Active Galaxies Newsletter	*An electronic publication dedicated to the observation and theory of active galaxies*
No. 31 — October 1999	Editor: Matt Redman (mpr@ast.man.ac.uk)

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

Hubble Space Telescope Observations of the CfA Seyfert 2s: The Fueling of Active Galactic Nuclei

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We present an investigation of possible fueling mechanisms operating in the inner kiloparsec of Seyfert galaxies. We analyze visible and near-infrared *Hubble Space Telescope* images of 24 Seyfert 2s from the CfA Redshift Survey sample. In particular, we are searching for the morphological signatures of dynamical processes reponsible for transporting gas from kiloparsec scales into the nucleus. The circumnuclear regions are very rich in gas and dust, often taking the form of nuclear spiral dust lanes on scales of a few hundred parsecs. While these nuclear spirals are found in 20 of our 24 Seyferts, we find only 5 nuclear bars among the entire sample, strongly reinforcing the conclusions of other investigators that nuclear bars are not the primary means of transporting this material into the nucleus. An estimate of the gas density in the nuclear spirals based on extinction measurements suggests that the nuclear spiral dust lanes are probably shocks in nuclear gas disks that are not strongly self-gravitating. Since shocks can dissipate energy and angular momentum, these spiral dust lanes may be the channels by which gas from the host galaxy disks is being fed into the central engines.

Accepted by The Astronomical Journal

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Polarimetry and Unification of Low-Redshift Radio Galaxies

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We have made high-quality measurements of the polarization spectra of 13 FR II radio galaxies and taken polarization images for 11 of these with the Keck telescopes. Seven of the eight narrow-line radio galaxies (NLRG) are polarized, and six of the seven show prominent broad Balmer lines in polarized light. The broad lines are also weakly visible in total flux. Some of the NLRG show bipolar regions with roughly circumferential polarization vectors, revealing a large reflection nebula illuminated by a central source. Our observations powerfully support the hidden quasar hypothesis for some NLRG. According to this hypothesis, the continuum and broad lines are blocked by a dusty molecular torus, but can be seen by reflected, hence polarized, light. Classification as NLRG, broad-line radio galaxy (BLRG), or quasar therefore depends on orientation. However, not all objects fit into this unification scheme. Our sample is biased towards objects known in advance to be polarized, but the combination of our results with those of Hill, Goodrich, & DePoy (1996) show that at least 6 out of a complete, volume and flux-limited sample of 9 FR II NLRG have broad lines, seen either in polarization or Pα.

The BLRG in our sample range from 3C 382, which has a quasar-like spectrum, to the highly-reddened IRAS source FSC 2217+259. This reddening sequence suggests a continuous transition from unobscured quasar to reddened BLRG to NLRG. Apparently the obscuring torus does not have a distinct edge. The BLRG have polarization images which are consistent with a point source broadened by seeing and diluted by starlight. We do not detect extended nebular or scattered emission, perhaps because it is swamped by the nuclear source. Our starlight-corrected BLRG spectra can be explained with a two-component model: a quasar viewed through dust, and quasar light scattered by dust. The direct flux is more reddened than the scattered flux, causing the polarization to rise steeply to the blue. Strong rotations of the electric vector position angle across Hα in 3C 227 and 3C 445 may be explained by systematic orbital motions in an equatorial broad-line region.

Astron. J. November 1999

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see astro-ph 9909125

Near-infrared photometry of isolated spirals with and without an AGN. I: The Data

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We present infrared imaging data in the J and K' bands obtained for 18 active spiral galaxies, together with 11 non active galaxies taken as a control sample. All of them were chosen to satisfy well defined isolation criteria so that the observed properties are not related to gravitational interaction. For each object we give: the image in the K' band, the sharp-divided image (obtained by dividing the observed image by a filtered one), the difference image (obtained by subtracting a model to the observed one), the color J-K' image, the ellipticity and position angle profiles, the surface brightness profiles in J and K', their fits by bulge+disk models and the color gradient.

We have found that four (one) active (control) galaxies previously classified as non-barred turn out to have bars when observed in the near-infrared. One of these four galaxies (UGC 1395) also harbours a secondary bar. For 15 (9 active, 6 control) out of 24 (14 active, 10 control) of the optically classified barred galaxies (SB or SX) we find that a secondary bar (or a disk, a lense or an elongated ring) is present.

The work presented here is part of a large program (DEGAS) aimed at finding whether there are differences between active and non active galaxies in the properties of their central regions that could be connected with the onset of nuclear activity.

Accepted by Astron. Astrophys. Suppl.

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A Possible 100-day X-ray-to-Optical Lag in the Variations of the Seyfert 1 Nucleus NGC 3516

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We present optical broadband (B and R) observations of the Seyfert 1 nucleus NGC 3516, obtained at Wise Observatory from 1997 March to 1998 September, contemporaneously with the X-ray 2–10 keV measurements of *RXTE*. The cross correlation function shows a positive peak when the optical variations lead the X-rays by $\sim$ 100 days, and anticorrelation peaks at various leads and delays between the X-rays and the optical. We show that the putative correlation signal at 100 days is entirely due to the slow ($\gtrsim$ 30 days) components of the light curves. During the first year or this monitoring, smoothed versions of the light curves are nearly identical copies of each other, but scaled in amplitude and shifted in time. However, for the next 200 days, the X-ray and optical variations are clearly different. During the whole period, the faster-changing components of the light curves are uncorrelated at any lag.

We consider the detection of these lags tentative and the significance of the correlations uncertain. If the 100-day delay is real, however, one interpretation is that that the slowly-varying part of the X-ray emission is an echo of the optical emission, Compton scattered from a medium located at, or extending, $\sim 50-100$ light days from the optical source. We point out that a possibly analogous phenomenon, of a lag between hard and soft X-rays for a given variability timescale, exists in Galactic stellar-mass accretors. Remarkably, in both cases the lag corresponds to a light travel distance of order 10^4 gravitational radii. Alternatively, the lag may not represent a physical size, but some other time scale. For example, it may be the manifestation of an instability propagating inward in an accretion flow, appearing first in the optical and then in the X-rays. In any event, we observe no strong correlation at zero lag, or at the small positive lags expected if the optical continuum were produced by reprocessing of X-rays. An energetically–significant reprocessed component in the optical emission of NGC 3516 is thus ruled out by our data.

Accepted by Astron. J.

E-mail contact: dani@wise.tau.ac.il . Paper available on astro-ph/9910023

Circumnuclear structure and kinematics in the active galaxy NGC 6951.

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A study is presented of the central structure and kinematics of the galaxy NGC 6951, by means of broad band *BIJK* images and high resolution high dispersion longslit spectroscopy, together with archival HST WFPC2 V and NICMOS2 J and H images. We find that there is little ongoing star formation inside the bar dominated region of the galaxy, except for the circumnuclear ring at 5 arcsec radius. There is some evidence that this star formation occurs in two modes, in bursts and continuously, along the ring and inwards, towards the nucleus. The equivalent width of the CaII triplet absorption lines show that, in the metal rich central region, the continuum is dominated by a population of red supergiants, while red giants dominate outside. The gaseous kinematics along three slit position angles, and the comparison with the stellar kinematics, suggest the existence of a hierarchy of disks within disks, whose dynamics are decoupled at the two inner Linblad resonances (ILR), that we find to be located at 180 pc and at 1100 pc. This is supported by the structure seen in the high resolution HST images. The nucleus is spatially resolved in the emission line ratio [NII]/Hα, and in the FWHM of the emission lines, within a radius of 1.5 arcsec, just inside the innermost ILR. Outside the iILR, the stellar CaT velocity profile is resolved into two different components, associated with the bar and the disk. Several results indicate that this is a dynamically old system: the little ongoing star formation inside the bar dominated part of the galaxy, the very large relative amount of molecular to total mass within the inner 6 arcsec radius, $\sim 25\%$, and the geometry of the circumnuclear ring that leads the stellar bar at a position angle greater than 90 degrees. It is thus possible that a nuclear bar has existed in NGC 6951 that drove the gas towards the nucleus, as in the bars within bars scenario, but that this bar has already dissolved by the gas accumulated within the circumnuclear region. We discuss the possibility that the kinematical component inside the iILR could be due to a nuclear outflow produced by the combined effects of SN and SN remnants, or to a nuclear disk, as in the disk within disk scenario that we propose for the fueling of the AGN in NGC 6951.

Accepted by Astron. & Astrophys.

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X-rays from the Highly Polarized Broad Absorption Line QSO CSO 755

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We present results from a BeppoSAX observation of the BAL QSO CSO 755, observed as part of our program to investigate the X-ray properties of highly polarized BAL QSOs. CSO 755 is clearly detected by the BeppoSAX MECS, making it the highest redshift ($z = 2.88$) and most optically luminous ($M_V = -27.4$) BAL QSO seen in X-rays. It is detected in several energy bands including the rest-frame 21–39 keV band, but we are only able to place loose constraints upon its X-ray spectral shape. Our X-ray detection is consistent with the hypothesis that the BAL QSOs with high optical continuum polarization tend to be the X-ray brighter members of the class. We examine a scattering interpretation of a polarization/X-ray flux connection, and we discuss the data needed to prove or refute such a connection. We also discuss a probable ROSAT detection of CSO 755. The observed-frame 2–10 keV flux from BeppoSAX (1.3×10^{-13} erg cm^{-2} s^{-1}) is high enough to allow XMM spectroscopy, and studies of iron K line emission should prove of particular interest if a large amount of scattered X-ray flux is present.

Accepted by the Astrophysical Journal

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STIS Longslit Spectroscopy of the Narrow-Line Region of NGC 4151. II. Physical Conditions along Position Angle 221°

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We have examined the physical conditions in the narrow-line region of the well-studied Seyfert galaxy NGC 4151, using long-slit spectra obtained with the *Hubble Space Telescope*/Space Telescope Imaging Spectrograph (*HST*/STIS). The data were taken along a position angle of 221°, centered on the optical nucleus. We have generated photoionization models for a contiguous set of radial zones, out to $2''.3$ in projected position to the southwest of the nucleus, and $2''.7$ to the northeast. Given the uncertainties in the reddening correction, the calculated line ratios successfully matched nearly all the dereddened ratios. We find that the narrow-line region consists of dusty atomic gas photoionized by a power-law continuum that has been modified by transmission through a mix of low and high ionization gas, specifically UV and X-ray absorbing components. The physical characteristics of the absorbers resemble those observed along our line of sight to the nucleus, although the column density of the X-ray absorber is a factor of ten less than observed. The large inferred covering factor of the absorbing gas is in agreement with the results of our previous study of UV absorption in Seyfert 1 galaxies. We find evidence, specifically the suppression of Lα, that we are observing the back-end of dusty ionized clouds in the region southwest of the nucleus. Since these clouds are blueshifted, this supports the interpretation of the cloud kinematics as being due to radial outflow from the nucleus. We find that the narrow-line gas at each radial position is inhomogeneous, and can be modeled as consisting of a radiation-bounded component and a more tenuous, matter-bounded component. The density of the narrow-line gas drops with increasing radial distance, which confirms our earlier results, and may be due to the expansion of radially outflowing emission-line clouds.

Accepted by Astrophysical Journal

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The case for a low-level active nucleus in M32

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The X-ray emission from M32 has been studied with ROSAT PSPC and HRI observations. A new analysis of the best available PSPC exposure with M32 in the central part of the frame improves on a previously published analysis and indicates only one source associated with M32. The spectral data suggest absorption greater than the Galactic column. Our analysis of a dedicated HRI exposure of M32 also leads to different conclusions than published recently. At HRI resolution this source may be extended, with an offset from the optical nucleus that is not deemed reliably established. In view of these results, conceivable interpretations are discussed that refer to a low-level active nucleus or a Supernova Remnant, rather than an X-ray binary as has been proposed. A low-level AGN remains an attractive interpretation for this X-ray source.

Accepted by New. A.

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An ultra-soft X-ray source (RX 215319-1514) and discovery of a narrow line Seyfert 1 galaxy

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We present results on the identification of the optical counterpart of an ultra-soft X-ray source discovered with *ROSAT*. Two optical candidates – a galaxy and a star, are found within the error circle of the X-ray source position. Optical spectroscopy of the two candidates reveals that a) the galaxy is a narrow-line Seyfert type 1 galaxy, and b) the star is a late A-type or an early F-type. The F_x/F_{opt} ratio is too high for the star to be the counterpart of the X-ray source, but consistent with that for an active galaxy. Although higher resolution X-ray imaging of the region is needed to definitely settle the question of the counterpart of the X-ray source, the narrow-line Seyfert 1 galaxy is the best candidate. The spectral properties of the newly discovered narrow-line Seyfert 1 galaxy are also presented, including its extreme X-ray power law spectral index of $\Gamma \geq 4$.

Accepted by MNRAS

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STIS Longslit Spectroscopy Of The Narrow Line Region Of NGC 4151. I. Kinematics and Emission Line Ratios

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Longslit spectra of the Seyfert galaxy NGC 4151 from the UV to near infrared have been obtained with STIS to study the kinematics and physical conditions in the NLR. The kinematics show evidence for three components, a low velocity system in normal disk rotation, a high velocity system in radial outflow at a few hundred km s^{-1} relative to the systemic velocity and an additional high velocity system also in outflow with velocities up to 1400 km s^{-1}, in agreement with results from STIS slitless spectroscopy (Hutchings *et al.*, 1998, Kaiser *et al.*, 1999, Hutchings *et al.*, 1999) We have explored two simple kinematic models and suggest that radial outflow in the form of a wind is the most likely explanation. We also present evidence indicating that the wind may be decelerating with distance from the nucleus.

We find that the emission line ratios along our slits are all entirely consistent with photoionization from the nuclear continuum source. A decrease in the [OIII] λ5007 / Hβ and [OIII] λ5007 / [OII] λ3727 ratios suggests that the density decreases with distance from the nucleus. This trend is borne out by the [SII] ratios as well. We find no strong evidence for interaction between the radio jet and the NLR gas in either the kinematics or the emission line ratios in agreement with the results of Kaiser *et al.* (1999) who find no spatial coincidence of NLR clouds and knots in the radio jet. These results are in contrast to other recent

studies of nearby AGN which find evidence for significant interaction between the radio source and the NLR gas.

Accepted by The Astrophysical Journal

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The radio structures of southern 2-Jy radio sources: new ATCA and VLA radio images.

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We present new radio images obtained with the Australia Telescope Compact Array (ATCA) and the Very Large Array (VLA) for a group of 14 galaxies belonging to the 2-Jy sample of radio sources. The new images improve the data already available on these objects and, in general, the database that we are building up on the sample. They will also be used for follow-up work where radio-optical comparison will be done.
We briefly discuss the core dominance parameter (R) for the objects for which the new data have given new information and, in particular, for broad line radio galaxies (BLRG). One of the BLRG does not show a core, even at 3 cm, and this is at variance with the general tendency of BLRG to have relatively strong cores. The depolarization is also discussed for a group of small double-lobed radio galaxies.

Accepted by Astron. Astroph. Suppl.

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Structure of the Broad-Line Region of 3C 273

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The number of discrete emitters in broad-line region cloud models of active galactic nuclei is still unknown. A finite number of clouds will cause intrinsic fluctuations in the emission line profiles. We observed the quasar 3C 273 with high spectral resolution (R$\simeq$10 km s^{-1}) and high signal to noise ratio to estimate the number of individual emitters in the broad-line region. The residua of the emission-line wings of the low ionization lines Hα and Hβ were cross-correlated. We compared the results of the cross-correlation analysis with models of different cloud distributions. The smoothness of the line profiles implies lower limits to the number of individual clouds and to the width of the line profiles of these clouds. For emitters with a line profile width of FWHM $\simeq$ 15 km s^{-1} corresponding to a temperature of $T_e \simeq 2\,10^4$ K, we found that the number of clouds is larger than $N_{cl} = 10^8$. For clouds of significantly larger individual profile width (FWHM $\simeq$ 100 km s^{-1}) it is found that the number of clouds can be of the order of $N_{cl} \approx 10^8$. Since the number of individual emitters is several orders of magnitude larger than the number of stars involved in bloated star models these models can be ruled out as dominant source for broad-line region clouds. However, the non-detection of a cross-correlation signal is consistent with BLR models which assume a continuous hydrodynamical flow as source of the line emitting material.

Accepted by Astron & Astrophy.

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A search for broad infrared recombination lines in NGC 1068

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We report infrared spectroscopy of the prototypical Seyfert 2 galaxy NGC 1068, aiming at detection of broad components of hydrogen recombination lines that originate in the obscured broad-line region. Using the Short Wavelength Spectrometer on board the Infrared Space Observatory, we have observed for the first time the regions of Brackett β 2.626μm and Pfund α 7.460μm, and present improved data for Brackett α 4.052μm. No significant broad components are detected, implying an equivalent visual extinction to the broad-line region of at least 50 magnitudes and an obscuring column density of at least 10^{23}cm^{-2}. While consistent with a highly obscured broad-line region, as required by the classical unified scenario, these limits are not yet significant enough to discriminate strongly between different torus models or to constrain properties of the gas causing the very large X-ray obscuration. We discuss the systematic limitations of infrared broad-line region searches and suggest that Brackett α may often be the most favorable transition for future searches.

Accepted by ApJ

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The warm absorber in IRAS 13349+2438: dusty or not ?

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IRAS13349+2438 was the first quasar suggested to host a warm absorber with internal dust. We obtained new HRI data for this object and derive constraints on the X-ray emitting region of IRAS13349+2438 by investigating its X-ray extent and lightcurve. Rapid X-ray variability is detected with a factor of two change in count rate within one day and 20% variability within about three hours, which practically rules out any significant contribution of scattered X-rays. We present for the first time a detailed, self-consistent modeling of the ROSAT PSPC and ASCA spectrum of IRAS13349+2438 in terms of a warm absorber including dust. It turns out that both a dust-free and a dusty $single - component$ warm absorber fail to explain the ROSAT, ASCA, and optical data simultaneously. We discuss possible explanations such as a variable and/or complex warm absorber, a variable soft X-ray continuum and instrumental effects.

to appear in A&A

Preprint and related papers available at http://www.xray.mpe.mpg.de/~skomossa/ and astro-ph/9909323

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/