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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.
Rob Beswick

Abstracts of recently accepted papers

X-ray Lighthouses of the High-Redshift Universe. II. Further Snapshot Observations of the Most Luminous $z \gtrsim 4$ Quasars with Chandra

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We report on *Chandra* observations of a sample of 11 optically luminous ($M_{\rm B} < -28.5$) quasars at z=3.96–4.55 selected from the Palomar Digital Sky Survey and the Automatic Plate Measuring Facility Survey. These are among the most luminous $z \gtrsim 4$ quasars known and hence represent ideal witnesses of the end of the "dark age ". with $\approx$ 2–57 counts in the observed 0.5–8 keV band. These detections increase the number of X-ray detected AGN at $z \gtrsim 4$ to $\approx$ 90; overall, *Chandra* has detected $\approx$ 85% of the high-redshift quasars observed with snapshot (few kilosecond) observations. the two X-ray undetected quasars, displays a number of notable features in its rest-frame ultraviolet spectrum, the most prominent being broad, deep Si IV and C IV absorption lines. spectral index for the present sample ($\langle\alpha_{\rm ox}\rangle$=$-1.88\pm0.05$) is steeper than that typically found for $z \gtrsim 4$ quasars but consistent with the expected value from the known dependence of this spectral index on quasar luminosity.

We present joint X-ray spectral fitting for a sample of 48 radio-quiet quasars in the redshift range 3.99–6.28 for which *Chandra* observations are available. The X-ray spectrum ($\approx$ 870 counts) is well parameterized by a power law with Γ=$1.93^{+0.10}_{-0.09}$ in the rest-frame $\approx$ 2–40 keV band, and a tight upper limit of $N_{\rm H} \approx 5\times10^{21}$ cm^{-2} is obtained on any average intrinsic X-ray absorption. There is no indication of any significant evolution in the X-ray properties of quasars between redshifts zero and six, suggesting that the physical processes of accretion onto massive black holes have not changed over the bulk of cosmic time.

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preprint available at http://www.astro.psu.edu/~niel/papers/papers.html and as astro-ph/0503301.

Discovery of 10 μm silicate emission in quasars. Evidence of the AGN unification scheme.

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According to the unified scheme, AGN are surrounded by a dust-torus and the observed diversity of AGN properties results from the different orientations relative to our line of sight. The strong resonance of silicate dust at 10 μm is therefore, as expected, seen in absorption towards many type-2 AGN. In type-1 AGN, it should be seen in emission because the hot inner surface of the dust torus becomes visible, however, this has not been observed so far, thus challenging the unification scheme or leading to exotic modifications of the dust-torus model. Here we report the discovery of the 10 μm silicate feature in emission in two luminous quasars with the Infrared Spectrograph of the Spitzer Space Telescope.

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http://www.eso.org/~rsiebenm/FTP/SiQuasars.pdf

The XMM-*Newton* view of Mrk 3 and IXO 30

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We present the analysis of the XMM-*Newton* EPIC pn spectrum of the Seyfert 2 galaxy, Mrk 3. We confirm that the source is dominated by a pure Compton reflection component and an iron Kα line, both produced as reflection from a Compton-thick torus, likely responsible also for the large column density ($1.36^{+0.03}_{-0.04} \times 10^{24}$ cm^{-2}) which is pierced by the primary powerlaw only at high energies. A low inclination angle and an iron underabundance of a factor $\simeq 0.82$, suggested by the amount of reflection and the depth of the iron edge, are consistent with the iron Kα line EW with respect to the Compton reflection component, being 610^{+30}_{-50} eV. Moreover, the iron line width, $\sigma = 32^{+13}_{-14}$ eV, if interpreted in terms of Doppler broadening due to the Keplerian rotation of the torus, puts an estimate to the inner radius of the latter, $r = 0.6^{+1.3}_{-0.3} \sin^2 i$ pc. Finally, two different photoionised reflectors are needed to take into account a large number of soft X-ray emission lines from N, O, Ne, Mg, Si, Fe L and the Fe XXV emission line at $6.71^{+0.03}_{-0.02}$ keV. RGS spectra show that the soft X-ray spectrum is dominated by emission lines, while the underlying continuum is best fitted by an unabsorbed powerlaw with the same photon index of the primary continuum, produced as reflection by a photoionised material with a column density of a few 10^{22} cm^{-2}. We also present the first X-ray spectrum of *ROSAT* source IXO 30, which shows a huge iron line at $6.5^{+0.3}_{-0.2}$ keV and is well represented either by an absorbed powerlaw with $\Gamma \simeq 1.8$ or bremsstrahlung emission at a temperature of $7.5^{+2.1}_{-1.6}$ keV. Its spectral properties point to a likely identification in terms of a weak Galactic Cataclysmic Variable, but the lack of any optical counterpart precludes excluding other possibilities, like an ULX at the distance of Mrk 3.

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HST/STIS low dispersion spectroscopy of three Compact Steep Spectrum sources. Evidence for jet-cloud interaction

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We present Hubble Space Telescope Imaging Spectrograph long-slit spectroscopy of the emission line nebulae in the compact steep spectrum radio sources 3C 67, 3C 277.1, and 3C 303.1. We derive BPT (Baldwin- Philips-Terlevich; Baldwin et al. 1981) diagnos tic emission line ratios for the nebulae which are consistent with a mix of shock excitation and photoionization in the extended gas. In addition, line ratios indicative of lower ionization gas are found to be associated with higher gas velocities. The r esults are consistent with a picture in which these galaxy scale radio sources interact with dense clouds in the interstellar medium of the host galaxies, shocking the clouds thereby ionizing and accelerating them.

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ISO observations and models of galaxies with Hidden Broad Line Regions

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In this paper we present *ISO* mid-infrared spectrophotometry and far-infrared photometry of galaxies with Hidden Broad Line Regions (HBLR). We also present radiative transfer models of their spectral energy distributions which enable us to separate the contributions from the dusty disc of the AGN and the dusty starbursts. We find that the combination of tapered discs (discs whose thickness increases with distance from the central source in the inner part but stays constant in the outer part) and starbursts provide good fits to the data. The tapered discs dominate in the mid-infrared part of the spectrum and the starbursts in the far-infrared. After correcting the AGN luminosity for anisotropic emission we find that the ratio of the AGN luminosity to the starburst luminosity, L_{AGN}/L_{sb}, ranges from about unity for IRAS14454-4343 to about 13 for IRAS01475-0740. Our results suggest that the warm IRAS colours of HBLR are due to the relatively high L_{AGN}/L_{sb}. Our fits are consistent with the unified model and the idea that the infrared emission of AGN is dominated by a dusty disc in the mid-infrared and starbursts in the far-infrared.

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Discovery of Optical Emission in the Hotspots of Three 3CR Quasars: High-Energy Particle Acceleration in Powerful Radio Hotspots

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Archival Hubble Space Telescope WFPC2 images were used to search for optical emission associated with the radio jets of a number of luminous quasars. From this search, we report new optical hotspot detections in the well-known blazar 3C 454.3 and the lobe-dominated quasars 3C 275.1 and 3C 336. We also find optical emission in the vicinity of the hotspot in 3C 208, but believe this is a chance alignment. Optical emission from the arcsecond-scale jet in 3C 454.3 is also detected. Multi-frequency archival radio data from the VLA and MERLIN are analyzed, and the synchrotron spectra of these high-power hotspots are presented. We estimate that their break frequencies are in the range of $10^{10} - 10^{11}$ Hz, with large uncertainties due to the wide gap in frequency coverage between the radio and optical bands. We also calculate their equipartition magnetic fields, and find that the anti-correlation between break frequency and magnetic field found by Brunetti et al. for lower power hotspots extends to these high power hotspots. This supports their model of hot-spots based on shock acceleration and synchrotron losses.

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Soft X-ray and Ultraviolet Emission Relations in Optically Selected AGN Samples

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Using a sample of 228 optically selected Active Galactic Nuclei (AGNs) in the 0.01–6.3 redshift range with a high fraction of X-ray detections (81–86%), we study the relation between rest-frame UV and soft X-ray emission and its evolution with cosmic time. The majority of the AGNs in our sample (155 objects) have been selected from the Sloan Digital Sky Survey (SDSS) in an unbiased way, rendering the sample results representative of all SDSS AGNs. The addition of two heterogeneous samples of 36 high-redshift and 37 low-redshift AGNs further supports and extends our conclusions. We confirm that the X-ray emission from AGNs is correlated with their UV emission, and that the ratio of the monochromatic luminosity emitted at 2 keV compared to 2500 Å decreases with increasing luminosity ($\alpha_{\rm ox} = -0.136 l_{\rm uv} + 2.616$, where $l_{\rm uv}$ is in log units), but does not change with cosmic time. These results apply to intrinsic AGN emission, as we correct or control for the effects of the host galaxy, UV/X-ray absorption, and any X-ray emission associated with radio emission in AGNs. We investigate a variety of systematic errors and can thereby state with confidence that (1) the $\alpha_{\rm ox}$–$l_{\rm uv}$ anti-correlation is real and not a result of accumulated systematic errors and (2) any $\alpha_{\rm ox}$ dependence on redshift is negligible in comparison. We provide the best quantification of the $\alpha_{\rm ox}$–$l_{\rm uv}$ relation to date for normal radio-quiet AGNs; this should be of utility for researchers pursuing a variety of studies.

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XMM-Newton Spectroscopy of the Starburst Dominated Ultra Luminous Infrared Galaxy NGC 6240

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We present new XMM-Newton observation of the Ultra Luminous Infrared Galaxy (ULIRG) NGC 6240. We analyze the reflecting grating spectrometer (RGS) data, and data from the other instruments, and find a starburst dominated 0.5–3 keV spectrum with global properties resembling those observed in M82 but with a much higher luminosity. We show that the starburst region can be divided into an outer zone, beyond a radius of about 2.1 kpc, with a gas temperature of about 10^7 K and a central region with temperatures in the range 2–6$\times 10^7$ K. The gas in the outer region emits most of the observed OVIII L_α line and the gas in the inner region the emission lines of higher ionization ions, including a strong FeXXV line. We also identify a small inner part, very close to the active nuclei, with typical Seyfert 2 properties including a large amount of photoionized gas producing a strong Fe Kα 6.4 keV line. The combined abundance, temperature and emission measure analysis indicates super solar Ne/O, Mg/O, Si/O, S/O and possibly also Fe/O. The analysis suggests densities in the range of 0.07–0.28$\epsilon^{1/2}$ cm^{-3} and a total thermal gas mass of $\sim 4 \times 10^8 \epsilon^{1/2}$ solar masses, where ϵ is the volume filling factor. We used a simple model to argue that a massive starburst with an age of $\simeq 2 \times 10^7$ years can explain most of the observed properties of the source. NGC 6240 is perhaps the clearest case of an X-ray bright luminous AGN, in a merger, whose soft X-ray spectrum is dominated by a powerful starburst.

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Type 2 counterparts of narrow-line Seyfert 1 galaxies

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Unified models of Seyfert galaxies, based on viewing angles, successfully explain the observed differences between type 1 and 2 Seyferts. The existence of a range in accretion rates ($\dot{m} \sim 0.001 - 1$) relative to the Eddington rate (from broad-line Seyfert 1s to narrow-line Seyfert 1s or NLS1s) and the unification of Seyfert galaxies imply that there must be type 2 counterparts of

NLS1s i.e., Seyfert 2s with high accretion rate or small black hole mass. One such Seyfert 2, NGC 5506, has already been unmasked based on near infra-red spectroscopy. Here we confirm the above result, and present evidence for two additional type 2 counterparts of NLS1s based on *XMM-Newton* observations. The three AGNs NGC 7314, NGC 7582 and NGC 5506, with a type 1.9/2 optical spectrum, show extremely rapid variability by factors > 2.4, ~ 1.3, and ~ 1.7 in 200 s, 350 s and 300 s, respectively, and steep $2-12$ keV spectrum ($\Gamma \geq 2$) in their intrinsic X-ray emission, characteristic of NLS1 galaxies. These observations establish the *'obscured NLS1 galaxies'* as a subclass of Seyfert 2 galaxies.

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The Relationship Between Luminosity and Broad-Line Region Size in Active Galactic Nuclei

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We reinvestigate the relationship between the characteristic broad-line region size ($R_{\rm BLR}$) and the Balmer emission-line, X-ray, UV, and optical continuum luminosities. Our study makes use of the best available determinations of $R_{\rm BLR}$ for a large number of active galactic nuclei (AGNs) from Peterson et al. Using their determinations of $R_{\rm BLR}$ for a large sample of AGNs and two different regression methods, we investigate the robustness of our correlation results as a function of data sub-sample and regression technique. Though small systematic differences were found depending on the method of analysis, our results are generally consistent. Assuming a power-law relation $R_{\rm BLR} \propto L^{\alpha}$, we find the mean best-fitting α is about 0.67 ± 0.05 for the optical continuum and the broad Hβ luminosity, about 0.56 ± 0.05 for the UV continuum luminosity, and about 0.70 ± 0.14 for the X-ray luminosity. We also find an intrinsic scatter of $\sim 40\%$ in these relations. The disagreement of our results with the theoretical expected slope of 0.5 indicates that the simple assumption of all AGNs having on average same ionization parameter, BLR density, column density, and ionizing spectral energy distribution, is not valid and there is likely some evolution of a few of these characteristics along the luminosity scale.

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Optical Monitoring of PKS 1510−089: A Binary Black Hole System?

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Three deep flux minima were observed with nearly the same time-scales and intervals for the blazar PKS 1510−089 in the past few years. A binary black hole system was proposed to be at the nucleus of this object, and a new minimum was predicted to occur in 2002 March. We monitored this source with a 60/90 cm Schmidt telescope from 2002 February to April. In combination with the data obtained by Xie et al. (2004) in the same period, we presented for the 2002 minimum a nearly symmetric light curve, which would be required by an eclipsing model of a binary black hole system. We also constrained the time-scale of the minimum to be 35 min, which is more consistent with the time-scales ($\sim$ 42 min) of the three previous minima than the 89 min time-scale given by the same authors. The wiggling miniarcsecond radio jet observed in this object is taken as a further evidence for the binary black hole system. The 'coupling' of the periodicity in light curve and the helicity in radio jet is discussed in the framework of a binary black hole system.

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The detection of silicate emission from quasars at 10 and 18 microns

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We report the spectroscopic detection of silicate emission at 10 and 18 μm in five PG quasars, the first detection of these two features in galaxies outside the Local Group. This finding is consistent with the unification model for Active Galactic Nuclei (AGNs), which predicts that an AGN torus seen pole-on should show a silicate emission feature in the mid-infrared. The strengths of the detected silicate emission features range from 0.12 to 1.25 times the continuum at 10 μm and from 0.20 to 0.79 times the continuum at 18 μm. The silicate grain temperatures inferred from the ratio of 18-to-10 μm silicate features under the assumption of optically thin emission range from 140 to 220 K.

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[O II] Emission in Quasar Host Galaxies: Evidence for a Suppressed Star Formation Efficiency

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The [O II] λ3727 line, a commonly used estimator of star formation rate in extragalactic surveys, should be an equally effective tracer of star formation in the host galaxies of quasars, whose narrow-line regions are expected to produce weak low-ionization emission. Quasar spectra generally show little or no [O II] emission beyond that expected from the active nucleus itself. The inferred star formation rates in optically selected quasars are typically below a few $M_\odot$ yr^{-1}, and some significantly less. Quasars do not appear to occur coevally with starbursts. Recent observations, on the other hand, reveal abundant molecular gas in low-redshift quasars. These two results suggest that the star formation efficiency in quasar host galaxies is somehow suppressed during the active phase of the nucleus. The low star formation rates also imply that the nonstellar nucleus powers the bulk of the thermal infrared emission in radio-quiet quasars.

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"Low-state" Black Hole Accretion in Nearby Galaxies

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I summarize the main observational properties of low-luminosity AGNs in nearby galaxies to argue that they are the high-mass analogs of black hole X-ray binaries in the "low/hard" state. The principal characteristics of low-state AGNs can be accommodated with a scenario in which the central engine is comprised of three components: an optically thick, geometrically accretion disk with a truncated inner radius, a radiatively inefficient flow, and a compact jet.

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A Comparison of Stellar and Gaseous Kinematics in the Nuclei of Active Galaxies

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To investigate the relationship between black holes and their host galaxies, many groups have used the width of the [O III] λ5007 line as a substitute for the stellar velocity dispersion (σ_*) of galaxy bulges. We directly test this assumption with a large and homogeneous sample of narrow-line active galactic nuclei from the Sloan Digital Sky Survey. We consider multiple transitions ([O II] λ3727, [O III] λ5007, and [S II] $\lambda\lambda$6716, 6731) and various techniques for quantifying the line width in order to obtain a calibration between the gas velocity dispersion, $\sigma_{\rm g}$, and σ_*. We find that $\sigma_{\rm g}$ of the low-ionization lines traces σ_*, as does $\sigma_{\rm g}$ for the core [O III] after its asymmetric blue wing is properly removed, although in all cases the correlation between $\sigma_{\rm g}$ and σ_* has considerable scatter. While the gas kinematics of the narrow-line region of active galaxies are primarily governed by the gravitational potential of the stars, the accretion rate, as traced by the Eddington luminosity ratio, seems to play an important secondary role. Departures from virial motions correlate systematically with accretion rate. We discuss the implications of these results for previous studies that use [O III] line widths to infer stellar velocity dispersions in quasars and narrow-line Seyfert 1 galaxies.

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Long-term variability of the optical emission lines in the nuclear spectrum of the Seyfert galaxy NGC 3227

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53 spectrograms in the optical region (3700-7300 Å) with the spectral resolution $\sim$ 8Åhave been obtained for the Seyfert nucleus of the galaxy NGC 3227 with the 6-m telescope on 1977 January while the nucleus was in the historically important epoch of its extreme maximum brightness. Width of the slit was $1''$, length of the box during the spectra measurements was $1.5''$. Data obtained by us and those compiled from literature showed that profiles of the Balmer lines Hα, Hβ and Hγ are different evidencing that the gas emitting these lines is highly self-absorbed. It was shown that narrow components of the profiles revealed by Rubin and Ford kept their positions (radial velocities) over 25 years. The components showed intensity variations compare to the central one from minimum to maximum of the nucleus brightness. The same variations were observed by us earlier in the emission line profiles of the NGC 7469 nucleus spectrum. Narrow profile components can reflect long-lived flows or jets in the broad line region (BLR). Obtained facts evidenced that long-lived gas streams and flows causing narrow components of broad line profiles presented not only when BLR of accretion disc is strong but when BLR of accretion disc declined. Blue bump at radial velocity of -5000 km/s in Hγ profile was revealed in spectra of high states of the nucleus, which disappeared in low state. One of the interpretations of this event can be in the framework of a model of one-sided or two-sided gas ejection during the high state of the nucleus, positive radial velocities of which being screened out by a circumnuclear disk.

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