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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

AGNs and Starbursts: What Is the Real Connection?

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It is now widely believed that the growth of massive black holes is closely linked to the formation of galaxies, but there have been few concrete constraints on the actual physical processes responsible for this coupling. Investigating the connection between AGN and starburst activity may offer some empirical guidance on this problem. I summarize previous observational searches for young stars in active galaxies, concluding that there is now compelling evidence for a significant post-starburst population in many luminous AGNs, and that a direct, causal link may exist between star formation and black hole accretion. Quantifying the ongoing star formation rate in AGNs, however, is much more challenging because of the strong contamination by the active nucleus. I discuss recent work attempting to measure the star formation rate in luminous AGNs and quasars. The exceptionally low level of coeval star formation found in these otherwise gas-rich systems suggests that the star formation efficiency in the host galaxies is suppressed in the presence of strong AGN feedback.

Invited review to appear in *Extreme Starbursts: Near and Far.*

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preprint available at http://xxx.lanl.gov/abs/astro-ph/0511157

The soft X–ray/NLR connection: a single photoionized medium?

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We present a sample of 8 nearby Seyfert 2 galaxies observed by *HST* and *Chandra*. All of the sources present soft X-ray emission which is coincident in extension and overall morphology with the [O III] emission. The spectral analysis reveals that

the soft X-ray emission of all the objects is likely to be dominated by a photoionized gas. This is strongly supported by the 190 ks combined XMM-*Newton*/RGS spectrum of Mrk 3, which different diagnostic tools confirm as bei ng produced in a gas in photoionization equilibrium with an important contribution from resonant scattering. We tested with the code CLOUDY a simple scenario where the same gas photoionized by the nuclear continuum produces both the soft X-ray a nd the [O III] emission. Solutions satisfying the observed ratio between the two components exist, and require the density to decrease with radius roughly like r^{-2}, similarly to what often found for the Narrow Line Region.

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preprint available at http://es.arxiv.org/abs/astro-ph/0511216

Revisiting the Infrared Spectra of Active Galactic Nuclei with a New Torus Emission Model

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We describe improved modelling of the emission by dust in a toroidal–like structure heated by a central illuminating source within Active Galactic Nuclei (AGN). We chose a simple but realistic torus geometry, a flared disc, and a dust grain distribution function including a full range of grain sizes. The optical depth within the torus is computed in detail taking into account the different sublimation temperatures of the silicate and graphite grains, which solves previously reported inconsistencies in the silicate emission feature in type-1 AGN. We exploit this model to study the spectral energy distributions (SEDs) of 58 extragalactic (both type-1 and type-2) sources using archival optical and infrared (IR) data. We find that both AGN and starburst contributions are often required to reproduce the observed SEDs, although in a few cases they are very well fitted by a pure AGN component. The AGN contribution to the far-IR luminosity is found to be higher in type-1 sources, with all the type-2 requiring a substantial contribution from a circum-nuclear starburst. Our results appear in agreement with the AGN Unified Scheme, since the distributions of key parameters of the torus models turn out to be compatible for type-1 and type-2 AGN. Further support to the unification concept comes from comparison with medium-resolution IR spectra of type-1 AGN by the Spitzer observatory, showing evidence for a moderate silicate emission around 10μ which our code reproduces. ¿From our analysis we infer accretion flows in the inner nucleus of local AGN characterized by high equatorial optical depths ($A_V \simeq 100$), moderate sizes ($R_{max} < 100\ pc$) and very high covering factors ($f \simeq 80$ per cent) on average.

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Photoionized Hβ Emission in NGC 5548: It Breathes!

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Emission-line regions in active galactic nuclei and other photoionized nebulae should become larger in size when the ionizing luminosity increases. This “breathing” effect is observed for the Hβ emission in NGC 5548 by using Hβ and optical continuum lightcurves from the 13-year 1989-2001 AGN Watch monitoring campaign. To model the breathing, we use two methods to fit the observed lightcurves in detail: (i) parameterized models and, (ii) the `MEMECHO` reverberation mapping code. Our models assume that optical continuum variations track the ionizing radiation, and that the Hβ variations respond with time delays τ due to light travel time. By fitting the data using a delay map $\Psi(\tau, F_c)$ that is allowed to change with continuum flux F_c, we find that the strength of the Hβ response decreases and the time delay increases with ionizing luminosity. The parameterized breathing models allow the time delay and the Hβ flux to depend on the continuum flux so that, $\tau \propto F_c^{\beta}$ and $F_{H\beta} \propto F_c^{\alpha}$. Our fits give $0.1 < \beta < 0.46$ and $0.57 < \alpha < 0.66$. α is consistent with previous work by Gilbert & Peterson (2003) and Goad, Korista and Knigge (2004). Although we find β to be flatter than previously determined by Peterson et al. (2002) using cross-correlation methods, it is closer to the predicted values from recent theoretical work by Korista & Goad (2004).

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The bulk Lorentz factor crisis of TeV blazars : evidence for an inhomogeneous pileup energy distribution ?

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There is growing evidence that the estimations of the beaming Doppler factor in TeV BL Lac object based on the Self Synchrotron Compton (SSC) models are in strong disagreement with those deduced from the unification models between blazars and radio galaxies. When corrected from extragalactic absorption by the diffuse infrared background (DIrB), the SSC one-zone models require very high Lorentz factor (around 50) to avoid strong $\gamma - \gamma$ absorption. However, the statistics on beamed *vs.* unbeamed objects, as well as the luminosity contrast, favors much lower Lorentz factor of the order of 3. In this paper, we show that for the special case of Markarian 501, the need for very high Lorentz factor is unavoidable for all one- zone models where all photons are assumed to be produced at the same location at the same time. Models assuming a double structure with two different beaming patterns can partially solve the problem of luminosity contrast, but we point out that they are inconsistent with the statistics on the number of detected TeV sources. The only way to solve the issue is to consider inhomogeneous models, where low energy and high energy photons are not produced at the same place, allowing for much smaller Lorentz factors. It implies that the jet is stratified, but also that the particle energy distribution is close to a monoenergetic one, and that pair production is likely to be significant. The implications on relativistic jet physics and particle acceleration mechanism are discussed.

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preprint available at http://arxiv.org/abs/astro-ph/0511610

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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The supermassive black hole in Centaurus A: a benchmark for gas kinematical measurements

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We present new HST Space Telescope Imaging Spectrograph observations of the nearby radio galaxy NGC 5128 (Centaurus A). The bright emission line with longest wavelength accessible from HST, [SIII]λ9533Å, was used to study the kinematics of the ionized gas in the nuclear region with a 0.1" spatial resolution. The STIS data were analized in conjunction with the ground-based near-infrared Very Large Telescope ISAAC spectra used by Marconi et al. 2001 to infer the presence of a supermassive black hole and measure its mass. The two sets of data have spatial resolutions differing by almost a factor of five but provide independent and consistent measures of the BH mass, which are in agreement with our previous estimate based on the ISAAC data alone. The gas kinematical analysis provides a mass of $M_{\rm BH} = (1.1 \pm 0.1) \times 10^8 M_\odot$ for an assumed disk inclination of $i = 25$ deg or $M_{\rm BH} = (6.5 \pm 0.7) \times 10^7 M_\odot$ for $i = 35$ deg, the largest i value allowed by the data. We performed a detailed analysis of the effects on $M_{\rm BH}$ of the intrinsic surface brightness distribution of the emission line, a crucial ingredient in the gas kinematical analysis. We estimate that the associated systematic errors are no larger than 0.08 in $\log M_{\rm BH}$, comparable with statistical errors and indicating that the method is robust. However, the intrinsic surface brightness distribution has a large impact on the value of the gas velocity dispersion. A mismatch between the observed and model velocity dispersion is not necessarily an indication of non-circular motions or kinematically hot gas, but is as easily due to an inaccurate computation arising from too course a model grid, or the adoption of an intrinsic brightness distribution which is too smooth. The observed velocity dispersion in our spectra can be matched with a circularly rotating disk and also the observed line profiles and the higher order moments in the Hermite expansion of the line profiles, h_3 and h_4, are consistent with emission from such a disk. To our knowledge, Centaurus A is the first external galaxy for which reliable BH mass measurements from gas and stellar dynamics are available and, as in the case of the Galactic Center, the $M_{\rm BH}$ gas kinematical estimate is in good agreement with that from stellar dynamics. The BH mass in Centaurus A is in excellent agreement with the correlation with infrared luminosity and mass of the host spheroid but is a factor $\sim 2-4$ above the one with the stellar velocity dispersion. But this disagreement is not large if one takes into account the intrinsic scatter of the $M_{\rm BH} - \sigma_{\rm e}$ correlation. Finally, the high HST spatial resolution allows us to constrain the size of any cluster of dark objects alternative to a BH to $r_\bullet < 0.035$" ($\simeq 0.6$ pc). Thus Centaurus A ranks among the best cases for supermassive Black Holes in galactic nuclei.

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Stellar populations in a complete sample of local radio galaxies

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We investigate the nature of the continuum emission and stellar populations in the inner 1–3 kiloparsecs of a complete sample of twenty-four southern radio galaxies, and compare the results with a control sample of eighteen non-active early-type galaxies. Twelve of the radio galaxies are classified as Fanaroff-Riley type I (FR I), eight as FR II and four as intermediate or undefined type (FR x). Optical long-slit spectra are used to perform spectral synthesis as a function of distance from the nucleus at an average sampling of 0.5–1.0 kpc and quantify the relative contributions of a blue featureless continuum and stellar population components of different ages. Our main finding is a systematic difference between the stellar populations of the radio and control sample galaxies: the former have a larger contribution from an intermediate age (1 Gyr) component, suggesting a connection between the present radio activity and a starburst which occurred ∼1 Gyr ago. In addition, we find a correlation between the contribution of the 1 Gyr component and the radio power, suggesting that more massive starbursts have led to more powerful radio emission. A similar relation is found between the radio power and the mean age of the stellar population, in the sense that stronger nuclear activity is found in younger galaxies. We also find that the stellar populations of FR I galaxies are, on average, older and more homogeneous than those of FR IIs. Significant population gradients were found in only four radio galaxies, which are also those with more than 10 % of their total flux at 4020 Å contributed by age components younger than 100 Myr and/or a featureless continuum (indistinguishable from a 3 Myr old stellar population).

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The dust-eliminated shape of quasar spectra in the near-infrared: a hidden part of the big blue bump

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The near-infrared shape of the big blue bump component in quasar spectra has been essentially unknown. It usually cannot be observed directly, due to the strong hot dust emission which dominates quasar spectra longward of $\sim 1\mu$m. However this is quite an important part of the spectrum theoretically. At least bare disk models provide quite a robust prediction for the overall continuum shape in the near-infrared. Self-gravity should become important in the outer, near-infrared emitting regions of the putative disk, possibly leaving a signature of disk truncation in the near-infrared. We propose here that this important part of the spectrum can be revealed for the first time by observing polarized flux from normal quasars. At least in some polarized quasars, the emission lines are all unpolarized and so the polarized flux should originate interior to the broad line region, and therefore also interior to the dust emitting region. This can then be used to eliminate the dust emission. We present the results of near-infrared polarimetry for such three quasars (Ton202, 4C37.43, B2 1208+32). The data for Ton202 have the highest S/N, and the near-infrared polarized flux in this case is measured to have quite a blue shape, $F_\nu \propto \nu^{+0.42\pm0.29}$, intriguingly consistent with the simple multi-temperature black body, bare disk prediction of $\nu^{+1/3}$. All these data, although still with quite low S/N for the other two objects, demonstrate the unique potential of the technique with future better data. We also present similar data for other quasars and radio galaxies, and briefly discuss the nature of the polarization.

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The Outburst of HST-1 in the M87 Jet

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The X-ray intensity of knot HST-1, $0.85''$ from the nucleus of the radio galaxy M87, has increased by more than a factor of 50 during the last 5 years. The optical increase is similar and our more limited radio data indicate a commensurate activity. We give the primary results of our Chandra X-ray Observatory monitoring program and consider some of the implications of this extreme variability in a relativistic jet. We find that the data support a 'modest beaming synchrotron' model as indicated in our earlier papers. Based on this model, the decay of the X-ray lightcurve appears to be dominated by light travel time across the emitting region of HST-1, rather than synchrotron loss timescales.

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