| Active Galaxies Newsletter | *An electronic publication dedicated to the observation and theory of active galaxies* |
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*Abstracts - Thesis Abstracts - Jobs - Meetings*

## From the Editor

The Active Galaxies Newsletter is produced monthly. The deadline for contributions is the last friday of the month. The Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter and are also available on the web page.
Matt Redman

## Abstracts of recently accepted papers

### The Steep Spectrum Quasar PG1404+226 with ASCA, HST and ROSAT


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We present and discuss our observations of the Narrow Line quasar PG1404+226 ($z_{em} = 0.098$) with ASCA and HST, and a re-analysis of our earlier observations with ROSAT. The soft X-ray spectrum is very steep and displays an absorption feature (edge or line at $\sim$ 1.1 keV). We have applied a variety of models to the ASCA and ROSAT spectra without finding a completely satisfactory fit, and the identification of the edge remains uncertain. A satisfactory fit of the ASCA spectrum assuming that the edge is produced by highly ionized iron (using the code absori in XSPEC) is obtained with an overabundance of iron by a factor $\geq$ 25 compared to solar, a suggestion supported by the extremely high equivalent width of the Fe K$\alpha$ line at 6.4 keV. A warm absorber model ( based on Cloudy) fitting the absorption feature with NeVII-NeX edges and assuming a peculiar oxygen/neon abundance ratio is consistent with the ROSAT data but not the ASCA data. Finally, it is also possible that the observed edge is caused by a OVIII or OVII edge or line, blueshifted by $z_{abs} = 0.2$ to 0.5 depending on the specific identification, as has been suggested previously for 2 other Narrow Line quasars, but there are no other features in the UV and X-ray spectra in support of this suggestion.

Two systems of UV absorption lines, one nearly at rest in the source frame, the other blueshifted by $\sim$ 1900 km s$^{-1}$ are identified in the HST/FOS spectra. Photoionization models indicate that the UV absorption and the $\sim$ 1 keV absorption are probably caused by absorbers with different physical conditions. PG1404+226 is one more case of AGN where both UV and X-ray absorption features are detected, thereby increasing further the significance of the previously noted statistical association of the two types of absorbers.



Accepted for publication in A&A



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## High resolution X-ray imaging observations of two low-luminosity Seyfert galaxies

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Results from observations of two *nearby, low X-ray luminosity* Seyfert-type galaxies, namely, NGC 1365, and NGC 4051, using the *ROSAT* High Resolution Imager (HRI) are presented. The observations carried out with the aim of detecting and resolving the extra-nuclear (beyond the central 5"–10") X-ray emission show evidence for an extended component of ≃2 kpc size in NGC 1365 and NGC 4051. The extended component contains 56±8% of the total observed flux in the case of NGC 1365, and 21%±6% in the case of NGC 4051. In NGC 1365, the extended X-ray emission shows a component aligned with the inner disk structure, another as wings or ears along the east and west direction aligned with the inner spiral arms, and an elongated edge-brightened structure ("chimney") breaking out of the disk in the north-west direction. The extended soft X-ray component around the nucleus of NGC 4051 is co-spatial with the disk of the galaxy. It also shows an elongation coincident with a "banana"-like feature in the north-east seen in the 6 cm radio band. Extensions are also seen towards the south and south-east of the nucleus. Starburst activity driving strong winds through the disk of NGC 1365 can account for most of the extended soft X-ray emission in it. In the case of NGC 4051, extended X-ray emission probably owes its origin to both nuclear activity as well as starburst induced activity.

The nuclear component of NGC 4051 shows strong soft X-ray variability with X-ray intensity changing by a factor of 2–3 on a time-scale of a few 100s. The power-spectrum of the variability has been extended to higher frequencies compared to the previous observations, and has now reached the true Poissonian noise level due to the source. At lower frequencies the power spectrum is best characterised by a power-law and a Gaussian. The power-law slope of ≃-1.8 is consistent with the previous low-energy observations with *EXOSAT*, and the presence of a Gaussian feature signifies the persistence of a quasi-periodic oscillation that was also seen earlier with *EXOSAT*. During its low intensity and low variability state, however, the extended component of soft X-ray emission dominates the flux in NGC 4051.

A list of X-ray sources, some of which are new, detected in the field of view of the HRI during the observations, is also presented.

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## X-ray properties of LINERs

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We present an investigation of the X-ray properties of 13 LINERs based on *ROSAT* all-sky survey and pointed PSPC and HRI observations. Several sources are studied for the first time in X-rays. The X-ray spectra are best described by a powerlaw with photon index $\Gamma_x \approx -2.0$ or thermal emission from gas with very subsolar abundances. The luminosities range between $\log L_x = 37.7$ (NGC 404) and 40.8 (NGC 4450). No X-ray variability on the timescale of hours/days is detected. This is in line with the suggestion that LINERs may accrete in the advection-dominated mode. On a longer term, one of the objects, NGC 2768, turns out to be slightly variable. Some sources appear to be extended at weak emission levels whereas the bulk of the X-ray emission is consistent with arising from a point source within the PSPC instrumental resolution. $L_x/L_B$ ratios are derived and emission mechanisms that potentially contribute to the observed X-ray luminosities are discussed.

We also examine the presence of bright second X-ray sources near the target sources both in terms of instrumental effects and in terms of 'real' sources within the LINER galaxies.

A&A, in press

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Preprint available at http://www.xray.mpe.mpg.de/~skomossa/ , at astro-ph/9907119, and as MPE Preprint 469/1999

## Testing Narrow-line Seyfert 1 scenarios with photoionization models

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Narrow Line Seyfert 1 (NLSy1) galaxies have recently received a lot of attention due to their unusual optical–X-ray properties which are not yet well understood. Photoionization models of the circum-nuclear emission/absorption regions allow to investigate scenarios to explain the main characteristics of NLSy1s, i.e., (i) extremely steep X-ray spectra within the ROSAT energy range, (ii) narrow Balmer lines and (iii) weak forbidden lines except for some relatively strong high-ionization iron lines. Here, we focus on (iii). In particular, we study the influence of different EUV - soft-X-ray spectral shapes (a giant soft excess, a steep X-ray powerlaw, presence of a warm absorber) and NLR cloud properties on the predicted optical emission-line ratios. The calculations were carried out with Ferland's code Cloudy.

Contribution to "Heating and Acceleration in the Universe" (Tokyo, March 17-19, 1999), H.Inoue et al. (eds);
*Astronomische Nachrichten* 320, 1999, in press

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Preprint available at http://www.xray.mpe.mpg.de/~skomossa/ and astro-ph/9907373

## Two little blazars

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Optical polarization observations are presented of two low-luminosity flat-spectrum radio sources with optical broad lines. Both objects have significantly polarized optical continuum. The polarization is diluted by the H$\alpha$ broad line, and must therefore be at least partly a continuum phenomenon. The objects therefore have all the properties of classical BL Lac objects, except, like BL Lac itself, they display significant broad lines for at least some of the time. The finding further blurs the distinction between BL Lac objects and other types of low-redshift, radio loud active galaxies.

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E-mail contact: njj@jb.man.ac.uk, preprint available from anonymous ftp to ftp.jb.man.ac.uk, cd pub/njj, get mini.ps.gz

## Symbiotic starburst-black hole AGN – I. Isothermal hydrodynamics of the mass-loaded ISM

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Compelling evidence associates the nuclei of active galaxies and massive starbursts. The symbiosis between a compact nuclear starburst stellar cluster and a massive black hole can self-consistently explain the properties of active nuclei. The young stellar cluster has a profound effect on the most important observable properties of active galaxies through its gravity, and by mass injection through stellar winds, supernovae and stellar collisions. Mass injection generates a nuclear ISM which flows under gravitational and radiative forces until it leaves the nucleus or is accreted onto the black hole or accretion disc.

The radiative force exerted by the black hole–accretion disc radiation field is not spherically symmetric. This results in complex flows in which regions of inflow can coexist with high Mach number outflowing winds and hydrodynamic jets. We present two-dimensional hydrodynamic models of such nISM flows, which are highly complex and time variable. Shocked shells, jets and explosive bubbles are produced, with bipolar winds driving out from the nucleus. Our results graphically illustrate why broad emission line studies have consistently failed to identify any simple, global flow geometry. The real structure of the flows is *inevitably* yet more complex.

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preprint available at http://ast.leeds.ac.uk/ rjrw/agn.html or as astro-ph/9907198

## NICMOS Imaging of Molecular Hydrogen Emission in Seyfert Galaxies

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We present NICMOS imaging of broad band and molecular hydrogen emission in Seyfert galaxies. In 6 of 10 Seyferts we detect resolved or extended emission in the 1-0 S(1) 2.121 micron or 1-0 S(3) 1.9570 micron molecular hydrogen lines. We did not detect emission in the most distant galaxy or in 2 Seyfert 1 galaxies because of the luminosity of the nuclear point sources. In NGC 5643, NGC 2110 and MKN 1066, molecular hydrogen emission is detected in the extended narrow line region on scales of a few hundred pc from the nucleus. Emission is coincident with [OIII] and H alpha + [NII] line emission. This emission is also near dust lanes observed in the visible to near-infrared color maps suggesting that a multiphase medium exists near the ionization cones and that the morphology of the line emission is dependent on the density of the ambient media. The high 1-0 S(1) or S(3) H2 to H alpha flux ratio suggests that shock excitation of molecular hydrogen (rather than UV fluorescence) is the dominant excitation process in these extended features. In NGC 2992 and NGC 3227 the molecular hydrogen emission is from 800 and 100 pc diameter 'disks' (respectively) which are not directly associated with [OIII] emission and are near high levels of extinction AV > 10). The molecular hydrogen emission in NGC 4945 appears to be from the edge of a 100 pc superbubble. The molecular gas in these 3 galaxies could be excited by processes associated with local star formation. We confirm previous spectroscopic studies finding that no single mechanism is likely to be responsible for the molecular hydrogen excitation in Seyfert galaxies.

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preprint available at astro-ph/9907011

## X–ray Spectral Variability of PKS 2005-489 During the Spectacular November 1998 Flare

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We report on monitoring of the BL Lac object PKS 2005−489 by the Rossi X–ray Timing Explorer (RXTE) in October-December 1998. During these months, the source underwent a spectacular flare; at its peak on November 10, its 2−10 keV flux was $3.33 \times 10^{-10}$ erg cm$^{-2}$ s$^{-1}$, over 30 times brighter than in quiescence. During the rising phase, the X–ray spectrum of PKS 2005−489 hardened considerably, reaching $\alpha = 1.32$ ($F_\nu \propto \nu^{-\alpha}$) near maximum. During the declining phase, the X–ray spectrum steepened rapidly, reaching $\alpha = 1.82$, then became somewhat harder towards the end of December ($\alpha \sim 1.6$). While such behavior has been seen before, the simplicity, magnitude and duration of this flare allowed us to study it in great detail. We argue that this flare was caused by either the injection of particles into the jet or *in situ* particle acceleration, and that the spectral steepening which followed the flare maximum was the result of synchrotron cooling. Contrary to other recently observed blazar flares (e.g., Mkn 501, 3C 279, PKS 2155-304), our results do not imply a major shift in the location of the synchrotron peak during this flare.

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## Magneto-Centrifugal Launching of Jets from Accretion Disks I: Cold Axisymmetric Flows

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The magneto-centrifugal model for jet formation is studied by time-dependent simulations reaching steady state in a gas with negligible fluid pressure, in an axisymmetric geometry, using a modification of the ZEUS3D code adapted to parallel computers. The number of boundary conditions imposed at the wind launching surface takes into account the existence of the fast and Alfvénic critical surfaces, avoiding over-determination of the flow and allowing fieldline inclination to vary in time. The size and shape of the computational box is chosen to include these critical surfaces, reducing the influence of the outer boundary conditions. As there is a region, near the origin, where the inclination $\theta$ of field lines to the axis is too small to drive a

centrifugal wind ($\theta < 30°$), we inject a thin, axial jet, as expected to form electromagnetically near black holes in AGN and Galactic superluminal sources. Acceleration and collimation appear for wide generic conditions. A reference run is shown in detail, with a wind leaving the computational volume in the axial direction with a poloidal velocity equal to 4 times the poloidal Alfvén speed, collimated inside an angle $\sim 11°$. Finally, the critical surfaces, fieldlines, thrust, energy, torque and mass discharge of the outgoing wind are shown for simulations with various profiles of mass and magnetic flux at the base of the wind.

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## Galactic Fountains and Galactic Winds

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The development of galactic fountain theories is reviewed with special emphasis on the different approaches and concepts that have been used in the past. In particular the outstanding contribution of Franz Kahn to our *physical* understanding is appreciated. It is argued that galactic outflows represent an essential phase during galaxy evolution. The dynamics of the outflow imprints its signature on the emission spectra of soft X-rays, which may well be observable with AXAF and XMM. Finally, some remarks about winds in starburst galaxies and AGN are made.

12 pages, contribution to “Astrophysical Dynamics” (held in honour of Franz Kahn; Evora, April 1999), D. Berry, D. Breitschwerdt, A. da Costa, J. Dyson (eds); *Ap&SS*, in press

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## The properties of the relativistic iron K-line in NGC 3516

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We present an analysis of the relativistic iron K$\alpha$ line in the Seyfert 1 galaxy NGC 3516, based on a continuous, five-day ASCA observation. The broad profile which has been found in several other AGN is confirmed in NGC 3516 with unprecedented signal-to-noise ratio. Disk-line models with either a Kerr or Schwarzschild metric fit the integrated profile, but both require emission very strongly concentrated in the inner disk. We find tentative evidence for the line signatures of Ni K$\alpha$ and/or Fe K$\beta$. The continuum flux varied by $\sim 50$ per cent during the observation and time-resolved analysis shows that the line also changes. The line core seems to follow the continuum, but the blue wing is unrelated and shows a greater amplitude (factor $\sim 2$) of variability. The red wing is formally consistent with a constant but appears to be correlated with the blue wing. We interpret this as evidence for independent variability of the broadest parts of the line. There also appears to be an absorption feature in the profile, consistent with resonance scattering in infalling material. This variable feature may be the signature of material being accreted by the central black hole.

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## On the Nature of Soft X-ray Weak Quasi-Stellar Objects

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Recent studies of Quasi-Stellar Objects (QSOs) with *ROSAT* suggest the existence of a significant population of Soft X-ray Weak QSOs (SXW QSOs) where the soft X-ray flux is $\sim$ 10–30 times smaller than in typical QSOs. Why are these QSOs soft X-ray weak, and what is their relationship to Broad Absorption Line QSOs (BAL QSOs) and X-ray warm absorber QSOs? As a first step in a systematic study of these objects, we establish a well-defined sample of SXW QSOs which includes all $\alpha_{\rm ox} \leq -2$ QSOs from the Boroson & Green (1992) sample of 87 Bright Quasar Survey QSOs. SXW QSOs comprise $\approx 11\%$ of this optically

selected QSO sample, and we find soft X-ray weakness in both radio-quiet and radio-loud QSOs. ¿From an analysis of C IV absorption in the 55 BG92 QSOs with available C IV data, we find a remarkably strong correlation between $\alpha_{\rm ox}$ and the C IV absorption equivalent width. This correlation suggests that absorption is the primary cause of soft X-ray weakness in QSOs, and it reveals a continuum of absorption properties connecting unabsorbed QSOs, X-ray warm absorber QSOs, SXW QSOs and BAL QSOs. Many of our SXW QSOs have ultraviolet absorption that is intermediate in strength between that of X-ray warm absorber QSOs and that of BAL QSOs, and their X-ray absorption is also likely to be of intermediate strength. From a practical point of view, our correlation demonstrates that selection by soft X-ray weakness is an effective ( $\gtrsim 80\%$ successful) and observationally inexpensive way to find low-redshift QSOs with strong and interesting ultraviolet absorption.

We have also identified several notable differences between the optical emission-line properties of SXW QSOs and those of the other Boroson & Green QSOs. SXW QSOs show systematically low [O III] luminosities and equivalent widths as well as distinctive H$\beta$-line profiles. They tend to lie toward the weak-[O III] end of Boroson & Green eigenvector 1, as do many low-ionization BAL QSOs. Unabsorbed Seyferts and QSOs with similar values of eigenvector 1 have been suggested to have extreme values of a primary physical parameter, perhaps mass accretion rate relative to the Eddington rate ($\dot{M}/\dot{M}_{\rm Edd}$). If these suggestions are correct, it is likely that SXW QSOs also tend to have generally high values of $\dot{M}/\dot{M}_{\rm Edd}$. Finally, we present and discuss correlations between $\alpha_{\rm ox}$ and other QSO observables after removal of the SXW QSOs.

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## Evidence for an ionised disc in the narrow-line Seyfert 1 galaxy Ark 564

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We present simultaneous ASCA and RXTE observations of Ark 564, the brightest known "narrow-line" Seyfert 1 in the 2–10 keV band. The measured X-ray spectrum is dominated by a steep ($\Gamma \approx 2.7$) power-law continuum extending to at least 20 keV, with imprinted Fe K-line and -edge features and an additional "soft excess" below $\sim 1.5$ keV. The energy of the iron K-edge indicates the presence of highly ionised material, which we identify in terms of reflection from a strongly irradiated accretion disc. The high reflectivity of this putative disc, together with its strong intrinsic O VIII Ly-$\alpha$ and O VIII recombination emission, can also explain much of the observed soft excess flux. Furthermore, the same spectral model also provides a reasonable match to the very steep 0.1–2 keV spectrum deduced from ROSAT data. The source is much more rapidly variable than "normal" Seyfert 1s of comparable luminosity, increasing by a factor of $\sim$50% in 1.6 hours, with no measurable lag between the 0.5–2 keV and 3–12 keV bands, consistent with much of the soft excess flux arising from reprocessing of the primary power-law component in the inner region of the accretion disc. We note, finally, that if the unusually steep power-law component is a result of Compton cooling of a disc corona by an intense soft photon flux, then the implication is that the bulk of these soft photons lie in the unobserved extreme ultraviolet.

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example:

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preprint available: astro-ph/9906445 or from http://ledas-www.star.le.ac.uk/Preprint/

# Announcements

## The Tartarus Database of ASCA Observations of AGN

We are proud to announce the release of version 1 of the tartarus database. For more details, please visit:

http://tartarus.gsfc.nasa.gov/

The database contains reduced images, spectra and light curves for ASCA observations of active galaxies and is currently complete up the the end of the AO-5 phase of the mission.

We hope you find this database useful, and welcome your comments to our helpdesk at:

tartarus@olegacy.gsfc.nasa.gov

Please pass on this message to colleagues who may be interested in the database. They can e-mail us if they wish to be added to the tartarus mailing list, which will be used infrequently to inform people of updates to tartarus and other related matters.

Best Regards,

The Tartarus Team http://tartarus.gsfc.nasa.gov/doc/team.html

The Active Galaxies Newsletter is available on the World Wide Web. You can access it via the University of Manchester home page :- http://www.ast.man.ac.uk/∼mpr/agn/