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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

X-Ray Insights Into the Physics of Mini-BAL Quasar Outflows

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We examine the UV and X-ray properties of 256 radio-quiet SDSS quasars (QSOs) observed in X-rays with *Chandra* and/or *XMM-Newton* in order to study the relationship between QSOs with broad CIV absorption lines (BALs; width > 2000 km s^{-1}) and those with CIV mini-BALs (here defined to have widths of 1000–2000 km s^{-1}). Our sample includes 42 BAL and 48 mini-BAL QSOs. The relative X-ray brightness and hard spectral slopes of the mini-BAL population are, on average, intermediate between those of BAL and non-BAL QSOs, as might be expected if narrower and broader absorption line outflows are physically related. However, a significant population of mini-BALs has outflow velocities higher than would be expected for BAL QSOs of the same relative X-ray brightness. Consistenly strong X-ray absorption is apparently not required to accelerate at least some mini-BALs to high outflow velocities. Assuming the mini-BAL features are correctly attributed to intrinsic CIV absorption, we suggest that their observed properties may be explained if mini-BALs are "seeds" which can be accelerated to form BALs when sufficient X-ray shielding is present.

We also examine several QSOs with broad CIV absorption that have been recently reported to be unusually X-ray bright. Such cases are frequently mini-BAL QSOs, which as a population are generally brighter in X-rays than BAL QSOs. Pointed *XMM-Newton* observations also suggest that these sources (or unresolved neighbors) may have been previously observed in a high flux state.

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E-mail contact: rgibson@astro.washington.edu,
preprint available at http://arxiv.org/abs/0902.0951

X-ray Insights into the Nature of Weak Emission-Line Quasars at High Redshift

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We present *Chandra* observations of nine high-redshift quasars ($z = 2.7 - 5.9$) discovered by the Sloan Digital Sky Survey with weak or undetectable high-ionization emission lines in their UV spectra (WLQs). Adding archival X-ray observations of six additional sources of this class has enabled us to place the strongest constraints yet on the X-ray properties of this remarkable class of AGNs. Although our data cannot rule out the possibility that the emission lines are overwhelmed by a relativistically boosted continuum, as manifested by BL Lac objects, we find that WLQs are considerably weaker in the X-ray and radio bands than the majority of BL Lacs found at much lower redshifts. If WLQs are high-redshift BL Lacs, then it is difficult to explain the lack of a large parent population of X-ray and radio bright weak-lined sources at high redshift. We also consider the possibility that WLQs are quasars with extreme properties, and in particular that the emission lines are suppressed by high accretion rates. Using joint spectral fitting of the X-ray spectra of 11 WLQs we find that the mean photon index in the hard X-ray band is consistent with those observed in typical radio-quiet AGNs with no hint of an unusually steep hard-X-ray spectrum. This result poses a challenge to the hypothesis that WLQs have extremely high accretion rates, and we discuss additional observations required to test this idea.

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Ionised Carbon and Galaxy Activity

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We investigate the possibility that the decrease in the relative luminosity of the 158 μm [C II] line with the far-infrared luminosity in extragalactic sources stems from a stronger contribution from the heated dust emission in the more distant sources. Due to the flux limited nature of these surveys, the luminosity of the detected objects increases with distance. However, the [C II] luminosity does not climb as steeply as that of the far-infrared, giving the decline in the $L_{[\mathrm{CII}]}/L_{\mathrm{FIR}}$ ratio with L_{FIR}. Investigating this further, we find that the [C II] luminosity exhibits similar drops as measured against the carbon monoxide and radio continuum luminosities. The former may indicate that at higher luminosities a larger fraction of the carbon is locked up in the form of molecules and/or that the CO line radiation also contributes to the cooling, done mainly by the [C II] line at low luminosities. The latter hints at increased activity in these galaxies at greater distances, so we suggest that, in addition to an underlying heating of the dust by a stellar population, there is also heating of the embedded dusty torus by the ultra-violet emission from the active nucleus, resulting in an excess in the far-infrared emission from the more luminous objects.

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preprint available at http://arxiv.org/abs/0807.4365

Ultraviolet Fe II emission in z ∼ 2 quasars

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We present spectra of six luminous quasars at $z \sim 2$, covering rest wavelengths 1600−3200 Å. The fluxes of the UV Fe II emission lines and Mg II λ2798 doublet, the line widths of Mg II, and the 3000 Å luminosity were obtained from the spectra. These quantities were compared with those of low-redshift quasars at $z = 0.06 - 0.55$ studied by Tsuzuki et al. In a plot of the Fe II(UV)/Mg II flux ratio as function of the cental black hole mass, Fe II(UV)/Mg II in our $z \sim 2$ quasars is systematically greater than in the low-redshift quasars. We confermed that luminosity is not responsible for this excess. It is unclear whether this excess is caused by rich Fe abundance at $z \sim 2$ over low-redshift or by non-abundance effects such as high gas density, strong radiation field, and high microturbulent velocity.

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Mass Outflow in the Seyfert 1 Galaxy NGC 5548[1]

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[1]Based on observations made with the NASA/ESA Hubble Space Telescope, obtained at the Space Telescope Science Institute, which is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5-26555. These observations are associated with proposal 9511.

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We present a study of the intrinsic UV absorption and emission lines in an historically low-state spectrum of the Seyfert 1 galaxy NGC 5548, which we obtained in 2004 February at high spatial and spectral resolution with the Space Telescope Imaging Spectrograph (STIS) on the *Hubble Space Telescope* (*HST*). We isolate a component of emission with a width of 680 km s^{-1} (FWHM) that arises from an "intermediate line region" (ILR), similar to the one we discovered in NGC 4151, at a distance of ∼1 pc from the central continuum source. From a detailed analysis of the five intrinsic absorption components in NGC 5548 and their behavior over a span of 8 years, we present evidence that most of the UV absorbers only partially cover the ILR and do not cover an extended region of UV continuum emission, most likely from hot stars in the circumnuclear region. We also find that four of the UV absorbers are at much greater distances (>70 pc) than the ILR, and none have sufficient N V or C IV column densities to be the ILR in absorption. At least a portion of the UV absorption component 3, at a radial velocity of −530 km s^{-1}, is likely responsible for most of the X-ray absorption, at a distance < 7 pc from the central source. The fact that we see the ILR in absorption in NGC 4151 and not in NGC 5548 suggests that the ILR is located at a relatively large polar angle (∼45 degrees) with respect to the narrow-line region outflow axis.

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Evidence of a pure starburst nature of the nuclear region of NGC 253

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We present high-resolution spectral line and continuum VLBI and VLA observations of the nuclear region of NGC 253 at 22 GHz. While the water vapor masers in this region were detected on arcsecond and milliarcsecond scales, we could not detect any compact continuum emission with a 5σ upper limit of ~ 1 mJy. The observations reveal that the water maser emission is not related to a possible low-luminosity active galactic nucleus but is almost certainly associated with star-formation activity. Not detecting any compact continuum source on milliarcsecond scales also questions the presence of a – previously assumed – active nucleus in NGC 253.

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The Role of Molecular Gas in Obscuring Seyfert AGN

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In a sample of local active galactic nuclei studied at a spatial resolution on the order of ten parsecs we show that the interstellar medium traced by the molecular hydrogen ν=1-0 S(1) line at 2.1 μm forms a geometrically thick, clumpy disk. The kinematics of the molecular gas reveals general rotation, although an additional significant component of random bulk motion is required by the high local velocity dispersion. The size scale of the typical gas disk is found to have a radius of $\sim$30 pc with a comparable vertical height. Within this radius the average gas mass is estimated to be $\sim 10^7$ $M_\odot$ based on a typical gas mass fraction of 10%, which suggests column densities of $N_H \sim 5 \times 10^{23}$ cm^{-2}. Extinction of the stellar continuum within this same region suggest lower column densities of $N_H \sim 2 \times 10^{22}$ cm^{-2}, indicating that the gas distribution on these scales is dominated by dense clumps. In half of the observed Seyfert galaxies this lower column density is still great enough to obscure the AGN at optical/infrared wavelengths. We conclude, based on the spatial distribution, kinematics, and column densities that the molecular gas observed is spatially mixed with the nuclear stellar population and is likely to be associated with the outer extent of any smaller-scale nuclear obscuring structure. Furthermore, we find that the velocity dispersion of the molecular gas is correlated with the star formation rate per unit area, suggesting a link between the two phenomena, and that the gas surface density follows known "Schmidt-Kennicutt" relations. The molecular/dusty structure on these scales may be dynamic since it is possible that the velocity dispersion of the gas, and hence the vertical disk height, is maintained by a short, massive inflow of material into the nuclear region and/or by intense, short-lived nuclear star formation.

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The Black Hole Mass – Bulge Luminosity Relationship for Active Galactic Nuclei from Reverberation Mapping and Hubble Space Telescope Imaging

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We investigate the relationship between black hole mass and bulge luminosity for AGNs with reverberation-based black hole mass measurements and bulge luminosities from two-dimensional decompositions of *Hubble Space Telescope* host galaxy images. We find that the slope of the relationship for AGNs is $0.76 - 0.85$ with an uncertainty of ~ 0.1, somewhat shallower than the $M_{\rm BH} \propto L^{1.0\pm0.1}$ relationship that has been fit to nearby quiescent galaxies with dynamical black hole mass measurements. This difference is somewhat perplexing, as the AGN black hole masses include an overall scaling factor that brings the AGN $M_{\rm BH} - \sigma_\star$ relationship into agreement with that of quiescent galaxies. We discuss biases that may be inherent to the AGN and quiescent galaxy samples and could cause the apparent inconsistency in the forms of their $M_{\rm BH} - L_{\rm bulge}$ relationships. Recent work by Graham, however, presents a similar slope of ~ 0.8 for the quiescent galaxies and may bring the relationship for AGNs and quiescent galaxies into agreement.

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The Space Density of Compton Thick AGN and the X-ray Background

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We constrain the number density and evolution of Compton-thick Active Galactic Nuclei (AGN). In the local Universe we use the wide area surveys from the Swift and INTEGRAL satellites, while for high redshifts we explore candidate selections based on a combination of X-ray and mid-IR parameters. We find a significantly lower space density of Compton-thick AGN in the local Universe than expected from published AGN population synthesis models to explain the X-ray background. This can be explained by the numerous degeneracies in the parameters of those models; we use the high-energy surveys described here to remove those degeneracies. We show that only direct observations of CT AGN can currently constrain the number of heavily-obscured supermassive black holes. At high redshift, the inclusion of IR-selected Compton-thick AGN candidates leads to a much higher space density, implying (a) a different (steeper) evolution for these sources compared to less-obscured AGN, (b) that the IR selection includes a large number of interlopers, and/or (c) that there is a large number of reflection-dominated AGN missed in the INTEGRAL and Swift observations. The contribution of CT AGN to the X-ray background is small, ∼9%, with a comparable contribution to the total cosmic accretion, unless reflection-dominated CT AGN significantly outnumber transmission-dominated CT AGN, in which case their contribution can be much higher. Using estimates derived here for the accretion luminosity over cosmic time we estimate the local mass density in supermassive black holes and find a good agreement with available constraints for an accretion efficiency of ∼10%. Transmission-dominated CT AGN contribute only ∼8% to total black hole growth.

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Mid-infrared spectroscopy of infrared-luminous galaxies at $z \quad sim$ 0.5–3

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We present results on low-resolution mid-infrared (MIR) spectra of 70 infra red-luminous galaxies obtained with the Infrared Spectrograph (IRS) onboard *Spitzer*. We selected sources from the European Large Area Infrared Survey (ELAIS) with $S_{15} >$ 0.8 mJy and photometric or spectroscopic $z > 1$. About half of the sample are QSOs in the optical, while the remaining sources are galaxies, comprising both obscured AGN and starbursts. Redshifts were obtained from optical spectroscopy, photometric redshifts and from the IRS spectra. The later turn out to be reliable for obscured and/or star-forming sources, thus becoming an ideal complement to optical spectroscopy for redshift estimation. We estimate monochromatic luminosities at several restframe wavelengths, equivalent widths and luminosities for the PAH features, and strength of the silicate feature in individual spectra. We also estimate integrated 8–1000 μm infrared luminosities via spectral energy distribution fitting to MIR and far-infrared (FIR) photometry from the Spitzer Wide-area Infrared Extragalactic survey (SWIRE) and the MIR spectrum. Based on these measurements, we classify the spectra using well-known infrared diagnostics, as well as a new one that we propose, into three types of source: those dominated by an unobscured AGN, mostly corresponding to optical quasars (QSOs), those dominated by an obscured AGN, and starburst-dominated sources. Starbursts concentrate at $z \sim 0.6$–1.0 favored by the shift of the 7.7-μm PA H band into the selection 15-μm band, while AGN spread over the $0.5 < z < 3.1$ range. Star formation rates (SFR) are estimated for individual sources from the lum inosity of the PAH features. An estimate of the average PAH luminosity in QSOs and obscured AGN is obtained from the composite spectrum of all sources with reliable redshifts. The estimated mean SFR in the QSOs is 50–100 $M_{\odot}yr^{-1}$, but the implied FIR luminosity is 3–10 times lower than that obtained from stacking analysis of the FIR photometry, suggesting destruction of the PAH carriers by energetic photons from the AGN. The SFR estimated in obscured AGN is 2–3 times higher than in QSOs of similar MIR luminosity. This discrepancy might not be due to luminosity effects or selection biasal one, but could instead indicate a connection between obscuration and star formation. However, the observed correlation between silicate absorption and the slope of the near- to mid-infrared spectrum is compatible with the obscuration of the AGN emission in these sources being produced in a dust torus.

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Synthetic synchrotron emission maps from MHD models for the jet of M87

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We present self-consistent global, steady-state MHD models and synthetic optically thin synchrotron emission maps for the jet of M87. The model consist of two distinct zones: an inner relativistic outflow, which we identify with the observed jet, and an

outer cold disk-wind. While the former does not self-collimate efficiently due to its high effective inertia, the latter fulfills all the conditions for efficient collimation by the magneto-centrifugal mechanism. Given the right balance between the effective inertia of the inner flow and the collimation efficiency of the outer disk wind, the relativistic flow is magnetically confined into a well collimated beam and matches the measurements of the opening angle of M87 over several orders of magnitude in spatial extent. The synthetic synchrotron maps reproduce the morphological structure of the jet of M87, i.e. center-bright profiles near the core and limb-bright profiles away from the core. At the same time, they also show a local increase of brightness at some distance along the axis associated to a recollimation shock in the MHD model. Its location coincides with the position of the optical knot HST-1. In addition our best fitting model is consistent with a number of observational constraints such as the magnetic field in the knot HST-1, and the jet-to-counterjet brightness ratio.

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Eight-Dimensional Mid-Infrared/Optical Bayesian Quasar Selection

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We explore the multidimensional, multiwavelength selection of quasars from mid-IR (MIR) plus optical data, specifically from *Spitzer*-IRAC and the Sloan Digital Sky Survey (SDSS). Traditionally quasar selection relies on cuts in 2-D color space despite the fact that most modern surveys (optical and infrared) are done in more than 3 bandpasses. In this paper we apply modern statistical techniques to combined *Spitzer* MIR and SDSS optical data, allowing up to 8-D color selection of quasars. Using a Bayesian selection method, we catalog 5546 quasar candidates to an 8.0μm depth of 56μJy over an area of ~ 24 deg^2. Roughly 70% of these candidates are not identified by applying the same Bayesian algorithm to 4-color SDSS optical data alone. The 8-D optical+MIR selection on this data set recovers 97.7% of known type 1 quasars in this area and greatly improves the effectiveness of identifying $3.5 < z < 5$ quasars which are challenging to identify (without considerable contamination) using MIR data alone. We demonstrate that, even using only the two shortest wavelength IRAC bandpasses (3.6 and 4.5μm), it is possible to use our Bayesian techniques to select quasars with 97% completeness and as little as 10% contamination (as compared to $\sim$60% contamination using colors cuts alone). We compute photometric redshifts for our sample; comparison with known objects suggests a photometric redshift accuracy of 93.6% ($\Delta z \pm 0.3$), remaining roughly constant when the two reddest MIR bands are excluded. Despite the fact that our methods are designed to find type 1 (unobscured) quasars, as many as 1200 of the objects are type 2 (obscured) quasar candidates. Coupling deep optical imaging data, with deep mid-IR data could enable selection of quasars in significant numbers past the peak of the quasar luminosity function (QLF) to at least $z \sim 4$. Such a sample would constrain the shape of the QLF both above and below the break luminosity (L^*_Q) and enable quasar clustering studies over the largest range of redshift and luminosity to date, yielding significant gains in our understanding of the physics of quasars and their contribution to galaxy evolution.

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Jobs

Advanced Fellowship

Radio Astronomy and Astrophysics group, Onsala, Chalmers University of Technology, Sweden
20th March with **Dr John Conway, Dr Susanne Aalto**

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To strengthen observational AGN and starburst research in our research group we are looking for talented researchers interested in applying together with us for a personal 4 year fellowship from the Swedish research council (VR), with a possible extension to 5 years. To be eligible for this fellowship your PhD should typically be more recent than April 2004 (with some exceptions, e.g. due to parental leave, military service), and you are normally expected to have at least two years of postdoc experience. The fellowship is prestigious, with only some 30 granted each year for all of the natural sciences in Sweden, and at most one in astronomy. The decision on the fellowship will be taken by the Swedish National Research Council late 2009, and the position could start any time during 2010.

Observational AGN and starburst research at Onsala is mostly concentrated at radio and millimetre wavelengths. The leading group members in this research field are Dr John Conway and Dr Susanne Aalto supported by postdoctoral researchers and PhD students. At Onsala the Swedish national facility for radio astronomy at Onsala runs a millimetre wave (20m) telescope and centimetre wave antenna (25m) and manages the Swedish time (23Ĩ) on the APEX single dish (sub)millimetre wave telescope in Chile. During 2009 a LOFAR station will be installed on the site. OSO also hosts the Nordic node of the European ALMA Regional Centre (ARC) whose primary mission is to support local and Nordic users of ALMA.

Within the group a number of large single dish and interferometric observing millimeter programs are ongoing whose goals are to help separate AGN and starburst activity and use molecular lines as tracers of starburst evolution. In particular a large 350 hour eMERLIN two frequency imaging legacy program on Luminous Infra-red galaxies (LIRGI, co-PI John Conway. see http://www.merlin.ac.uk/legacy/projects/lirgi.html for goals) has recently been approved. The group is also involved in the eMERLIN LeMMINGs project (see http://www.merlin.ac.uk/legacy/projects/lemmings.html). Finally the group is active within the LOFAR Extragalactic survey Key Science Project in the areas of nearby galaxies and nearby AGN. Applicants interested in contributing to any of the above programs are particularly encouraged to apply.

Since the actual application to the research council has to be done jointly with the research group (with a deadline in April), we invite those interested in applying to contact one of us before March 20th at the latest.

The Active Galaxies Newsletter is available on the World Wide Web. You can access it via the University of Manchester home page :- http://www.manchester.ac.uk/jodrellbank/∼agnews
If you move or your e-mail address changes, please send the editor your new address. If the Newsletter repeatedly bounces back from an address then that address is deleted from the mailing list.