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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 day 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.

Melanie Gendre

Abstracts of recently accepted papers

X-ray Signatures of Circumnuclear Gas in AGN

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X-ray spectra of AGN are complex. X-ray absorption and emission features trace gas covering a wide range of column densities and ionization states. High resolution spectra show the absorbing gas to be outflowing, perhaps in the form of an accretion disk wind. The absorbing complex shapes the form of the X-ray spectrum while X-ray reverberation and absorption changes explain the spectral and timing behaviour of AGN. We discuss recent progress, highlighting some new results and reviewing the implications that can be drawn from the data.

To appear in the proceedings of "Suzaku 2011, Exploring the X-ray Universe: Suzaku and Beyond", publisher AIP

X-ray spectroscopy of the Compton-thick Seyfert 2 ESO 138−G1

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We report on our analysis of *XMM-Newton* observations of the Seyfert 2 galaxy ESO 138−G1 (z= 0.0091). These data reveal a complex spectrum in both its soft and hard portions. The 0.5–2 keV band is characterized by a strong "soft-excess" component with several emission lines, as commonly observed in other narrow-line AGN. Above 3 keV, a power-law fit yields a very flat slope ($\Gamma \sim 0.35$), along with the presence of a prominent line-like emission feature around ∼6.4 keV. This indicates heavy obscuration along the line of sight to the nucleus. We find an excellent fit to the 3-10 keV continuum with a pure reflection model, which provides strong evidence of a Compton-thick screen, preventing direct detection of the intrinsic nuclear X-ray emission. Although a model consisting of a power law transmitted through an absorber with $N_H \sim 2.5 \times 10^{23}$ cm^{-2} also provides a reasonable fit to the hard X-ray data, the equivalent width (EW) value of ∼ 800 eV measured for the Fe Kα emission line is inconsistent with a primary continuum obscured by a Compton-thin column density. Furthermore, the ratio of 2-10 keV to de-reddened [OIII] fluxes for ESO 138−G1 agrees with the typical values reported for well-studied Compton-thick Seyfert galaxies. Finally, we also note that the upper limits to the 15-150 keV flux provided by *Swift*/BAT and *INTEGRAL*/IBIS seem to rule out the presence of a transmitted component of the nuclear continuum even in this very hard X-ray band, hence imply that the column density of the absorber could be as high as 10^{25} cm^{-2}. This makes ESO 138−G1 a very interesting, heavy Compton-thick AGN candidate for the next X-ray missions with spectrosco pic and imaging capabilities above 10 keV.

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preprint available at http://arxiv.org/abs/1108.5898

Can we measure the accretion efficiency of Active Galactic Nuclei?

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The accretion efficiency for individual black holes is very difficult to determine accurately. There are many factors that can influence each step of the calculation, such as the dust and host galaxy contribution to the observed luminosity, the black hole mass and more importantly, the uncertainties on the bolometric luminosity measurement. Ideally, we would measure the AGN emission at every wavelength, remove the host galaxy and dust, reconstruct the AGN spectral energy distribution and integrate to determine the intrinsic emission and the accretion rate. In reality, this is not possible due to observational limitations and our own galaxy line of sight obscuration. We have then to infer the bolometric luminosity from spectral measurements made in discontinuous wavebands and at different epochs. In this paper we tackle this issue by exploring different methods to determine the bolometric luminosity. We first explore the trend of accretion efficiency with black hole mass ($\epsilon \propto M^{\sim 0.5}$) found in recent work by Davis & Laor and discuss why this is most likely an artefact of the parameter space covered by their PG quasar sample. We then target small samples of AGN at different redshifts, luminosities and black hole masses to investigate the possible methods to calculate the accretion efficiency. For these sources we are able to determine the mass accretion rate and, with some assumptions, the accretion efficiency distributions. Even though we select the sources for which we are able to determine the parameters more accurately, there are still factors affecting the measurements that are hard to constrain. We suggest methods to overcome these problems based on contemporaneous multi-wavelength data measurements and specifically targeted observations for AGN in different black hole mass ranges.

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Dense gas without star formation: The kpc-sized turbulent molecular disk in 3C326 N

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We report the discovery of a 3 kpc disk of few 10^9 $M_\odot$ of dense, warm H_2 in the nearby radio galaxy 3C326 N, which shows no signs of on-going or recent star formation and falls a factor 60 below the Schmidt-Kennicutt law. VLT/SINFONI imaging spectroscopy shows broad (FWHM$\sim$500 km s^{-1}) ro-vibrational H_2 lines across all of the disk, with irregular profiles and line ratios consistent with shocks. The ratio of turbulent and gravitational energy suggests that the gas is highly turbulent and not gravitationally bound. In absence of the driving by the jet, short turbulent dissipation times suggest the gas should collapse rapidly and form stars, at odds with the recent star-formation history. Motivated by hydrodynamic models of rapid H_2 formation boosted by turbulent compression, we propose that the molecules formed from diffuse atomic gas in the turbulent jet cocoon. Since the gas is not self-gravitating, it cannot form molecular clouds or stars while the jet is active, and is likely to disperse and become atomic again after the nuclear activity ceases. We speculate that very low star-formation rates are to be expected under such conditions, provided that the large-scale turbulence sets the gas dynamics in molecular clouds. Our results illustrate that jets may create large molecular reservoirs as expected in 'positive feedback' scenarios of AGN-triggered star formation, but that this alone is not sufficient to trigger star formation.

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The Lick AGN Monitoring Project 2011: Reverberation Mapping of Markarian 50

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The Lick AGN Monitoring Project 2011 observing campaign was carried out over the course of 11 weeks in Spring 2011. Here we present the first results from this program, a measurement of the broad-line reverberation lag in the Seyfert 1 galaxy Mrk

50. Combining our data with supplemental observations obtained prior to the start of the main observing campaign, our dataset covers a total duration of 4.5 months. During this time, Mrk 50 was highly variable, exhibiting a maximum variability amplitude of a factor of ~ 4 in the U-band continuum and a factor of ~ 2 in the Hβ line. Using standard cross-correlation techniques, we find that Hβ and Hγ lag the V-band continuum by $\tau_{\rm cen} = 10.64^{+0.82}_{-0.93}$ and $8.43^{+1.30}_{-1.28}$ days, respectively, while the lag of He II $\lambda4686$ is unresolved. The Hβ line exhibits a symmetric velocity-resolved reverberation signature with shorter lags in the high-velocity wings than in the line core, consistent with an origin in a broad-line region dominated by orbital motion rather than infall or outflow. Assuming a virial normalization factor of $f = 5.25$, the virial estimate of the black hole mass is $(3.2 \pm 0.5) \times 10^7\ M_\odot$. These observations demonstrate that Mrk 50 is among the most promising nearby active galaxies for detailed investigations of broad-line region structure and dynamics.

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VLBI observations of 10 CSO candidates: expansion velocities of hot spots

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Observations of ten Compact Symmetric Objects (CSO) candidates have been made with the Very Long Baseline Array at 8.4 GHz in 2005 and with a combined Chinese and European VLBI array at 8.4 GHz in 2009. The 2009 observations incorporate for the first time the two new Chinese telescopes at Miyun and Kunming for international astrophysical observations. The observational data, in combination with archival VLBA data from previous epochs, have been used to derive the proper motions of the VLBI components. Because of the long time baseline of $\sim$16 years of the VLBI data sets, the expansion velocities of the hot spots can be measured at an accuracy as high as $\sim$1.3 μas yr^{-1}. Six of the ten sources are identified as CSOs with a typical double or triple morphology on the basis of both spectral index maps and their mirror-symmetry of proper motions of the terminal hot spots. The compact double source J1324+4048 is also identified as a CSO candidate. Among the three remaining sources, J1756+5748 and J2312+3847 are identified as core-jet sources with proper motions of their jet components relating to systemic source expansion. The third source J0017+5312 is likely also a core-jet source, but a robust detection of a core is needed for an unambiguous identification. The kinematic ages of the CSOs derived from proper motions range from 300 to 2500 years. The kinematic age distribution of the CSOs confirm an overabundance of compact young CSOs with ages less than 500 years. CSOs with known kinematic ages may be used to study the dynamical evolution of extragalactic radio sources at early stages.

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Optical Line Emission in Brightest Cluster Galaxies at 0 < z < 0.6: Evidence for a Lack of Strong Cool Cores 3.5 Gyr Ago?

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In recent years the number of known galaxy clusters beyond $z > 0.2$ has increased drastically, with the release of multiple catalogs containing >30,000 optically-detected galaxy clusters over the range $0 < z < 0.6$. Combining these catalogs with the availability of optical spectroscopy of the brightest cluster galaxy from the Sloan Digital Sky Survey allows for the evolution of optical emission-line nebulae in cluster cores to be quantified. For the first time, the continuous evolution of optical line emission in brightest cluster galaxies over the range $0 < z < 0.6$ is determined. A minimum in the fraction of BCGs with optical line emission is found at $z \sim 0.3$, suggesting that complex, filamentary emission in systems such as Perseus A are a recent phenomenon. Evidence for an upturn in the number of strongly-emitting systems is reported beyond $z > 0.3$, hinting at an earlier epoch of strong cooling. We compare the evolution of emission line nebulae to the X-ray-derived cool core fraction from the literature over the same redshift range and find overall agreement, with the exception that an upturn in the strong CC fraction is not observed at $z > 0.3$. The overall agreement between the evolution of cool cores and optical line emission at low redshift suggests that emission-line surveys of galaxy clusters may provide an efficient method of indirectly probing the evolution of cool cores and, thus, provide insights into the balance of heating and cooling processes at early cosmic times.

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Suzaku broad-band observations of the Seyfert 1 galaxies Mrk 509 and Mrk 841

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Context. Markarian 509 and Markarian 841 are two bright Seyfert 1 galaxies with X-ray spectra characterised by a strong soft excess and a variable Fe Kα line, as shown by several X-ray observatories in the past.

Aims. We report an analysis and modelling of new Suzaku observations of these sources, taken between April and November, 2006, for Mrk 509, and between January and July, 2007, for Mrk 841, for a total exposure time of $\approx$ 100 ks each. Data from XIS and HXD/PIN instruments, going from 0.5 to 60 keV, represent the highest spectral resolution simultaneous broad-band X-ray spectrum for these objects, and provide the strongest constraints yet on the origin of the soft excess emission.

Methods. We fitted the broad-band spectrum of both sources with a double Comptonisation model, adding neutral reflection from distant material and a two-phase warm absorber. We then studied the two competing models developed to explain the soft excess in terms of atomic processes: a blurred ionised disc reflection and an ionised absorption by a high velocity material.

Results. When fitting the data in the 3 - 10 keV range with a power law spectrum, and extrapolating this result to low energies, a soft excess is clearly observed below 2 keV, although its strength is weak compared to previous observations of both sources. A moderate hard excess is seen at energies higher than 10 keV, together with a neutral Fe Kα narrow emission line at E0 $\approx$ 6.4 keV and a broad Fe emission line. For Mrk 509, the broad Fe emission line is required in all the three physical models to ensure a good fit to the data: this finding suggests that the blurred reflection model correctly describes the soft excess, but that it underestimates the broad Fe emission line. For the smeared absorption model, this suggests instead that the continuum spectrum absorbed by the outflowing gas should indeed contain a reflected component. For Mrk 841, all three models that we tested provide a good fit to the data, and we cannot rule out any of them. A broad emission line is required in the double Comptonisation and smeared absorption models, while the blurred reflection model consistently fits the broad-band spectrum, without adding any extra emission-line component.

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AGN Unification at $z \sim 1$: $u - R$ Colors and Gradients in X-ray AGN Hosts

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We present uncontaminated rest-frame $u - R$ colors of 78 X-ray-selected AGN hosts at $0.5 < z < 1.5$ in the Chandra Deep Fields measured with HST/ACS/NICMOS and VLT/ISAAC imaging. We also present spatially-resolved $NUV - R$ color gradients for a subsample of AGN hosts imaged by HST/WFC3. Integrated, uncorrected photometry is not reliable for comparing the mean properties of soft and hard AGN host galaxies at $z \sim 1$ due to color contamination from point-source AGN emission. We use a cloning simulation to develop a calibration between concentration and this color contamination and use this to correct host galaxy colors.

The mean $u - R$ color of the unobscured/soft hosts beyond ~ 6 kpc is statistically equivalent to that of the obscured/hard hosts (the soft sources are 0.09 ± 0.16 magnitudes bluer). Furthermore, the rest-frame $V - J$ colors of the obscured and unobscured hosts beyond ~ 6 kpc are statistically equivalent, suggesting that the two populations have similar distributions of dust extinction. For the WFC3/IR sample, the mean $NUV - R$ color gradients of unobscured and obscured sources differ by less than ~ 0.5 magnitudes for $r > 1.1$ kpc. These three observations imply that AGN obscuration is uncorrelated with the star formation rate beyond ~ 1 kpc.

These observations favor a unification scenario for intermediate-luminosity AGNs in which obscuration is determined geometrically. Scenarios in which the majority of intermediate-luminosity AGN at $z \sim 1$ are undergoing rapid, galaxy-wide quenching due to AGN-driven feedback processes are disfavored.

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Special Announcements

2012 Carnegie Observatories Graduate Research Fellowship

We announce the continuation of the Graduate Research Fellowship at the Carnegie Observatories in Pasadena, California. This Fellowship provides a stipend to graduate students interested in carrying out all or part of their thesis research under the supervision of a Carnegie Staff member, in residence at Carnegie. We encourage applications from current Ph.D. graduate students in astronomy from an accredited (US or non-US) university, pursuing thesis research in observational astronomy, theoretical astrophysics, or instrumentation development. The student must have completed all requisite coursework and examinations prior to arriving at Carnegie. The Fellowship, beginning in September, 2012, will be awarded for one year and may be renewed for two additional years. Foreign students should note that Carnegie can only consider applicants who hold or are eligible to obtain a J-1 visa.

Carnegie Observatories provides a vibrant environment for vigorous scientific research and academic excellence. Major areas of research include cosmology and the distance scale, physics of active galactic nuclei, searches for massive black holes, galaxy formation and evolution, galaxy groups and clusters, intergalactic medium, star formation, supernovae, star clusters, and nucleosynthesis and chemical abundances of stars.

Carnegie observing facilities at Las Campanas Observatory in Chile include the two 6.5-meter Magellan telescopes, the 2.5-meter du Pont telescope, and the 1.0-meter Swope telescope. In addition, the scientific Staff actively pursues research using a wide range of ground-based and space-based facilities, across the electromagnetic spectrum from radio to X-rays.

The application should include a curriculum vitae, bibliography, brief essay describing the applicant's current research, research proposal based on a project sponsored by a Carnegie Staff member, transcript of grades, approval letter from the department head of the applicant's home institution, and three letters of reference. Applications are due by April 15, 2012, 17:00 PST. Full details of the program and application instructions can be found at this web site: http://obs.carnegiescience.edu/gradfellowships/. Email inquiries may be sent to Dr. Luis Ho at gradfellowships@obs.carnegiescience.edu.