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Abstracts - Thesis Abstracts - Jobs - Meetings

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

High Redshift Quasars and Star Formation in the Early Universe

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In order to derive information on the star formation history in the early universe we observed 6 high-redshift (z$\simeq$3.4) quasars in the near-infrared to measure the relative iron and MgII emission strengths. A detailed comparison of the resulting spectra with those of low-redshift quasars show essentially the same FeII / MgII emission ratios and very similar continuum and line spectral properties, indicating a lack of evolution of the relative iron to magnesium abundance of the gas since $z \simeq 3.4$ in bright quasars. On the basis of current chemical evolution scenarios of galaxies, where magnesium is produced in massive stars ending in type II SNe, while iron is formed predominantly in SNe of type Ia with a delay of ~ 1 Gyr and assuming as cosmological parameters $H_o = 72$ km s^{-1} Mpc^{-1}, $\Omega_M = 0.3$, and $\Omega_\Lambda = 0.7$, we conclude that major star formation activity in the host galaxies of our $z \simeq 3.4$ quasars must have started already at an epoch corresponding to $z_f \simeq 10$, when the age of the universe was less than 0.5 Gyrs.

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Deep 10 Micron Imaging of M87

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We analyze a 10.8 μm image of M87, obtained with the Gemini 8m telescope + OSCIR. The image has $< 0.5''$ resolution and represents 7 hours of observing time, making it the deepest high-resolution mid-IR image ever. The nucleus is resolved, and we also detect five optically bright knots in the jet. The spectral energy distributions of these features are entirely consistent with synchrotron radiation; we find little evidence of thermal emission from a dusty torus. Four faint jet regions are below the noise level of these observations. We also find evidence for diffuse galactic emission.

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Black Hole Mass and Eddington Ratio as Drivers for the Observable Properties of Radio-Loud and Radio-Quiet QSOs

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Recent studies of black holes in the nuclei of both active and normal galaxies have yielded relationships that permit a physical interpretation of the principal components of the spectra of QSOs. It is shown that principal component (or eigenvector) 1 (PC1) is driven predominantly by L/L_{Edd}, and principal component 2 (PC2) is driven by accretion rate. This results in a PC2 vs. PC1 diagram in which lines of constant black hole mass are diagonal. Using a sample consisting of the low-redshift PG objects supplemented by 75 radio-loud QSOs, it is shown that such a diagram effectively distinguishes radio-loud from radio-quiet as well as demonstrating that both narrow-line Seyfert 1s and broad absorption-line QSOs (BALQSOs) lie at the high L/L_{Edd} extreme, though these two types of objects are well separated in the PC2 direction. A simple picture that ties together physical parameters (black hole mass and Eddington ratio) and classification of AGN is presented. Based on the location of core-dominated and lobe-dominated radio-loud QSOs, orientation can be modeled as a third parameter in this scheme, implying an enhancement in the radio flux of core-dominated objects.

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Stellar and Ionized Gas Kinematics of the Interacting Seyfert 1.9 Galaxy NGC 2992

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Integral field spectroscopy in the central $16'' \times 12''$ (2.4 kpc $\times$ 1.8 kpc, if $H_0 = 75$ km s^{-1} Mpc^{-1}) of the Seyfert 1.9 galaxy NGC 2992 has been obtained using the fibre system INTEGRAL. The data are mainly used for studying the stellar and ionized gas kinematics. In spi te of the photometric disruptions in the outer parts ($r > 6$ kpc) produced by the interaction with its close companion (NGC 2993), the present stellar velocity field shows regular rotation. The ioniz ed gas presents several kinematically distinct components. Apart from the outflo wing component already reported by other authors, we found an additional (high i onization) kinematic component which seems to be associated with the boundaries of the figure-of-eight-shaped emission detected in the 6 cm radio map. We locate the hidden nucleus in the apex of the biconical structure d efined by the [O III] emission, coincident with the outflow origin and wit h the center of the dust lane. We do not find any clear evidence of direct influ ence of the interaction in the kinematics of the stars or the ionized gas in the circumnuclear region of NGC 2992.

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preprint available at http://www.ing.iac.es/~bgarcia/NGC2992/paper/n2992_INTEGRAL.ps.gz

Mid-IR and CO Observations of the IR/X-Ray Luminous Seyfert I Galaxy NGC985: The Making or Breaking of a ULIRG?

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We describe ISO and BIMA observations of the $z = 0.04$ Seyfert 1 ring galaxy NGC 985 which suggest close parallels with some quasar host galaxies. NGC 985 contains two closely spaced nuclei embedded in an $R^{1/4}$–law stellar bulge and an outer ring, evidence of an ongoing merger. The system contains $\sim 1.8 \times 10^{10}\,M_\odot$ of highly disturbed molecular gas which lies in an asymmetric bar-like structure with the peak in observed CO column densities significantly offset from the compact double nucleus. In contrast to this, the ISO observations show strong dust emission centered on the AGN, located in one of the two nuclei. Fainter CO, MIR, and radio continuum emission provide a glimpse of the complexities of star formation in the outer ring.

An analysis of the kinematics of the main CO emission reveal evidence for two dynamically distinct molecular components within NGC 985. The first is a set of isolated super-giant molecular clouds (SGMCs) which are concentrated within 9–10 kpc of the active nucleus. Although randomly distributed about the center, the clouds may form part of a clumpy highly-disturbed disk which may be either just forming around double-nucleus (the making of a ULIRG), or alternatively may be in the process of being disrupted-perhaps as a result of a powerful nuclear outflow (the breaking of a ULIRG). A second major concentration of CO lies offset from the double-nucleus in a dynamically coherent ridge of emission in which powerful star formation is occurring. We tentatively associate CO emission with two out of six UV absorption-lines seen in the blue wing of the very broad Lyα emission. Such an association would imply a complex inter-relationship between the nuclear CO cloud population in colliding systems, and AGN-driven winds.

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preprint available at http://arXiv.org/abs/astro-ph/0109448
and with high resolution figures at http://www.astro.cornell.edu/~vassilis/papers/ngc985.ps.gz

Emission-Line Properties of $z > 4$ Quasars

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High redshift QSOs provide important opportunities for advancing our understanding of the astrophysics of galaxy formation and evolution. Although a growing number of these sources are now known to exist at redshifts beyond 4, systematic studies of the emission-line properties of these objects are quite limited. We present results of a program of high signal-to-noise spectroscopy for 44 QSOs using the MMT and Keck observatories. The quasar spectra cover 1100 – 1700 Å in the rest frame for sources spanning a luminosity range of ~ 2 orders of magnitude. Comparisons between these data and spectra of lower redshift quasars reveal a high degree of similarity, although differences are present in the profiles and the strengths of some emission features. An examination of the luminosity dependence of the emission lines reveals evidence for a weak or absent Baldwin effect among $z \gtrsim 4$ QSOs. We compare measurements for objects in our sample with results from other high redshift surveys characterized by different selection techniques. Distributions of equivalent widths for these different ensembles are consistent with a common parent population, suggesting that our sample is not strongly biased, or in any case, subject to selection effects that are not significantly different from other surveys, including the Sloan Digital Sky Survey. Based on this comparison, we tentatively conclude that the trends identified here are representative of high z QSOs. In particular, the data bolster indications of supersolar metallicities in these luminous, high-z sources, which support scenarios that assume substantial star formation at

epochs preceding or concurrent with the QSO phenomena.

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The Starburst-AGN connection: Implications for the Unification of Seyferts

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Observations at ultraviolet, optical and near-infrared wavelengths have shown the existence of recent star formation in the nuclear regions of Seyfert 2 (Sy2) galaxies that suggest a connection between the Starburst and the Seyfert phenomenon. According with the standard unified models of AGN circumnuclear starbursts also have to be present (and in the same numbers) in Sy1 as in Sy2 galaxies. This review discuss evidence in favor of the Starburst-AGN connection, as well as possible differences in terms of star formation activity between Sy1 and Sy2, that suggest an alternative interpretation of the Seyfert classification to that proposed by the standard unification model.

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Short-term emission line and continuum variations in Mrk 110

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We present results of a variability campaign of Mrk 110 performed with the 9.2-m Hobby-Eberly Telescope (HET) at McDonald Observatory. The high S/N spectra cover most of the optical range. They were taken from 1999 November through 2000 May. The average interval between the observations was 7.3 days and the median interval was only 3.0 days. Mrk 110 is a narrow-line Seyfert 1 galaxy. During our campaign the continuum flux was in a historically low stage. Considering the delays of the emission lines with respect to the continuum variations we could verify an ionization stratification of the BLR. We derived virial masses of the central black hole from the radial distances of the different emission lines and from their widths. The calculated central masses agree within 20%. Furthermore, we identified optical HeI singlet emission lines emitted in the broad-line region. The observed line fluxes agree with theoretical predictions. We show that a broad wing on the red side of the [OIII]λ5007 line is caused by the HeI singlet line at 5016 Å.

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A Chandra X-ray Study of Cygnus A — III. The Cluster of Galaxies

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We present an analysis of the *Chandra* Advanced CCD Imaging Spectrometer (ACIS) observation of the intracluster gas associated with the cluster of galaxies surrounding Cygnus A. The dominant gaseous structure is a roughly elliptical (presumably prolate spheroidal in three dimensions) feature with semi-major axis $\simeq 1.'1$ ($\simeq$ 100 kpc). This structure apparently represents intracluster gas which has been swept up and compressed by a cavity inflated in this gas by relativistic material which has passed through the ends of the radio jets. The X-ray emitting gas shows this prolate spheroidal morphology to $\simeq 1.'2$ (110 kpc) from the radio galaxy, but is spherical on larger scales. The X-ray emission from the intracluster gas extends to at least $8'$ ($\simeq$ 720 kpc) from the radio galaxy, and a second, extended source of X-ray emission (probably associated with a second cluster of galaxies) is seen some $12'$ ($\simeq$ 1 Mpc) to the NW of Cygnus A. The X-ray spectrum of the integrated intracluster gas imaged

on the S3 chip (dimensions $8' \times 8' = 720 \times 720$ kpc), excluding the contribution from the radio galaxy and other compact sources of X-ray emission, has a gas temperature, metallicity, and unabsorbed 2–10 keV rest-frame luminosity of 7.7 keV, 0.34 times solar, and 3.5×10^{44} erg s^{-1}, respectively.

We have deprojected the X-ray spectra taken from 12 elliptical and circular annuli in order to derive a run of temperature, metallicity, density, and pressure as a function of radius. The temperature of the X-ray emitting gas drops from $\simeq 8$ keV more than 100 kpc from the center to $\simeq 5$ keV some 80 kpc from the center, with the coolest gas immediately adjacent to the radio galaxy. "Belts" of slightly cooler ($\simeq 4$ keV) X-ray emitting gas run around the minor dimension of the cavity created by the radio source, while the limb-brightened edges of the cavity are slightly hotter ($\simeq 6$ keV), perhaps as a result of heating by a bow shock driven by the probably expanding cavity into the intracluster gas. There is a metallicity gradient in the X-ray emitting gas, with the highest metallicities ($\sim$ solar) found close to the center, decreasing to ~ 0.3 solar in the outer parts. We have used the assumption of hydrostatic equilibrium to derive a total cluster mass within 500 kpc of $2.0 \times 10^{14}\ M_\odot$ and $2.8 \times 10^{14}\ M_\odot$ for a constant and centrally decreasing temperature profile, respectively. The total mass of X-ray emitting gas within the same radius is $1.1 \times 10^{13}\ M_\odot$. Thus, the gas fraction of the cluster within 500 kpc is 0.055 and 0.039 for the constant and centrally decreasing temperature profiles, respectively.

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A Radio Study of Neutral gas and Dust in the Radio Galaxy 3C 293

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We have observed broad HI absorption in the radio galaxy 3C 293 using MERLIN at 0''.2 angular resolution and the GMRT at arcsecond resolution. Extensive HI is found in absorption across the center of this peculiar radio galaxy allowing a detailed study of the dynamics of the neutral gas on linear scales down to $\sim$160 pc. In optical depth position-velocity diagrams across the central few kiloparsecs we detect a distinct velocity gradient of 179 kms^{-1} arcsec^{-1} associated with the broad absorption. This is interpreted as a ring of neutral gas rotating around the suspected position of the AGN. The radius of this high velocity gradient ring is found to be >0''.74 (600 pc), implying an upper limit upon the enclosed mass of $3.9{\times}10^9(\sin^{-2}i)$ M$_\odot$, assuming a near edge on disk with an inclination of i. The optical depth of HI is mapped across the entire central region of 3C 293 showing enhancements of a factor 4 in the areas that are co-spatial with dust lanes seen in HST imaging of this galaxy.

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Type 1 AGN Unification

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The model I recently proposed for the structure of quasars offers to unify the many aspects of Type 1 AGN: emission lines, absorption lines and reflection features. This makes the model heavily overconstrained by observation and readily tested.

Here I first outline the model, and then concentrate on how the model answers objections raised since publication - with many of the tests being reported at this meeting. I then begin to explore how these and future tests can discriminate between this wind model and 3 well-defined alternatives.

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Broad-line radio galaxies: old and feeble?

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Far-infrared photometry of broad-line radio galaxies shows this class of AGN to consist of many hot and some cool infrared emitters, with peaks in their spectral energy distributions around 25 μm or longward of 60 μm, respectively. Quantitative analysis indicates that this distribution relates to a substantial dispersion in the strength of the cool dust component: broad-line radio galaxies are relatively poor in large-scale dust. Possibly they have undergone a different merger evolution, or are relatively old AGN.

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