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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.

HAPPY NEW YEAR!

Rob Beswick

Abstracts of recently accepted papers

Evolution of the accretion disk in the nucleus of NGC 1097

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We discuss the long-term evolution of the broad double-peaked Hα profile of the LINER/Seyfert 1 nucleus of NGC 1097. Besides the previously known variation of the relative intensities of the blue and red peaks, the profile has recently shown an increasing separation between the two peaks, at the same time as the integrated flux has decreased. We successfully model these variations using a precessing asymmetric accretion disk with a varying emissivity law. We interpret the emissivity variation as due to the fact that the source of ionization is getting dimmer, causing the region of maximum emission to drift inwards (and thus to regions of higher velocities). In addition, in the last 3 yrs of observations, the central wavelength of the double-peaked line has shifted to bluer wavelengths, which may be due to a wind from the disk. It is the first time that such evolution is observed so clearly, giving additional support for an accretion disk as the origin of the double-peaked profile in NGC 1097.

To be published in the proceedings of the Meudon conference on “Active Galactic Nuclei: from Central Engine to Host Galaxy”, Eds. S. Collin, F. Combes & I. Shlosman

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preprint available as astro-ph/0211122

Stellar population gradients in Seyfert 2 galaxies

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We study the variation of the stellar population properties as a function of distance from the nucleus for a sample of 35 Seyfert 2 galaxies using the technique of stellar population synthesis. We sample regions at the galaxies with dimensions in the range 200×200 to 400×400 pc and compare the synthesis results with those of a control sample of non-Seyfert galaxies. We find that both at the nucleus and up to 3 kpc from it the oldest age component (10 Gyr) presents a smaller contribution to the total flux in the Seyfert than in the non-Seyfert galaxies of the same Hubble type, while the components younger than 100 Myr present a larger contribution in the Seyfert's than in non-Seyferts. In addition, while for the non-Seyferts clear gradients are present, in which the contribution of the oldest components decreases with distance from the nucleus and the contribution of the 1 Gyr component increases – we do not find such gradients in most Seyferts. These results suggest that the AGN-starburst connection is a large scale phenomenon affecting not only the inner few hundred parsecs, but the inner kiloparsecs.

To be published in the proceedings of the Granada 2002 conference on "Star Formation through Time", Eds. E. Perez, R. González Delgado & G. Tenoriao Tagle

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X-rays from the First Massive Black Holes

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X-ray studies of high-redshift ($z > 4$) active galaxies have advanced substantially over the past few years, largely due to results from the new generation of X-ray observatories. As of this writing X-ray emission has been detected from nearly 60 high-redshift active galaxies. This paper reviews the observational results and their implications for models of the first massive black holes, and it discusses future prospects for the field.

In New X-ray Results from Clusters of Galaxies and Black Holes (Oct 2002; Houston, TX), eds. C. Done, E.M. Puchnarewicz, M.J. Ward, Advances in Space Research, submitted

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preprint and list of $z > 4$ X-ray detections available from http://www.astro.psu.edu/users/niel/papers/papers.html

The Baldwin Effect and Black Hole Accretion: A Spectral Principal Component Analysis of a Complete QSO Sample

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We have performed a spectral principal component analysis (SPCA) for an essentially complete sample of 22 low redshift QSOs with spectral data from Lyα to Hα. SPCA yields a set of independent principal component spectra, each of which represents a set of relationships among QSO continuum and line properties. We find three significant principal components, which account for ~78% of the total intrinsic variance. The first component, carrying ~41% of the intrinsic variance, represents Baldwin relationships – anti-correlations between equivalent width of broad emission lines and continuum luminosity. The narrow line core (FWHM ~2000 km s^{-1}) of the broad emission lines dominate this component. The second component, accounting for ~23% of the intrinsic variance, represents the variations in UV continuum slope, which is probably the result of dust reddening, with possible contributions from starlight. The third principal component is directly related to the Boroson & Green "Eigenvector 1" (their first principal component), clearly showing the anti-correlation between strengths of optical Fe II and [O III] λ5007, and other relationships previously found in the Hβ – [O III] region. This third component shows the expected strong correlation with soft X-ray spectral index. The widths of C III] λ1909, Mg II λ2798, and Balmer emission lines are also involved and clearly correlated, relating this component to black hole mass or Eddington accretion ratio. We find an inverse correlation between the strengths of the UV and optical Fe II blends, as suggested by some photoionization models. We also find correlations of the strengths of several low-ionization UV lines with Fe II(opt), and a strong positive correlation of C IV λ1549 with [O III] strength. The wide wavelength coverage of our data enable us to see clearly the relationships between the UV and optical spectra of QSOs. The Baldwin effect and Boroson & Green's Eigenvector 1 relationship are clearly independent. We demonstrate how Baldwin relationships can be derived using our first principal component, virtually eliminating the scatter caused by the third principal component. This rekindles the hope that the Baldwin relationships can be used for cosmological study.

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The Largest black holes and the most luminous galaxies

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The empirical relationship between the broad line region size and the source luminosity in active galactic nuclei (AGNs) is used to obtain black holes (BH) masses for a large number of quasars in three samples. The largest black hole masses exceed 10^{10} $M_{\odot}$ and are found to occur in the objects with the highest luminosities. Such BH masses, when converted to galactic bulge mass and luminosity, indicate masses in excess of 10^{13} $M_{\odot}$ and σ_* in excess of 700 km/sec. Such massive galaxies have never been observed. The largest BHs reside, almost exclusively, in high redshift quasars. All this is inconsistent with several suggested scenarios of BH and galaxy formation. Possible ways out are that either the observed size-L relationship in low luminosity AGNs does not extend to very high luminosity or else the $M_{\rm BH} - M_{\rm bulge} - \sigma_*$ correlations observed in the local universe do not reflect the relation between those quantities at the epoch of galaxy formation.

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An Intrinsic Baldwin Effect in the Hβ Broad Emission Line in the Spectrum of NGC 5548

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We investigate the possibility of an intrinsic Baldwin Effect (i.e., nonlinear emission-line response to continuum variations) in the broad Hβ emission line of the active galaxy NGC 5548 using cross-correlation techniques to remove light travel-time effects from the data. We find a nonlinear relationship between the Hβ emission line and continuum fluxes that is in good agreement with theoretical predictions. We suggest that similar analysis of multiple lines might provide a useful diagnostic of physical conditions in the broad-line region.

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preprint available at http://xxx.lanl.gov/abs/astro-ph/0212379

What ignites optical jets?

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The properties of radio galaxies and quasars with and without optical or X-ray jets are compared. The majority of jets from which high-frequency emission has been detected so far (13 with optical emission, 11 with X-rays, 13 with both) are associated with the most powerful radio sources at any given redshift. It is found that optical/X-ray jet sources are more strongly beamed than the average population of extragalactic radio sources. This suggests that the detection or non-detection of optical emission from jets has so far been dominated by surface brightness selection effects, not by jet physics. It implies that optical jets are much more common than is currently appreciated.

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Preprint available at http://arxiv.org/abs/astro-ph/0212397

Evolution of the X-ray spectrum in the flare model of Active Galactic Nuclei

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Nayakshin & Kazanas (2002) have considered the time-dependent illumination of an accretion disc in Active Galactic Nuclei, in the lamppost model, where it is assumed that an X-ray source illuminates the whole inner-disc region in a relatively steady way. We extend their study to the flare model, which postulates the release of a large X-ray flux above a small region of the accretion disc. A fundamental difference with the lamppost model is that the region of the disc below the flare is not illuminated before the onset of the flare. After the onset, the temperature and the ionization state of the irradiated skin respond immediately to the increase of the continuum, but pressure equilibrium is achieved later. A few typical test models show that the reflected spectrum which follows immediately the increase in continuum flux should always display the characteristics of a highly illuminated but dense gas, i.e. very intense X-ray emission lines and ionization edges in the soft X-ray range. The behaviour of the iron line is however different in the case of a "moderate" and a "strong" flare: for a moderate flare, the spectrum displays a neutral component of the Fe Kα line at 6.4 keV, gradually leading to more highly ionized lines. For a strong flare, the lines are already emitted by FeXXV (around 6.7 keV) after the onset, and are very intense, with an equivalent width of several hundreds of eV. A strong flare is also characterized by a steep soft X-ray spectrum. The variation timescale in the flare model is likely smaller than in the lamppost model, due to the smaller dimension of the emission region, so the timescale for pressure equilibrium is long compared with the duration of a flare. It is therefore highly probable that several flares contribute at the same time to the luminosity. We find that the observed correlations between R, Γ, and the X-ray flux, are well accounted by a combination of flares having not achieved pressure equilibrium, also strongly suggesting that the observed spectrum is always dominated by regions in non-pressure equilibrium, typical of the onset of the flares. Finally a flare being confined to a small region of the disc, the spectral lines should be narrow (except for a weak Compton broadening) and Doppler shifted, as stressed by Nayakshin & Kazanas (2001). All these features should constitute specific variable signatures of the flare model, distinguishing it from the lamppost model. It is however difficult, on the basis of the present observations and models, to conclude in favor of one of the hypothesis.

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