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Accepted Abstracts - Submitted Abstracts - Thesis Abstracts
Jobs Adverts - Meetings Adverts - Special Announcements

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.

As always as editor of the newsletter I am very interested to hear any suggestions or feedback regarding the newsletter. So do not hesitate in emailing me your suggestions.

Many thanks for your continued subscription.

Rob Beswick

Abstracts of recently accepted papers

HST NIR Snapshot Survey of 3CR Radio Source Counterparts II: An Atlas and Inventory of the Host Galaxies, Mergers and Companions

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We present the second part of an H-band (1.6 μm) "atlas" of $z < 0.3$ 3CR radio galaxies, using the *Hubble Space Telescope Near Infrared Camera and Multi-Object Spectrometer* (HST NICMOS2). We present new imaging for 21 recently acquired sources, and host galaxy modeling for the full sample of 101 (including 11 archival) – an 87% completion rate. Two different modeling techniques are applied, following those adopted by the galaxy morphology and the quasar host galaxy communities. Results are compared, and found to be in excellent agreement, although the former breaks down in the case of strongly nucleated sources. Companion sources are tabulated, and the presence of mergers, tidal features, dust disks and jets are catalogued. The tables form a catalogue for those interested in the structural and morphological dust-free host galaxy properties of the 3CR sample, and for comparison with morphological studies of quiescent galaxies and quasar host galaxies. Host galaxy masses are estimated, and found to typically lie at around 2×10^{11} $M_{\odot}$. In general, the population is found to be consistent with the local population of quiescent elliptical galaxies, but with a longer tail to low Sérsic index, mainly consisting of low-redshift ($z < 0.1$) and low-radio-power (FR I) sources. A few unusually disky FR II host galaxies are picked out for further discussion. Nearby external

sources are identified in the majority of our images, many of which we argue are likely to be companion galaxies or merger remnants. The reduced NICMOS data are now publicly available from our website – http://archive.stsci.edu/prepds/3cr/. Based on observations with the NASA/ESA Hubble Space Telescope, obtained at the Space Telescope Science Institute, which is operated by the Assciation of Universities for Research in Astronomy, Inc. (AURA), under NASA contract NAS5-26555.

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preprint available at http://arxiv.org/abs/0712.0595
STScI e-print # 1789

First Detection of ^{12}CO $(1 \rightarrow 0)$ Emission from Two Narrow-Line Seyfert 1 Galaxies

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In order to investigate how the growth of galactic bulges progresses with the growth of central black holes (BHs), we observed molecular gas (fuel for the coming star formation) in possibly young active galaxies, narrow-line Seyfert 1 galaxies (NLS1s). We present the results of radio observations of ^{12}CO $(1 \rightarrow 0)$ using the Nobeyama Millimeter Array (with 2–4 kpc spatial resolution) for two FIR-bright NLS1s, yielding the first detection of their CO emission. Corresponding molecular–gas masses $M(H_2)$ of $(1-3) \times 10^9 M_\odot$ are the 2nd and 4th largest ones among NLS1s. By estimating dynamical masses and bulge masses $M_{\rm bulge}$ for these two NLS1s using CO channel map and CO line widths, we found $M(H_2)$ amount to 0.13–0.35 of these masses. Taking account the star formation efficiency (~ 0.1), the increase in $M_{\rm bulge}$ in those NLS1s in the near future ($\lesssim 10^{7.5}$ yr) is expected not to be a huge fraction (1–5 % of the preexisting stars). Bulge growth may have finished before BH growth, or bulge–BH coevolution may proceed with many, occasional discrete events, where one coevolution event produces only a small amount of mass growth of BHs and of bulges. We also discuss the ratios of star-formation rate–to–gas accretion rate onto BHs, finding that two NLS1s have very small ratios (≈ 1) compared with the $M_{\rm bulge}/M_{\rm BH}$ ratios found in active and inactive galaxies (≈ 700). This huge difference suggests either the non-overlapped coevolution, long star formation duration or temporarily high accretion rate during NLS1 phase.

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preprint available at http://arxiv.org/abs/0712.0994

The broad emission lines in the active galactic nucleus Fairall 9

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We present a study of UV and optical spectra of the active galaxy Fairall 9 taken as a part of the International AGN Watch database. We have measured CIV/Lyα, Lyα/Hβ and Hβ/Hα ratios at the different radial velocities which are varies across the line profiles. The ratio Lyα/H$\beta$is low in the low-velocity center of the lines, but increases a little in the high-velocity wings. The CIV/Lyα and Hα/Hβ line intensities ratios however are high at the line center but become low in the wings. The modeling with the photoionization code CLOUDY shows that the observed line ratios can be described by two systems of clouds. One corresponds to the high-ionization line zone (HIL) with an electron density, $ne \sim 10^{8-10}$ cm^{-3}. It is presumably located above the accretion disk or in the jets. The other system corresponds to the low-ionization line zone (LIL) which is probably a part of the accretion disk and which has a higher electron density, $ne \sim 10^{12-13}$cm^{-3}. We discuss the possible geometry of the BLR in Fairall 9.

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A Radio Through X-ray Study of the Jet/Companion-Galaxy Interaction in 3C 321

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We present a multiwavelength study of the nucleus, environment, jets, and hotspots of the nearby FRII radio galaxy 3C 321, using new and archival data from MERLIN, the VLA, *Spitzer*, *HST*, and *Chandra*. An initially collimated radio jet extends northwest from the nucleus of its host galaxy and produces a compact knot of radio emission adjacent (in projection) to a companion galaxy, after which it dramatically flares and bends, extending out in a diffuse structure 35 kpc northwest of the nucleus. We argue that the simplest explanation for the unusual morphology of the jet is that it is undergoing an interaction with the companion galaxy. Given that the northwest hotspot that lies >250 kpc from the core shows X-ray emission, which likely indicates *in situ* high-energy particle acceleration, we argue that the jet-companion interaction is not a steady-state situation. Instead, we suggest that the jet has been disrupted on a timescale less than the light travel time to the end of the lobe, $\sim 10^6$ years, and that the jet flow to this hotspot will only be disrupted for as long as the jet-companion interaction takes place. The host galaxy of 3C 321 and the companion galaxy are in the process of merging, and each hosts a luminous AGN. As this is an unusual situation, we investigate the hypothesis that the interacting jet has driven material on to the companion galaxy, triggering its AGN. Finally, we present detailed radio and X-ray observations of both hotspots, which show that there are multiple emission sites, with spatial offsets between the radio and X-ray emission.

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preprint available at http://arxiv.org/abs/0712.2669
high-resolution version at http://hea-www.harvard.edu/ devans/publications/3c321.pdf

Variable VHE gamma-ray emission from non-blazar AGNs

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The observation of rapidly variable very high energy (VHE) gamma-rays from non-aligned active galactic nuclei (AGNs), as reported from M87, proves challenging for conventional theoretical acceleration and emission models. Motivated by recent work on pulsar-type particle acceleration in M87 (Neronov & Aharonian 2007), we re-examine the centrifugal acceleration of particles by rotating jet magnetospheres in the vicinity of accreting supermassive black hole systems and analyze the energy constraints imposed for highly underluminous systems. The maximum Lorentz factor for centrifugally accelerated electrons in the presence of inverse Compton losses, and the associated characteristic variability time scale, are determined. Applications are presented for conditions expected to be present in the radio galaxy M87, assuming accretion onto the central black hole to occur in an advection-dominated (ADAF) mode. We show that for a highly underluminous source like M87, centrifugally accelerated electrons may reach Lorentz factors up to $\gamma \sim (10^7 - 10^8)$, allowing inverse Compton (Thomson) upscattering of sub-mm disk photons to the TeV regime. Upscattering of Comptonized disk photons results in a flat TeV spectrum $L_\nu \propto \nu^{-\alpha_c}$ with spectral index $\alpha_c \simeq 1.2$. The characteristic variability time scale is of the order $r_{\rm L}/c$, which in the case of M87 corresponds to $\simeq 1.7$ d for a typical light cylinder radius of $r_{\rm L} \simeq 5\, r_{\rm s}$. Centrifugal acceleration could provide a natural explanation for the challenging VHE emission features in M87. Our results suggest that some advection-dominated accreting (non-blazar) AGNs could well be observable VHE emitting sources.

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Observational Overview of the Feeding of Active Galactic Nuclei

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I present an overview of the observational signatures of feeding of Active Galactic Nuclei, discussing briefly the role of interactions among galaxies on extragalactic scales, and of non-axisymmetric gravitational potentials – such as bars – on galactic scales. Then I discuss at larger length the feeding signatures on hundred of parsec scales, for which new results include: (1) recent star formation surrounding the active nucleus on tens of parsec scales; (2) excess of gas and dust in active galaxies relative to non-active ones, in the form of nuclear spirals and disks; (3) new kinematic signatures of gas inflow along nuclear spiral arms, which may be the long sought mechanism to bring gas from kiloparsec scales down to the nucleus to feed the supermassive black hole.

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The impact of radio feedback from active galactic nuclei in cosmological simulations: Formation of disk galaxies

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In this paper, we present a new implementation of feedback due to active galactic nuclei (AGN) in cosmological simulations of galaxy formation. We assume that a fraction of jet energy, which is generated by an AGN, is transferred to the surrounding gas as thermal energy. Combining a theoretical model of mass accretion onto black holes with a multiphase description of star-forming gas, we self-consistently follow evolution of both galaxies and their central black holes. The novelty in our model is that we consider two distinct accretion modes: standard radiatively efficient thin accretion disks and radiatively inefficient accretion flows which we will generically refer to as RIAFs; motivated by theoretical models for jet production in accretion disks, we assume that only the RIAF is responsible for the AGN feedback. The focus of this paper is to investigate the interplay between galaxies and their central black holes during the formation of a disc galaxy. We find that, after an initial episode of bursting star formation, the accretion rate of the central black hole drops so that the accretion disk switches to a RIAF structure. At this point, the feedback from the AGN becomes efficient and slightly suppresses star formation in the galactic disk and almost completely halts star formation in the bulge. This suppression of the star formation regulates mass accretion onto the black hole and associated AGN feedback. As a result, the nucleus becomes a stochastically fuelled low-luminosity AGN (Seyfert galaxy) with recurrent short-lived episodes of activity after the starbursts. During the "on" events the AGN produces reasonably powerful jets (radio-loud state) and is less luminous than the host galaxy, while in the "off" phase the nucleus is inactive and "radio-quiet". Our model predicts several properties of the low-luminosity AGN including the bolometric luminosity, jet powers, the effect on kpc-scale of the radio jet and the AGN lifetime, which are in broad agreement with observations of Seyfert galaxies and their radio activity. We also find that the ratios between the central black hole mass and the mass of the host spheroid at $z = 0$ are $\sim 10^{-3}$ regardless of the strength of either supernova feedback or AGN feedback because the radiation drag model directly relates the star formation activity in the galactic centre and the mass accretion rate onto the central black hole.

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preprint available at http://arxiv.org/abs/0704.1218

Outflow-Dominated Emission from the Quiescent Massive Black Holes in NGC 4621 and NGC 4697

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The nearby elliptical galaxies NGC 4621 and NGC 4697 each host a supermassive black hole with $M_\bullet > 10^8 M_\odot$. Analysis of archival *Chandra* data and new NRAO Very Large Array data shows that each galaxy contains a low-luminosity active galactic nucleus (LLAGN), identified as a faint, hard X-ray source that is astrometrically coincident with a faint 8.5-GHz source. The latter has a diameter less that 0.3 arcsec (26 pc for NGC 4621, 17 pc for NGC 4697). The black holes energizing these LLAGNs have Eddington ratios $L(2-10\ keV)/L(Edd) \sim 10^{-9}$, placing them in the so-called quiescent regime. The emission from these quiescent black holes is radio-loud, with $log\ R_X = log\ \nu L_\nu(8.5\ GHz)/L(2-10\ keV) \sim -2$, suggesting the presence of a radio outflow. Also, application of the radio–X-ray–mass relation from Yuan & Cui for quiescent black holes predicts the observed radio luminosities $\nu L_\nu(8.5\ GHz)$ to within a factor of a few. Significantly, that relation invokes X-ray emission from the outflow rather than from an accretion flow. The faint, but detectable, emission from these two massive black holes is therefore consistent with being outflow-dominated. Observational tests of this finding are suggested.

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Mass Functions of the Active Black Holes in Distant Quasars from the Sloan Digital Sky Survey Data Release 3

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We present the mass functions of actively accreting supermassive black holes over the redshift range $0.3 \leq z \leq 5$ for a well-defined, homogeneous sample of 15,180 quasars from the Sloan Digital Sky Survey Data Release 3 (SDSS DR3) within an effective area of 1644 deg^2. This sample is the most uniform statistically significant subset available for the DR3 quasar sample. It was used for the DR3 quasar luminosity function, presented by Richards et al., and is the only sample suitable for the determination of the SDSS quasar black hole mass function. The sample extends from $i = 15$ to $i = 19.1$ at $z \lesssim 3$ and to $i = 20.2$ for $z \gtrsim 3$. The mass functions display a rise and fall in the space density distribution of active black holes at all epochs. Within the uncertainties the high-mass decline is consistent with a constant slope of $\beta \approx -3.3$ at all epochs. This slope is similar to the bright end slope of the luminosity function for epochs below $z = 4$. Our tests suggest that the down-turn toward lower mass values is due to incompleteness of the quasar sample with respect to black hole mass. Further details and analysis of these mass functions will be presented in forthcoming papers.

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preprint will be available at astro-ph: arXiv:0801.0243v1 (e.g., see http://arxiv.org/list/astro-ph/new on January 3, 2008)