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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

ASCA Observations of the Seyfert 2 Galaxy NGC 7582: An Obscured and Scattered View of the Hidden Nucleus

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We present the results of two ASCA observations of the Seyfert 2 galaxy NGC 7582. An $\sim$ 40 ksec observation performed in 1996 revealed it was variable at >99% confidence. The shortest timescale of significant variation was $\sim 2 \times 10^4$ s.

Variations were significant only in the hard X–ray (2-10 keV) light curve with the normalized variability amplitude $\sigma_{RMS} \approx 0.3$, while the soft X-ray (0.5-2 keV) light curve almost remained constant. The source showed similar variability properties in another shorter observation performed earlier in 1994.

The overall broadband (0.5-10 keV) spectrum is complex. It shows a heavily absorbed ($N_H \sim 1.0 \times 10^{23}$ cm^{-2}) and flat ($\Gamma \sim 1.5$) power-law continuum plus a slightly broad iron Kα line near 6.4 keV with $EW \sim 170$ eV. Below 2 keV, a “soft excess” emission dominates the spectrum.

No significant variations in the average continuum and line flux level were detected between the two observations. However, the inferred column density was observed to increase by $\sim 4 \times 10^{22}$ cm^{-2} from 1994 to 1996. This variation could be interpreted in terms of “patchy torus”, namely suggesting that absorbing material on our line-of-sight comprises many individual clouds. The observed iron line feature is also consistent with the picture of the transmission of nuclear X–ray continuum through the torus-like geometry. The nuclear X–ray (2–10 keV) luminosity is $\sim 3.1 \times 10^{42}$ ergs s^{-1}, similar to typical values for Seyfert 1 galaxies. The constant 0.5-2 keV soft X–ray spectrum, though at least partially accounted for by some starburst contribution, could be interpreted mostly as the scattered central continuum from an extended spatial region, this is consistent with the lack of rapid soft X–ray variability. Thus NGC 7582 is a typical example of a type 2 Seyfert galaxy which exhibits both an obscured and scattered emission component as expected from the AGN unification model.

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preprint available at ftp://vega.bac.pku.edu.cn/xue/paper.tar.gz

The ULIRG NGC 6240: Luminous extended X-ray emission and evidence for an AGN

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We briefly review and extend our discussion of the *ROSAT* detection of the extraordinarily luminous ($> 10^{42}$ erg/s) partly *extended* ($>$ 30 kpc diameter) X-ray emission from the double-nucleus ultraluminous infrared galaxy (ULIRG) NGC 6240. The *ROSAT* spectrum can be well fit by emission from two components in roughly equal proportions: a thermal optically thin plasma with $kT \sim$0.6 keV and a hard component that can be represented by a canonical AGN powerlaw. Source counts appear to have dropped by 30% within a year. Altogether, these findings can be well explained by a contribution of radiation from an AGN essentially hidden at other wavelengths. Fits of *ASCA* spectra, conducted by various groups, corroborate this result, revealing a high-equivalent width FeKα blend which again is straightforwardly interpreted by scattered AGN light.

If radiating at the Eddington limit, the central black hole mass does not exceed $\sim 10^7 M_\odot$. We discuss implications for the formation of this AGN. However, the luminosity in the remaining extended thermal component is still at the limits of a pure starburst-wind-induced source. We suggest that the deeply buried starburst has switched to a partially dormant phase so that heating of the outflow is diminished and a cooling flow could have been established. This flow may account for the extended shock heating traced by LINER-like emission line ratios and the extremely luminous H_2 2.121 μm emission from the central region of this galaxy. Next-generation X-ray telescopes will be able to test this proposal.

4 pages, to appear in the proceedings of *Highlights in X-ray Astronomy*, (Garching, June 1998); B. Aschenbach et al. (eds)

E-mail contact: hschulz@astro.ruhr-uni-bochum.de; MPE preprint 448, also available as astro-ph/9809088

Physical conditions in the Seyfert galaxy NGC 2992

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This paper presents long slit spectral maps of the bi-cone shaped extended narrow line region (ENLR) in the Seyfert galaxy NGC 2992. We investigate the physical properties of the ENLR via emission line diagnostics, and compare the observations to shock and photoionization models for the excitation mechanism of the gas. The line ratios vary as a function of position in the ENLR, and the loci of the observed points on line ratio diagrams are shown to be most consistent with shock+precursor model grids. We consider the energetics of a nuclear ionizing source for the ENLR, and perform the q-test in which the rate of ionizing photons from the nucleus is inferred from measurements of the density and ionization parameter. The q-test is shown to be invalid in the case of NGC 2992 because of the limitations of the [SII] λ6717/λ6731 density diagnostic. The excitation of the gas is shown to be broadly consistent with the kinematics, with higher [NII] λ6583/Hα present in the more dynamically active region. We also show that the pressure associated with the X-ray emitting plasma may provide a large fraction of the pressure required to power the ENLR via shocks.

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preprint available at http://msowww.anu.edu.au/~mga/papers.html, and also on Astro-ph

Emission-Line Probes of Circumnuclear Dust in AGNs

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Emission lines that trace elements subject to strong depletion onto grains provide a means for probing the dust content of AGNs. Examples include infrared [Fe II] and optical [Ca II] lines. The excitation mechanisms underlying the [Fe II] lines remain controversial, resulting in related disagreement over the gas-phase abundance of iron in Seyfert narrow-line regions. In this contribution we emphasize the utility of the [Ca II] features as a consistency test for claims of grain destruction affecting the [Fe II] lines. A search for [Ca II] emission in NGC 1068 at the location of strongest [Fe II] emission along the radio jet yields a strong upper limit, but no detection. This result suggests that grains survive largely intact in a region that otherwise shows strong evidence of shock processing.

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Far-infrared polarisation of the quasar 3C 279

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We present the first FIR polarisation results of the OVV quasar 3C 279 obtained with ISOPHOT for two epochs in 1996 and 1997. We describe its integral polarisation properties at a wavelength of 170 μm, where the source shows a maximum in its energy distribution. After a γ–ray flare in January 1996, a polarisation of 23%, closely aligned with the radio jet axis, was measured in July 1996. In June 1997, the polarisation degree had decreased to 6.5% with a less good alignment. On the other hand, the total 170 μm flux is the same for both epochs. Our measurements provide additional constraints for the multi-wavelength properties of synchrotron emission in radio jets and the temporal evolution of these properties: they show that the FIR radiation of 3C 279 is optically thin and that its origin is very close to the core. The variability of the FIR polarisation without any change of the total FIR flux can be explained by a disordering of the magnetic field in between the core and the first stationary VLBI radio knot.

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preprint available at http://xxx.lanl.gov/form/astro-ph?MULTI=form+interface (astro-ph/9809153)

HST Observations of the Host Galaxies of BL Lacertae Objects

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Six BL Lac objects from the complete 1 Jy radio-selected sample of 34 objects were observed in Cycle 5 with the *HST* WFPC2 camera to an equivalent limiting flux of $\mu_I \sim 26$ mag arcsec^{-2}. Here we report results for the second half of this sample, as well as new results for the first three objects, discussed previously by Falomo et al. (1997). In addition, we have analyzed in the same way *HST* images of three X-ray-selected BL Lacs observed by Jannuzi et al. (1997). The ensemble of 9 BL Lac objects spans the redshift range from $z = 0.19$ to ~ 1. Host galaxies are clearly detected in seven cases, while the other two, at $z \sim 0.258$ (redshift highly uncertain) and $z = 0.997$, are not resolved. The *HST* images constitute a homogeneous data set with unprecedented morphological information between a few tenths of an arcsecond and several arcseconds from the nucleus, allowing us in 6 of the 7 detected host galaxies to rule out definitively a pure disk light profile. The host galaxies are luminous ellipticals with an average absolute magnitude of $M_I \sim -24.6$ mag (with dispersion 0.7 mag), more than a magnitude brighter than L^* and comparable to brightest cluster galaxies. The morphologies are generally smooth and have small ellipticities ($\epsilon \lesssim 0.2$). Given such roundness, there is no obvious alignment with the more linear radio structures. In the six cases for which we have *HST* WFPC2 images in two filters, the derived color profiles show no strong spatial gradients and are as expected for K-corrected passively evolving elliptical galaxies. The host galaxies of the radio-selected and X-ray-selected BL Lacs for this very limited sample are comparable in both morphology and luminosity.

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An investigation of the relation between the spectral energy distributions and the emission lines in low-redshift quasars.

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We investigate the relations between the observed emission line strengths, widths and continuum properties of a sample of 41 low redshift ($z < 1$) quasars for which contemporaneous IR-soft-X-ray spectral energy distributions (SEDs) are available. This includes investigating correlations between optical/UV lines with both the luminosity and the shape of the quasars' continuum, as well as correlations between the various lines. The sample is heterogeneous, primarily selected upon the existence of good quality *Einstein* X-ray data and includes 18 radio-loud and 23 radio-quiet quasars.

We find anticorrelations between the equivalent-width (EW) and various UV luminosities (the Baldwin effect) for the Lyα and Hβ lines and a marginal anticorrelation for CIII]. Exclusion of narrow line, low luminosity AGN reveals a significant Baldwin effect for the CIV and CIII] lines. A significant anticorrelation of EW(CIV) with α_{ox} is also present. We find no correlations between any lines and the X-ray luminosity or X-ray slope. The FeII optical multiplet shows no simple relationship with luminosity or continuum slope, however there is a tendency for objects with flat X-ray spectra and/or strong X-ray luminosities to have weak FeII.

Our data do not favor a model in which changes in continuum shape (due to e.g. a decreasing ionization parameter) cause the Baldwin effect. The data can instead be explained by an accretion disk (AD) model in which limb darkening and the projected surface area of an optically thick, geometrically thin disk combine to cause a viewing-angle dependent UV luminosity and a more isotropic X-ray luminosity. The scatter in our correlations is larger than that expected from this AD model, suggesting the presence of dust, which reddens both the continuum and the broad emission lines. The CIV and CIII] carbon lines show flatter slopes and larger scatter in the line - continuum relations than predicted by the AD + dusty torus model. This may be due to a significant contribution from collisional excitation which is not directly related to the ionising continuum.

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SEDs vs. Emission-Line Correlations in Low Redshift Quasars

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We investigate the relations between the observed emission line strengths, widths and continuum properties of a sample of low redshift quasars for which contemporaneous IR-soft-X-ray spectral energy distributions (SEDs) are available. This includes investigating correlations between optical/UV lines with both the luminosity and the shape of the quasars' continua, as well as correlations between the various lines. Our data do not favor a model in which changes in continuum shape (due to e.g. ionization parameter decreasing with luminosity) cause the Baldwin effect. The data can instead be explained by an accretion disk (AD) model in which limb darkening and the projected surface area of an optically thick, geometrically thin disk combine to cause a viewing-angle dependent apparent optical/UV (OUV) luminosity and a more isotropic X-ray luminosity. The scatter in our correlations is larger than that expected from this AD model, suggesting the presence of dust which reddens both the continuum and the broad emission lines. We also look in greater detail at the line properties of NLS1 galaxies which do not follow the Baldwin effect for the remainder of the sample and discuss reasons for the discrepancy.

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Infrared spectroscopy of NGC 4151: ISO observations and NLR line profiles

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We present ISO-SWS and ISOPHOT-S spectroscopy of the Seyfert galaxy NGC 4151. We detect a total of 17 fine-structure emission lines emitted by a wide range of low- and high-excitation ions, two rotational lines of molecular hydrogen, and the Brβ HI line.

We find that the mid-IR fine-structure line profiles display blue asymmetries which are very similar to those observed in the optical lines produced in the narrow line region. Because the mid-infrared lines are much less sensitive to extinction than are the optical lines this similarity places strong constraints on scenarios which have been invoked to explain the optical line asymmetries. For example, we are able to rule out the simplest radial-motion-plus-dust scenarios for the production of the line asymmetries. Our preferred model is that of a central, geometrically thin but optically thick, obscuring screen of sub-arcsecond extension, enclosing a total hydrogen gas mass of $\geq 5 \times 10^6$ M$\odot$. This mass may be molecular.

The weakness of 'PAH' emission features in the low resolution spectrum is evidence that star formation plays a minor role in the circumnuclear region of NGC 4151. In a companion paper, we use the rich set of mid-infrared lines to determine the obscured photoionizing continuum produced by the active galactic nucleus.

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Infrared spectroscopy of NGC 4151: Probing the obscured ionizing AGN continuum

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The ISO-SWS infrared spectroscopic observations of the nucleus of Seyfert galaxy NGC 4151, which are described in a companion paper, are used together with a compilation of UV to IR narrow emission line data to determine the spectral shape of the obscured extreme-UV continuum that photoionizes the narrow line emitting gas in the active galactic nucleus. We present a new method to determine the best fitting photoionizing continuum and emission line cloud model from a heterogeneous set of emission line data.

For NGC 4151, we find a best-fit model that reproduces the observed line fluxes to within a factor of 2 on average, and which is consistent with the observed geometry of the optical Narrow Line Region (NLR). Our model consists of a clumpy, optically thick (ionization bounded) gas distribution, with a hydrogen gas density of $\sim 1000\,\mathrm{cm}^{-3}$ and a volume filling factor of $6.5\,10^{-4}$.

Our best fitting spectral energy distribution (SED) falls sharply beyond the Lyman limit and then rises sharply again towards 100 eV. In particular, it does not display a 'Big Blue Bump' signature of a hot accretion disk. We find that this SED, which best reproduces the NLR line emission on the 100–500 pc scale, does not have enough UV photons to produce the observed BLR recombination emission from the inner 1 pc. This suggests that the BLR is photoionized by the intrinsic continuum source, which does have a strong UV component (perhaps a Big Blue Bump), but that this UV component is absorbed by material located between the NLR and BLR. Our analysis suggests that the absorber consists of $\sim 5\,10^{19}\,\mathrm{cm}^{-2}$ of neutral hydrogen. Such an absorber was independently detected by UV absorption lines (Kriss et al. 1992, 1995).

Using our new method, we confirm our previous conclusion that a Big Blue Bump is present in the SED of the Seyfert 2 galaxy Circinus.

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Announcement

Centaurus A web site

I have established several web pages devoted entirely to the nearest active galaxy Centaurus A. The pages contain a lot of information including a pretty complete list of references with many direct links to the papers, a collection of pictures and much more. This site is available at URL

http://www.gamma.mpe-garching.mpg.de/ hcs/Cen-A/WWW/cen-a-home.html

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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/