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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

The Chandra, HST, and VLA View of the Circumnuclear Extended Emission in the Narrow Emission Line Galaxy NGC 2110

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We present results from new *Chandra* and archival *HST* and VLA imaging observations of the circumnuclear extended emission in the nearby Type 2 Seyfert galaxy NGC 2110. We find resolved soft-band X-ray emission $\sim 4''$ ($\sim$ 160 pc) north of the nucleus, which is spatially coincident with [O III] emission, but lies just beyond the northern edge of the radio jet in the source. We find that shock-heating of multi-phase gas clouds can successfully account for this extended emission, although we can not rule out alternative models, such as the scattering of nuclear radiation by ionized material, or pure photoionization from the nucleus. In addition, we detect kpc-scale ($\sim 30''$) extended soft-band X-ray emission south of the nucleus. Finally, we compare our results for NGC 2110 with the prototypical Type 2 Seyfert galaxy NGC 1068, and suggest that different physical processes could produce extended circumnuclear X-ray emission in Seyfert galaxies.

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E-mail contact: devans@cfa.harvard.edu,
preprint available at http://arxiv.org/abs/astro-ph/0608419

Star-forming QSO host galaxies

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The recent finding of substantial masses of cold molecular gas as well as young stellar populations in the host galaxies of quasars is at odds with results of Hubble Space Telescope imaging studies, since the latter appear to yield mature, quiescent early type hosts. It is demonstrated here that the characterization as 'quiescent' is incorrect. Radio and far-infrared properties of both the HST sample and a larger comparison sample of uv-excess selected radio-quiet QSOs are consistent with substantial recent star-formation activity.

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E-mail contact: pdb@astro.rug.nl,
preprint available at http://arxiv.org/abs/astro-ph/0607667

Gemini Near Infrared Integral Field Spectroscopy of the Narrow-Line Region of ESO 428-G14: kinematics, excitation and the role of the radio jet

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We present two-dimensional (2D) gas kinematics and excitation of the inner 300 pc of the Seyfert galaxy ESO 428-G14 at a sampling of 14 pc^2, from near-infrared spectroscopic observations at R≈6000 obtained with the Integral Field Unit o f the Gemini Near-Infrared Spectrograph. From measurements of fluxes and profiles of the emission lines [Fe II]$\lambda 1.257\mu$m, Paβ, $H_2\lambda 2.121\mu$m and Brγ, we construct 2D maps of line intensities and ratios, radial velocities and velocity dispersions. Emission lines "tomography" is provided by velocity slices obtained across the line profiles, a unique capability of IFUs, which allows the mapping of not only of peak velocities but including also the wings. We compare these maps with a previously published high spatial resolution radio map and find a tight relation between the radio structure and the emission-line flux distributions and kinematics, revealing that the radio-jet plays a fundamental role not only in shaping the NLR but also in the imprint of it s kinematics. Blueshifts of up to 400 $\mathrm{km\,s^{-1}}$ and velocity dispersions of up to 150 $\mathrm{km\,s^{-1}}$ are observed in association with the radio jet at position angle PA = 129°, which is also the PA of the photometric major axis of the galaxy. We concl ude that the radio jet is launched at a small angle relative to the galactic plane, with the NW side slightly oriented toward us. This angle is small enough for the radio jet to shock and compress the gas in the plane of the galaxy, and for the nuclea r continuum to ionize and heat it. The distinct kinematics and flux distributions observed for the different emission lines suggest different origins for their emission. The [Fe II] shows the largest blueshifts and velocity dispersions and its flux distribution is concentrated alo ng the jet, while the H_2 shows the lowest velocity dispersions and has additional flux contribution from regions beyond the jet. Both X-rays emitted by the active galactic nucleus and shocks produced by the radio jet can excite the H_2 and [Fe II] emission lines. We use the 2D velocity dispersion maps to estimate upper limits to the contribution of the radio jet to the excitation of [Fe II] and H_2 which may reach 90% for [Fe II] and 80% for H_2 in the jet region. The [Fe II]/Paβ emission-line ratios and the association of the [Fe II] flux distribution and kinematics with the radio structure supports a stronger contribution of the radio jet to the [Fe II] excitation than to that of H_2. In the regions beyond the jet the observations favor X-ray excitation.

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E-mail contact: rogemar@ufrgs.br,
preprint available at http://www.arxiv.org/abs/astro-ph/0609322

Precision Fe Kα and Fe Kβ Line Spectroscopy of the Seyfert 1.9 Galaxy NGC 2992 with Suzaku

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We present detailed time-averaged X-ray spectroscopy in the 0.5–10 keV band of the Seyfert 1.9 galaxy NGC 2992 with the *Suzaku* X-ray Imaging Spectrometers (XIS). The source had a factor ~ 3 higher 2–10 keV flux ($\sim 1.2\times10^{-11}$ erg cm^{-2} s^{-1}) than the historical minimum and a factor ~ 7 less than the historical maximum. The XIS spectrum of NGC 2992 can be described by several components. There is a primary continuum, modeled as a power-law with a photon index of $\Gamma = 1.57^{+0.06}_{-0.03}$ that is obscured by a Compton-thin absorber with a column density of $8.0^{+0.6}_{-0.5} \times 10^{21}$ cm^{-2}. There is another, weaker, unabsorbed power-law component (modeled with the same slope as the primary), that is likely to be due to the primary continuum being electron-scattered into our line-of-sight by a region extended on a scale of hundreds of parsecs. We measure the Thomson depth of the scattering zone to be $\tau_{\rm es} = (0.073 \pm 0.021)/[\Omega/4\pi]$, where $\Omega/4\pi$ is the fraction of the sky covered by the zone (as seen from the X-ray source) that is visible to the observer. An optically-thin thermal emission component, which probably originates in the same extended region, is included in the model and yields a temperature and luminosity of $kT = 0.656^{+0.088}_{-0.061}$ keV and $\sim 1.2\pm0.4\times10^{40}$ erg s^{-1} respectively. We detect an Fe K emission complex which we model with broad and narrow lines and we show that the intensities of the two components are decoupled at a confidence level $> 3\sigma$. The broad Fe Kα line has an equivalent width of 118^{+32}_{-61} eV and could originate in an accretion disk (with inclination angle greater than $\sim 30^\circ$) around the putative central black hole. The narrow Fe Kα line has an equivalent width of 163^{+47}_{-26} eV and is unresolved (FWHM < 4090 km s^{-1}) and likely originates in distant matter. The absolute flux in the narrow line implies that the column density out of the line-of-sight could be much higher than measured in the line-of-sight, and that the mean (historically-averaged) continuum luminosity responsible for forming the line could be a factor of several higher than that measured from the data. We also detect the Fe Kβ line (corresponding to the narrow Fe Kα line) with a high signal-to-noise ratio and describe a new robust method to constrain the ionization state of Fe responsible for the Fe Kα and Fe Kβ lines that does not require any knowledge of possible gravitational and Doppler energy shifts affecting the line energies. For the distant line-emitting matter (e.g. the putative obscuring torus) we deduce that the predominant ionization state is lower than Fe VIII (at 99% confidence), conservatively taking into account residual calibration uncertainties in the XIS energy scale and theoretical and experimental uncertainties in the Fe K fluorescent line energies. From the limits on a possible Compton-reflection continuum it is likely that the narrow Fe Kα and Fe Kβ lines originate in a Compton-thin structure.

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E-mail contact: yaqoob@pha.jhu.edu,
preprint available at http://xxx.lanl.gov/abs/astro-ph/0609581

Frequency-dependent time delays for strong outbursts in four blazars from the Metsähovi and UMRAO monitoring databases

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The combined data of the University of Michigan Radio Astronomy Observatory and Metsähovi Radio Observatory provide us with radio light curves for Active Galactic Nuclei monitored by both observatories from 4.8 to 37 GHz covering time intervals up to $\sim$ 25 years. We consider here such composite light curves for four γ-ray blazars that have been nearly continuously monitored at both observatories: 0458–020, 0528+134, 1730–130 and 2230+114. We have decomposed the most prominent outbursts in the light curves of these four blazars into individual components using Gaussian model fitting, and estimated the epochs, amplitudes, and half-widths of these components as functions of frequency. We attempt to distinguish "core outbursts," which show frequency-dependent time delays and are associated with brightening of the core, from "jet outbursts," which appear nearly synchronously at all frequencies and are accompanied by the emergence of new jet components and their subsequent evolution. The outbursts in 0528+134 and 2230+114 display fine structure and consist of individual sub-outbursts. Available 43 GHz VLBA images allow us to identify only one pure core outburst (in 2230+114) and one pure jet outburst (0458–020). Most of the outbursts analyzed are mixed, in the sense that they display frequency-dependent time delays (i.e., they are optically thick) and are associated with the eventual emergence of new jet components. The maxima of the jet and mixed outbursts probably correspond to epochs when newly ejected components become fully optically thin. These epochs are also marked by a significant increase in the angular velocities of the ejected components. There is evidence that the outbursts in 2230+114 repeat every 8.0 ± 0.3 years, with the positions of individual sub-outbursts being preserved from one quasi-periodic eight-year cycle to another, even though their amplitudes vary by more than a factor of two. Preliminary estimates of the total durations of possible activity cycles based on an analysis of total flux-density variations and all available VLBI data are given for the remaining sources.

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preprint available at http://arxiv.org/abs/astro-ph/0609494

The quest for Type 2 quasars: Chandra observations of luminous obscured quasars in the Sloan Digital Sky Survey

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We report on new *Chandra* exploratory observations of six candidate Type 2 quasars at z=0.49–0.73 selected among the most [OIII] luminous emitters from the Sloan Digital Sky Survey (SDSS). Under the assumption that [OIII] is a proxy for the intrinsic luminosity of the central source, their predicted rest-frame X-ray luminosities are $L_{2-10keV} \approx 10^{45}$ erg s^{-1}. photon statistics are good enough to allow for basic X-ray spectral analyses, which indicate the presence of intrinsic absorption ($\approx 10^{22-23}$ cm^{-2}) and luminous X-ray emission ($L_{\rm X} > 10^{44}$ erg s^{-1}). Of the remaining four targets, two are detected with only a few (3–6) X-ray counts, and two are undetected by *Chandra*. If these four sources have the large intrinsic X-ray luminosities predicted by the [OIII] emission, then their nuclei must be heavily obscured ($N_{\rm H} >$ few $\times 10^{23}$ cm^{-2}) and some might be Compton thick ($N_{\rm H} > 1.5 \times 10^{24}$ cm^{-2}). present the results for two Type 2 quasar candidates serendipitously lying in the fields of the *Chandra* targets, and provide an up-to-date compilation of the X-ray properties of eight additional SDSS Type 2 quasars from archival *Chandra* and XMM-*Newton* observations (five with moderate-quality X-ray data). The combined sample of 16 SDSS Type 2 quasars (10 X-ray detections) provides further evidence that a considerable fraction of optically selected Type 2 quasars are obscured in the X-ray band (at least all the objects with moderate-quality X-ray spectra), lending further support to the findings presented in Vignali, Alexander and Comastri (2004a) and unification schemes of Active Galactic Nuclei, and confirms the reliability of [OIII] emission in predicting the X-ray emission in obscured quasars.

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The Spatial Clustering of the Low Luminosity Active Galactic Nuclei

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Based on the Sloan Digital Sky Survey (SDSS) DR2 sample, we present a multi-parameter analysis of the spatial clustering of nearby active galactic nuclei (AGN). Estimates of the redshift space two-point correlation function reveal that Seyferts are less clustered than normal galaxies, while LINERs' clustering amplitude (s_0) is consistent with that of the parent galaxy population. This difference in clustering is not driven by the morphology-density relation as colors and concentration indices follow similar

distributions. The fact that objects of given spectral types are clustered differently seems correlated with a variety of their physical properties including $L_{[OI]}$, $L_{[OIII]}$, the emitting gas density n_e, and the obscuration level. LINERs, which exhibit high s_0, show the lowest luminosities and obscuration levels, and relatively low n_e, suggesting that these objects harbor relatively massive black holes that are weakly active or inefficient in their accretion, probably due to the insufficiency of their fuel supply. Seyferts, which have low s_0, are very luminous and show large n_e, suggesting that their black holes are less massive but accrete quickly and efficiently enough to clearly dominate the ionization. Star-forming galaxies, the H IIs, are weakly clustered; this trend can be understood as a consequence of both the morphology-density and star formation rate-density relations. The spectral properties of the H II's suggest however that they hide in their centers, amidst large amounts of obscuring material, black holes of generally low mass whose activity remains relatively feeble. Our own Milky Way may be such a case.

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The Central Engines of Narrow-Line Seyfert 1 Galaxies

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It has been suggested that Narrow-Line Seyfert 1 (NLS1) galaxies are evolutionarily young objects, powered by the accretion of gas onto central black holes that are significantly lower in mass than those found in typical broad-line Seyferts. We explore this hypothesis through the analysis of high-spatial resolution, near-IR imaging data obtained in J and K' for a sample of 11 NLS1s. Surface brightness profiles are separated into their constituent components using two-dimensional decomposition techniques. By employing the correlation between black-hole mass and host galaxy bulge luminosity, calibrated for near-IR wavelengths using 2MASS data, we determine the mean black-hole mass for our sample to be, in solar units, $\langle \log(M_{BH}) \rangle = 7.9$. Using the correlation between the size of the broad-line region and the monochromatic continuum luminosity, we obtain black-hole mass estimates under the assumption that the emission-line gas is in virial equilibrium. The mean black-hole mass derived from this relation is $\langle \log(M_{BH}) \rangle = 6.4$. It is found that the estimates obtained from the black-hole mass-bulge luminosity relation are systematically one full order of magnitude larger than those derived from the black-hole mass-broad-line region radius relation. We explore possible causes for this discrepancy in M_{BH} estimates and the ramifications for our understanding of the role played by NLS1s in AGN evolution.

Because numerical simulations constrain the start of the AGN duty cycle to a time shortly after a significant gravitational interaction, we examine the morphology and near-IR bulge colors of the NLS1 sample for evidence of recent encounters. The mean bulge color is found to be $\langle (J - K_s) \rangle = +1.85 \pm 0.58$, which is redder than that of both a matched sample of non-active galaxies and published estimates for broad-line Seyferts. The source of the unusual bulge colors may be an excess of flux, peaking at around 2.2 μm, that has been detected near the centers of some NLS1s such as Mrk 1239. No evidence is found for light asymmetries or an extra stellar component that would indicate NLS1s are young objects. Finally, we postulate that there may be some interesting lines of circumstantial evidence suggesting that secular processes may be relevant in the evolution of NLS1s.

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preprint available at astro-ph/0609729

Meetings

Fifth Stromlo Symposium: Disks, Winds and Jets - From Planets to Quasars

Mt Stromlo Observatory, Canberra, Australia
3 – 8 December 2006

Webpage: http://www.mso.anu.edu.au/5SS/
Email enquiries: 5SS@mso.anu.edu.au
SOC co-chairs: Geoff Bicknell & Rita Sambruna

Final registrations for this symposium are now open with a closing date of 15 October. The second announcement is available at the above web-site, which also contains details of the symposium including the invited talks and the registration procedure.

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