating emission from the innermost regions of the accretion disc. The best fitting line parameters indicate an innermost emitting radius $R_{in} < 2.2\,R_g$, strongly suggesting that SAX J1711.6-3808 harbors a spinning black hole.

Chapter 5

Variable shifted lines

Relativistically blue- and red-shifted absorption lines in AGN (Invited)

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Current, accumulating evidence for relativistically blue- and red-shifted absorption lines in AGN is reviewed. Based on sensitive X-ray observations, some recent attempts which start probing not only the kinematics (velocity) but also the dynamics (accelerations) of this gas flowing in-and-out from, likely, a few gravitational radii from the black hole are shown. Clearly, new potential is at hand to map the accretion flows near black holes, and to probe the launching regions of relativistic jets/outflows through absorption-line spectroscopy. Requirements to address these issues with future high energy missions are briefly addressed.

Variability of the FeK line relativistic component in a sample of Seyfert 1

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We present the analysis of X-ray spectral variability made on a sample of 7 Seyfert 1 bright galaxies, using XMM-Newton data. From the (XSA) public archive, we selected those showing one or more prominent flares in their 2-10 keV light curves. For each of them we extracted spectra in 3 different time intervals: before, during and after the flare. We fitted them with a simple power law and then shifted a narrow Gaussian emission line template across the 2.5-10 keV data, in order to investigate the presence of line-like features with a confidence level greater than 99%. Some highly significant features were detected in 3 out of 7 sources studied. In particular, the 3 sources showed the presence of a variable emission feature in the 4.5-5.8 keV band, characterized by an increase of its intensity after the flare peak. Because of the observed variability pattern, this feature seems to be ascribable to a reverbered redshifted relativistic component of the FeK line.

Search for energy-shifted lines in AGN X-ray spectra in the XMM-Newton archive (Poster)

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Thanks to the large effective area and the spectral resolution of current X-ray satellites, the detection of X-ray narrow spectral features in the 5-7 keV band is becoming commonplace in many AGN observations. Such lines, both in emission and in absorption, are mostly interpreted as arising from Iron atoms. When observed with some displacement from their rest frame position, these lines carry the potential to study the motion of circumnuclear gas in AGN, providing a diagnostic of the effects of the gravitational field of the central black hole. These narrow features have been often found with marginal statistical significance.

A systematic search for narrow features in type1 AGN is being performed on all spectra available in the XMM-Newton archive with the aim to estimate the significance of the features with Monte Carlo simulations of synthetic spectra. Preliminary results on the occurrence and the physical properties of the features in the sample will be presented.

The Onset of GR - Gravitationally Redshifted Emission lines

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Emission lines launched in the vicinity of a Kerr black hole are subject of gravitational redshift. It is presented in the talk that there are two modes of gravitational redshift: shift and distortion - each starting in different distances to the black hole and overlapping close to the hole. Current resolving power in the UV allows for probing gravitational redshift out to 75000 gravitational radii e.g. with optical BLR lines. It is demonstrated how gravitationally redshifted spectral features can be exploited to determine black hole mass and inclination of the inner accretion disk. However, black hole spin can only be tested within the innermost few gravitational radii e.g. with iron K lines.

Time-resolved spectroscopy analysis of ESO 113-G010 (Poster)

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J.N. Reeves, T.J. Turner, M. Dovciak, I. George, P. Uttley, S. Deluit, S. Bianchi

The Seyfert 1.8 ESO 113-G010 (z=0.0257) was observed for the first time above 2 keV with XMM-Newton in May 2001 during a short exposure time of 4 ks. A significant narrow emission Gaussian line at 5.4 keV in the object rest-frame was detected at 99% confidence (from performing Monte Carlo simulations), most probably originating from a redshifted iron Kalpha line. The energy of the line could have indicate either emission from relativistic (0.17-0.23 c) ejected matter moving away from the observer; or emission from a small, localized hot-spot on the disk, occurring within a fraction of a complete disk orbit. Here we will present the time-resolved spectroscopy analysis of a much longer observation of about 103 ks hold in November 2005.

XMM-Newton observation of MKN 766 (Invited)

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L. Miller, J. Reeves, I.M. George, D. Porquet, K. Nandra

XMM data from Mrk 766 have revealed rapid energy shifts in the peak of the Fe-K emission, and rapid flux variability in the ionized component of Fe-K emission tightly correlated with flux variability in the X-ray continuum down to $\sim$ 10 ksec. These discoveries strengthen the oft-debated assertion that a significant fraction of Fe Kα emission originates from the inner accretion disk.

Chapter 6

Broad iron lines and reflection in AGN

Broad iron lines or absorption processes in NLS1s: Status report (Invited)

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We describe the present knowledge on the underlying pyhsics of sharp spectral drops observed in NLS1s. We critically review the line emission model and the absorption scenario and describe the future strategy to completely solve these puzzling observational effects. Associated aspects like outflows, BH mass growth rates and metallicity effects will also be included.

The complex iron emission line of MCG-5-23-16: the long XMM-Newton look

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On December 2005 the bright Seyfert 1.9 galaxy MCG-5-23-16 has been target of simultaneous and deep X-ray observations with all the major X-ray observatories (XMM-Newton, Chandra, RXTE and SUZAKU). The energy resolution and the broad bandpass covered with this X-ray campaign allowed us to conduct a spectral variability study as well as an investigation of the complex profile of the broad iron K alpha emission line. We present the main results on the different components of the Fe line which is confirmed to be a superposition of a narrow and a relativistically broadened Fe line and we show that MCG-5-23-16 presents the signatures of both a Compton-thin and a Compton-thick reprocessor. The spectral variability study preformed within this last XMM-Newton exposure and comparing with previous observations shows no significant variation of the Fe lines fluxes. Interestingly this study shows the possible presence of an transient absorption feature at E$\sim$7.8 keV; which could be explained as sporadic high velocity outflow.

Discovery of a Double Peaked Fe Emission Line and X-ray BALs in Quasar H1413+117

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We present results from a Chandra observation of the low-ionization broad absorption line (LoBAL) quasar H 1413+117 (Cloverleaf quasar). Our analysis of the individual spectra of the images indicates the presence of a double peaked Fe emission feature near the rest-frame energy of 6.4 keV. In the combined spectrum of the images the Fe emission feature is detected at the greater than the 97% confidence level and its shape is reminiscent of the skewed broad iron line detected in several Seyfert 1 galaxies. The Fe Ka emission in the Cloverleaf quasar is fit well with an accretion disk-line model, however, the best-fit accretion disk model parameters are not well constrained or unique. Additional observations are required to constrain better the parameters of the accretion disk model. The significant absorption of the direct emission from the central source has resulted in the increased equivalent widths of the observed Fe emission thus making possible for the first time the detection of the inner regions of the accretion disk of a LoBAL quasar. The deep observation of H 1413+117 has also revealed several remarkable absorption features. The spectra of images C and D show significant high-energy broad absorption lines that extend up to rest-frame energies of 9 keV and 15 keV, respectively. We investigate several plausible scenarios to explain the spectral differences between the images.

The relativistic disc reflection model - soft excesses and more

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A.C. Fabian, L. Gallo, R. Ross, G. Miniutti

We present the results of relativistic disc reflection model fits to XMM-Newton X-ray observations. The fits allow us to explain the features of the spectrum, such as the soft excess, and derive information about the central black hole. We also present our attempts to apply the model over a larger wavelength range, using UV data and the Hard X-ray Detector (HXD) on Suzaku.

Flux dependency on the level of spectral complexity in NLS1

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The sharp spectral drops or gradual curvature found in the 2-10 keV spectra of some NLS1 can be attributed to either absorption or reflection. In this presentation I show that the level of complexity is dependent on the X-ray flux state of the AGN. I then discuss how how this can be understood in the framework of current models.

XMM Monitoring observations of Markarian 3 (Poster)

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We present preliminary results on the analysis of 12, monitoring short (2-14 ks) XMM-Newton observations of Markarian-3 spanning a period of 18 months. We combine these with an available public observation of about 100 ks increasing the observing time range to 23 months. We discuss the implications of the monitoring observations, with emphasis on the Fe lines, to the physical conditions and the geometry of the circumnuclear region.

Statistics of broad iron lines in AGN (Invited)

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How common are the general relativistical effects traced by broad and skewed iron line profiles in Active Galactic Nuclei (AGN)? In my talk I will review our current understanding of the "statistics" of broad iron lines, on the basis of Chandra and XMM-Newton results on larg(ish) sample of (mainly type 1) AGN.

4U 1344-60: A bright Seyfert 1.5 with relativistic Fe Kα emission features

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E. Piconcelli, M. Sanchez-Portal, M. Guainazzi, A. Martocchia et al.

We will present the analysis of optical and X-ray data of the bright INTEGRAL source 4U 1344-60. On the basis of the optical data we propose to classify 4U 1344-60 as a Seyfert 1.5 galaxy. The XMM-Newton spectra is complex and can be described as a power law obscured by two neutral absorption components. 4U 1344-60 exhibits a broad and skewed iron line most likely originated in the accretion disk. The analysis also reveals the presence of two narrow emission line-like features at ~ 4.9 keV and ~ 5.2 keV.

The X-ray spectral variability of the Seyfert I galaxy MCG-6-30-15 (Poster)

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The spectral variability of the Seyfert I galaxy MCG-6-30-15 is studied using two long XMM-Newton observations taken in 2000 and 2001. The source has previously been well fitted with a two component model consisting of a variable power law and a much more constant reflection component containing a broad relativistic iron line. The lack of variability of the reflection component has been interpreted as an effect of strong gravitational light bending very close to the central black hole. Using an improved reflection model and the most recent calibrations, the two component model was fitted to 39 x 10 ks spectra of both observations. The reflection component shows a larger variability than previously found but is still uncorrelated with variations in the power law. This result is consistent with the predictions of the light-bending model.

Suzaku's confirmation of the broad Fe line in NGC 3516

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Suzaku SWG AGN Team

Suzaku's contributions to our understanding of the broad and narrow Fe K lines and Compton reflection hump in Seyfert AGN thus far are reviewed. Results from the Suzaku SWG observation of the Seyfert 1 NGC 3516 will be presented. Suzaku's broad bandpass allows us to simultaneously disentangle the coronal continuum, Compton reflection hump, broad and narrow Fe K alpha and K beta lines, photo-ionized absorbing components, and scattered continuum, thereby removing model degeneracies inherent in previous analyses. The presence of the broad line is thus confirmed by Suzaku in NGC 3516, as well as in several other Seyferts (MCG-5-23-16, NGC 2110, MCG-6-30-15). Furthermore, in at least two Seyferts (MCG-5-23-16 and MCG-6-30-15), there is evidence for the reflection components to be constant in time.

Continuum reflection from AGN

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T.J. Turner, J.N. Reeves, I.M. George

Reflected iron-line emission must have an associated reflected continuum component. We discuss the evidence for continuum reflection components in the X-ray spectra of AGN, and in particular use analysis of continuum spectral variability to separate reflected and direct continuum components in those AGN with good data. We discuss the relationship of these components to the reflected iron-line emission, and discuss what may be learnt about both the ionisation and location of the line and continuum reflection.

Automated spectral and timing analysis of AGN spectra (Poster)

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Our script for steering of analysis of data from PN/MOS detectors of XMM was developped with the aim of automated search (using XSPEC) for lines and other interesting features in 2-8 keV range of spectra of selected AGNs (focusing on disk emission). The eventlists extracted in this process where studied further applying special methods for 2-D analysis in the phase space that combines energy distributions, lightcurves and their spectral densities.

XMM observations of broad lines in Seyfert galaxies

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P. O'Neill, I.M. George, T.J. Turner, J.N. Reeves

We present the results from a survey of a large sample of Seyfert galaxies observed by XMM-Newton, concentrating on their iron line properties. We discuss how commonly broad emission is seen around the iron-K complex, and the robustness of its interpretation as emission from a relativistic accretion disk.

Fourier resolved spectroscopy of AGN using XMM-Newton data (Invited)

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Fourier-resolved X-ray spectroscopy is a powerful new method that can be used to study in a new way the spectral variability of AGN. Its usefulness lies on the fact that the Fourier frequency-resolved spectra receive significant contribution only from the spectral components (e.g. soft excess, power-law, iron line) that are variable on the time scales sampled by the observations. We will describe briefly how the method works, and summarize past results from the application of this method to Galactic Black Hole binaries. We will present new results, putting emphasis on those regarding the variability properties of the iron line, from the Fourier-resolved spectroscopy of seven AGN using archival, long XMM observations. Finally, we will briefly discuss these results within the context of simple X-ray reprocessing models.

Unveiling the X-ray broad band continuum and iron line complex in Mkn 841

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A strong soft excess and a complex iron line profile are known to be present in this source since a long time. Recent XMM-Newton observations perform in 2001 (simultaneously to BeppoSAX) and 2005 not only confirm their presence but reveal their extreme and puzzling spectral and temporal behaviors. The soft X-ray flux decreases by a factor ~ 3 in 4 years while the 3-10 keV photon index strongly hardens. Moreover, rapid variability (on ~ 15 ks time scale) of the broad and narrow line components is clearly observed during the 2005 pointing. We present a detailed spectral analysis of this data showing that the 0.5-10 keV emission can be entirely explained by the combination of a relativistically blurred photoionized reflection, producing simultaneously the soft excess and the broad iron line, and a neutral, unblurred, one producing the narrow line. Possible physical interpretations are discussed.

XMM-Newton study of the spectral variability of NGC 4051 and IRAS 13224-3809

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A new interpretation of the X-ray spectral variability of the two Narrow Line Seyfert 1 galaxies NGC 4051 and IRAS 13224-3809 will be presented. The nuclear emission is decomposed into two variable components: a direct power-law from a hot corona plus a relativistic ionized reflection from a Kerr disc. The reflected component seems to correlate with the direct component only at low flux, being almost constant elsewhere. This behaviour is predicted by models in which the light bending effect is dominant, thus, these data are consistent with the nuclear emission coming from a few gravitational radii from the central black hole.

AGN outflows and its effect on observations of the Iron K line (Invited)

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The properties of AGN outflows in the X-ray band are reviewed. High resolution observations with XMM-Newton and Chandra have shown that the majority of AGN possess warm absorbers, arising from outflowing matter with velocities of 1000 km/s. In addition there are claims of high velocity outflows seen in the iron K band, which may result from an outflow driven off the inner accretion disk. I illustrate how the modeling of the warm absorber can affect the profile of the iron line. Indeed many AGN can be modeled with a narrow iron line from distant matter when the effects of the WA are taken into account, without requiring a broad relativistic line. To break the degeneracies inherent in modeling the iron line, broad spectral bandpass is needed to account for both the soft X-ray absorption and the high energy reflection hump. I will show examples based on early Suzaku data to illustrate how this can be achieved. Once the exact form of the high energy continuum is known, then the profile of the broad iron line can be accurately constrained.

Evidence for a Broad Iron Line in the Seyfert 2 galaxy F 02581-1136 (Poster)

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F. Nicastro, G. Matt, M. Guainazzi, A. Martocchia, F. Panessa

We report on the analysis of XMM-Newton (EPIC and MOS) data of the nearby (z=0.0299), low-luminosity (F(2-10 keV) = $3{\cdot}10^{42}$ cgs) Seyfert 2 galaxy F02581-1136. The optical polarimetric spectrum of F 02581-1136 shows the presence of hidden BLR, so revealing its intrinsic nature of type-1 AGN. We observed F 02581-1136 with XMM-Newton, for 19 ks. The EPIC spectra of this source confirm that our line of sight to the nucleus is obscured by a large column of neutral gas ($N_H >\sim 1 \cdot 10^{24}$ cm^{-2}). Interestingly, the EPIC-PN spectrum of F 02581-1136 also shows, at moderately high significance (P(>F) < 0.01, when comparing a gaussian with a gravitationally broadened emission line), the presence of a relativistically broadened Iron line at 6.4 keV (rest frame). MOS1 and MOS2 spectra confirm (at lower significance) these findings.

Observations of Iron Lines and Reflection in AGN with Suzaku (Invited)

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We present Suzaku observations of AGN in the Guaranteed time phase of the mission. Here, preliminary results on the iron K line and Compton reflection component will be presented. The early Suzaku data show complex iron lines in many AGN, with both narrow and broad components of the lines present in many Seyfert galaxies. The broad bandpass of Suzaku allows tight constraints to be placed on the continuum and the Compton reflection component is detected in several sources. Suzaku's bandpass also removes much of the ambiguity in modeling the broad component of iron K associated with the inner accretion disk. The narrow iron K lines can be resolved in a few cases, which when coupled with accurate measurement of the calibration lines, can place limits on the location of the emitting material (e.g. outer BLR, torus). Time resolved studies of the iron line and reflection component can be performed. In a few sources (e.g. MCG -6-30-15, MCG -5-23-16), both the iron line and reflection hump appear to be less variable than the primary continuum emission.

Chapter 7

Summary & Outlook

Summary & Outlook (Invited)

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(Abstract not available)

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