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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

Adaptive optics imaging of low and intermediate redshift quasars

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We present the results of adaptive-optics imaging in the H and K bands of 12 low and intermediate redshift ($z < 0.6$) quasars using the PUEO system mounted on the Canada-France-Hawaii telescope. Five quasars are radio-quiet and seven are radio-loud. The images, obtained under poor seeing conditions, and with the QSOs ($m_{\rm V} > 15.0$) themselves as reference for the correction, have typical spatial resolution of $FWHM \sim 0.3$ arcsec before deconvolution. The deconvolved H-band image of PG 1700+514 has a spatial resolution of 0.16 arcsec and reveals a wealth of details on the companion and the host-galaxy.
Four out of the twelve quasars have close companions and obvious signs of interactions. The two-dimensional images of three of the host-galaxies unambiguously reveal bars and spiral arms. The morphology of the other objects are difficult to determine from one dimensional surface brightness profile and deeper images are needed.
Analysis of mocked data shows that elliptical galaxies are always recognized as such, whereas disk hosts can be missed for small disk scale lengths and large QSO contributions.

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A two-phase model for the Narrow Line Region of NGC 4151

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NGC 4151 is one of the brightest and best-studied Seyfert galaxies. Here, we present a two-phase model of the narrow-line region (NLR) of NGC 4151. This study is motivated by (i) the fact that the X-ray spectrum of NGC 4151 is among the flattest known for Seyferts, and (ii) the recent *Chandra* detection of an X-ray narrow-line region in this galaxy. X-ray spectra as flat as that of NGC 4151 ($\Gamma_x \simeq -1.5$) are expected to favor the presence of two gas phases in pressure equilibrium (Krolik, McKee & Tarter 1981). In the present study, we show that a pronounced two-phase equilibrium develops in the extended emission-line region *if we use the observed multi-wavelength spectrum of NGC 4151* to ionize the clouds. The material is stable to isobaric perturbations over a wide range of temperatures. We therefore propose that such a condition has arisen in the NLR of NGC 4151, and that it explains the detection of hot, extended X-ray gas which we identify as the NLR-cloud confining medium.

Astronomy & Astrophysics, in press

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Preprint and related papers are available at http://www.xray.mpe.mpg.de/~skomossa/

High-Resolution X-ray and Ultraviolet Spectroscopy of the Complex Intrinsic Absorption in NGC 4051 with *Chandra* and *HST*

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We present the results from simultaneous observations of the Narrow-Line Seyfert 1 galaxy NGC 4051 with the *Chandra* High Energy Transmission Grating Spectrometer and the *HST* Space Telescope Imaging Spectrograph. The X-ray grating spectrum reveals absorption and emission lines from hydrogen-like and helium-like ions of O, Ne, Mg and Si. We resolve two distinct X-ray absorption systems: a high-velocity blueshifted system at -2340 ± 130 km s^{-1} and a low-velocity blueshifted system at -600 ± 130 km s^{-1}. In the UV spectrum we detect strong absorption, mainly from C IV, N V and Si IV, that is resolved into as many as nine different intrinsic absorption systems with velocities between -650 km s^{-1} and 30 km s^{-1}. Although the low-velocity X-ray absorption is consistent in velocity with many of the UV absorption systems, the high-velocity X-ray absorption seems to have no UV counterpart. In addition to the absorption and emission lines, we also observe rapid X-ray variability and a state of low X-ray flux during the last ≈ 15 ks of the observation. NGC 4051 has a soft X-ray excess which we fit in both the high and low X-ray flux states. The high-resolution X-ray spectrum directly reveals that the soft excess is not composed of narrow emission lines and that it has significant spectral curvature. A power-law model fails to fit it, while a blackbody produces a nearly acceptable fit. We compare the observed spectral variability with the results of previous studies of NGC 4051.

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The Chandra Deep Survey of the Hubble Deep Field North Area. IV. An Ultradeep Image of the HDF-N

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We present results from a 479.7 ks *Chandra* exposure of the Hubble Deep Field North (HDF-N) and its immediate vicinity. In this X-ray image, the deepest ever reported with a 0.5–2.0 keV flux limit of $\approx 4.9 \times 10^{-17}$ erg cm^{-2} s^{-1}, four new HDF-N X-ray sources are detected bringing the total number of such sources to 12. The new sources include two optically bright ($R = 18.3$–18.8), low-redshift ($z < 0.15$) galaxies, a Fanaroff-Riley I radio galaxy, and an edge-on spiral hosting either a powerful starburst and/or a low-luminosity active galactic nucleus (AGN). Notably, X-ray emission has now been detected from *all* luminous galaxies ($M_V < -18$) with $z < 0.15$ known in the HDF-N. We have also detected the remarkable μJy radio source VLA J123642.09+621331.4, which is located just outside the HDF-N and has a likely redshift of $z = 4.424$. The observed X-ray emission supports the presence of an AGN in this object, and its X-ray-to-optical flux ratio (i.e., $\alpha_{\rm ox}$) is consistent with what is seen for low-redshift AGN.

We have detected X-ray variability from two of the previously known HDF-N X-ray sources, and spectral fitting shows clear evidence for X-ray absorption in the brightest X-ray source in the HDF-N, a $z = 0.960$ broad-line AGN with associated Mg II absorption. Stacking analyses of optically bright HDF-N galaxies not individually detected in X-rays have provided estimates of their average X-ray fluxes, and we find that the X-ray luminosities of "normal" spirals at $z \approx 0.5$ are not more than a factor of ≈ 2 larger (per unit B-band luminosity) than those of spirals in the local Universe ($z < 0.01$). This constrains models for the evolution of low-mass X-ray binary populations in galaxies in response to the declining cosmic star-formation rate. Monte-Carlo simulations support the validity of the stacking analyses and show that the *Chandra* Advanced CCD Imaging Spectrometer (ACIS) performs source detection well even with effective exposure times of ≈ 8 Ms.

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Quasar Evolution and the Baldwin Effect in the Large Bright Quasar Survey

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From a large homogeneous sample of optical/UV emission line measurements for 993 quasars from the Large Bright Quasar Survey (LBQS), we study correlations between emission line equivalent width and both restframe ultraviolet luminosity (i.e., the Baldwin Effect) and redshift. Our semi-automated spectral fitting accounts for absorption lines, fits blended iron emission, and provides upper limits to weak emission lines. Use of a single large, well-defined sample and consistent emission line measurements allows us to sensitively detect many correlations, most of which have been previously noted. A new finding is a significant Baldwin Effect in UV iron emission. Further analysis reveals that the primary correlation of iron emission strength is probably with redshift, implying an evolutionary rather than a luminosity effect. We show that for most emission lines with a significant Baldwin Effect, and for some without, evolution dominates over luminosity effects. This may reflect evolution in abundances, in cloud covering factors, or overall cloud conditions such as density and ionization. We find that in our sample, a putative correlation between Baldwin Effect slope and the ionization potential is not significant. Uniform measurements of other large quasar samples will extend the luminosity and redshift range of such spectral studies and provide even stronger tests of spectral evolution.

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A Chandra Observation of the Circinus Galaxy

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We report on a recent *Chandra* ACIS-S observation of the Circinus galaxy. These observations confirm that the nuclear spectrum results from reflection of a hard X-ray continuum by "neutral" matter. The nuclear X-ray emission is extended by ~ 60 pc in the general direction of the optical "ionization cone". An image in the Fe Kα line has been made and shows that this emission extends up to 200 pc from the nucleus. There is also large-scale X-ray emission both along and perpendicular to the galaxy disk. Thermal plasma models for this extended gas indicate temperatures $kT \sim 0.6$ keV, though cooler photoionized gas is also possible. The X-ray emission from gas in the disk is probably associated with the starburst ring of radius 150–250 pc. The gas extending ~ 600 pc perpendicular to the disk is closely correlated with the high-excitation optical-line emission. In addition to its soft X-ray emission, we tentatively detect a hard component from the gas above the plane; this hard emission may represent nuclear X-rays scattered into our line of sight by electrons in the outflowing wind. Ten compact sources are found in the central kpc of the galaxy. The most luminous has an X-ray luminosity of $\simeq 10^{40}$ erg s^{-1} and seems to be an X-ray binary in the Circinus galaxy with a black-hole mass exceeding 80 $M_{\odot}$.

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High Redshift Quasars and Star Formation History

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Quasars are among the most luminous objects in the universe, and they can be studied in detail up to the highest known redshift. Assuming that the gas associated with quasars is closely related to the interstellar medium of the host galaxy, quasars can be used as tracer of the star formation history in the early universe. We have observed a small sample of quasars at redshifts $3 \leq z \leq 5$ and present results using NV/CIV and NV/HeII as well as MgII/FeII to estimate the date of the first major star formation epoch. These line ratios indicate solar and supersolar metallicities of the gas close to the quasars. Assuming times of $\tau_{evol} \simeq 1$ Gyr the first star formation epoch can be dated to $z_f \simeq 10$, corresponding to an age of the universe of less than $5 \cdot 10^8$ yrs ($\mathrm{H_o} = 65\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$, Ω_M=0.3, $\Omega_\Lambda = 0.7$).

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STIS Echelle Observations of the Intrinsic UV Absorption in the Seyfert 1 Galaxy NGC 3783.[1]

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We present observations of the UV absorption lines in the Seyfert 1 galaxy NGC 3783, obtained with the medium resolution ($\lambda/\Delta\lambda \approx 40{,}000$) echelle gratings of the Space Telescope Imaging Spectrograph (STIS) on the *Hubble Space Telescope (HST)*. The spectra reveal the presence of three kinematic components of absorption in Lyα, C IV, and N V, at radial velocities of -1365, -548, and -724 km s^{-1} with respect to the systemic velocity of the host galaxy (Components 1, 2 and 3, respectively); Component 1 also shows absorption by Si IV. Component 3 was not detected in any of the earlier Goddard High Resolution Spectrograph (GHRS) spectra, and the C IV absorption in the other components has changed since the most recent GHRS observation obtained ~ 5 yr earlier. Somewhat unexpectedly, each component has a covering factor (of the continuum source + broad emission line region) of ~ 0.6. We have calculated photoionization models to match the UV column densities in each of the three components. The models predict a zone characterized by high ionization parameter (U = 0.65 – 0.80) and column density (6.4×10^{20} – 1.5×10^{21} cm^{-2}) for each component, and a second, low ionization (U = 0.0018) and low column density (4.9×10^{18} cm^{-2}) zone for Component 1. Based on the model results, there should be strong absorption in the bandpass of the *Far Ultraviolet Spectroscopic Explorer (FUSE)*, 912 Å – 1200 Å , including saturated O VI lines at each component velocity. The models also predict large O VII and O VIII column densities but suggest that the UV absorbers cannot account for all of the X-ray absorption detected in recent *Chandra* spectra. Finally, there is no evidence for a correlation between the characteristics of the UV absorbers and the UV continuum flux, and, by inference, the ionizing continuum. Hence, we suggest that the variations observed in the GHRS and STIS spectra are due in a large part to changes in the column densities of the absorbers as the result of transverse motion.

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Supermassive Black Holes in Active Galactic Nuclei. I. The Consistency of Black Hole Masses in Quiescent and Active Galaxies.

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We report the first results of a program to measure accurate stellar velocity dispersions in the bulges of the host galaxies of active galactic nuclei (AGNs) for which accurate black hole (BH) masses have been determined via reverberation mapping. We find good agreement between BH masses obtained from reverberation mapping, and from the $M_{\bullet} - \sigma$ relation as defined by quiescent galaxies, indicating a common relationship between active and quiescent black holes and their larger-scale environments.

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The evidence for jet-cloud interactions in a sample of high-redshift radio galaxies

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We present detailed long-slit spectroscopic observations of a sample of four powerful radio galaxies, with high redshifts ($0.47 < z < 0.81$). The observations cover the rest-wavelength range 2600 Å- 6600 Å, chosen to include important diagnostic emission lines ([NeV]λ3426, [OII]λ3727, [NeIII]λ3869, Hβ, [OIII]λ5007), which are also measured in optical observations of low-redshift radio galaxies. In two of the galaxies (3C 352 and 3C 435A) the radio sources are of the same scale as the emission-line regions, whereas in the other two (3C 34 and 3C 330) the radio sources are extended on a larger scale than the emission-line structures. We find that the extended regions of *all* the galaxies present highly disturbed kinematics, consisting of line-splitting ($\Delta v \sim$ 1000 km s^{-1}) and/or underlying broad components (FWHM = 1000 — 1500 km s^{-1}). These features are difficult to explain in terms of gravitational motion in the haloes of the host galaxies. Rather, it is likely that they are the result of strong shocks driven through the ISM/IGM by the radio sources. These observations suggest that jet-induced shocks have an important effect on the emission-line properties even in sources in which the radio structures are on a much larger scale than the emission-line structures.

While the emission-line kinematics provide strong evidence for shock acceleration, the dominant ionization mechanism for the emission-line gas remains uncertain. We have compared the optical diagnostic line ratios of the galaxies in our sample with various ionization models, including: pure shock ionization, shocks including a photoionized precursor, power-law photoionization and photoionization including matter-bounded clouds. We find that both pure-shock ionization and power-law photoionization model predictions fail to provide good fits to the data. On the other hand, on individual diagnostic diagrams, models for shocks which include a photoionized precursor are consistent with the results for the majority of the EELR of the galaxies in our sample, and photoionization including matter-bounded clouds models also give reasonable fits to some of the EELR. However, in terms of the positions of the points relative to the model sequences on the diagnostic diagrams, there is a lack of consistency from diagram to diagram. The diagnostic diagram involving the line ratios [OIII](4959+5007)/4363 and HeII(4686)/Hβ is particularly problematic in this regard. Overall, our results suggest that, if the EELR are shock-ionized, one or more of the assumptions implicit in the shock models may need to be reconsidered.

In addition, we have investigated the nebular continuum contribution to the UV excess in the galaxies in our sample. We find

a substantial nebular emission contribution to the UV continuum in all the cases, in the range ~ 10 — 40 per cent. However, after the subtraction of the nebular component, a significant UV excess remains in the extended nebulae of most of the objects.

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Optical and X-ray characteristics of a newly discovered narrow-line QSO : RX J1334.2+3759

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We report the discovery of a narrow-line QSO (NLQSO) RX J1334.2+3759 with a steep soft X-ray spectrum. Soft X-ray emission from the NLQSO is highly variable. Changes in the intensity by a factor of ~ 2 have been detected in the *ROSAT* PSPC observations of RX J1334.2+3759 on time scales of $\sim 20000 - 40000$ s. Rapid variability events have also been observed from RX J1334.2+3759. The most extreme variable event has $\frac{\Delta L}{\Delta t} = (1.95 \pm 1.02) \times 10^{42}$ erg s^{-2} corresponding to a change in intensity by a factor of ~ 4 within ≤ 400 s. The PSPC spectra of the NLQSO can be well represented by a power-law of photon index, $\Gamma_X \sim 3.8$ modified by an absorbing column local to the source ($\Delta N_H \sim 3.3 \times 10^{20}$ cm^{-2}) over and above that due to our own Galaxy ($N_{\rm H} = 7.9 \times 10^{19}$ cm^{-2}). The intrinsic soft X-ray luminosity of RX J1334.2+3759 is estimated to be $\sim 2.2 \times 10^{44}$ erg s^{-1} in the energy band of $0.1 - 2.0$ keV. The optical spectrum of RX J1334.2+3759 is typical of the NLS1 galaxies showing strong Balmer Hβ, Hα, and forbidden line of [O III]λ5007. Fe II multiplets, usually present in the optical spectra of NLS1 galaxies, are also detected from RX J1334.2+3759. Decomposition of the Hβ and Hα line profiles shows the presence of narrow (FWHM ~ 880 km s^{-1}) and broad (FWHM ~ 2850 km s^{-1}) components in the spectrum of RX J1334.2+3759. The narrow-line region of RX J1334.2+3759 appears to be significantly different from those of normal Seyfert galaxies. A possible explanation for the observed properties of the narrow line region and the broad line region is suggested in terms of density enhancements.

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