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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

Resolving the buried starburst in Arp 299

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We present new 37.7 μm far-infrared imaging of the infrared luminous ($L_{IR} \sim 5.16 \times 10^{11} L_\odot$) interacting galaxy Arp 299 (= IC 694 + NGC 3690). We show that the 38 μm flux, like the 60 and 100 μm emission, traces the luminosity of star forming galaxies, but at considerably higher spatial resolution. Our data establish that the major star formation activity of the galaxy originates from a point source in its eastern component, IC 694, which is inconspicuous in the optical, becoming visible only at the near and mid-infrared. We find that IC 694 is two times more luminous than NGC 3690, contributing to more than 46% of the total energy output of the system at this wavelength. The spectral energy distribution of the different components of the system clearly shows that IC 694, has 6 times the infrared luminosity of M82 and it is the primary source responsible for the bolometric luminosity of Arp 299.

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preprint available at http://arXiv.org/abs/astro-ph/0201278

Hubble Space Telescope Imaging of the Circumnuclear Environments of the CfA Seyfert Galaxies: Nuclear Spirals and Fueling

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We present archival *Hubble Space Telescope* images of the nuclear regions of 43 of the 46 Seyfert galaxies found in the volume-limited, spectroscopically complete CfA Redshift Survey sample. Using an improved method of image contrast enhancement, we create detailed high-quality "structure maps" that allow us to study the distributions of dust, star clusters, and emission-line gas in the circumnuclear regions (100-1000 pc scales) and in the associated host galaxy. Essentially all of these Seyfert galaxies have circumnuclear dust structures with morphologies ranging from grand-design two-armed spirals to chaotic dusty disks. In

most Seyferts there is a clear physical connection between the nuclear dust spirals on hundreds of parsec scales and large-scale bars and spiral arms in the host galaxies proper. These connections are particularly striking in the interacting and barred galaxies. Such structures are predicted by numerical simulations of gas flows in barred and interacting galaxies, and may be related to the fueling of AGN by matter inflow from the host galaxy disks. We see no significant differences in the circumnuclear dust morphologies of Seyfert 1s and 2s, and very few Seyfert 2 nuclei are obscured by large-scale dust structures in the host galaxies. If Seyfert 2s are obscured Seyfert 1s, then the obscuration must occur on smaller scales than those probed by HST.

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preprint available at http://arXiv.org/abs/astro-ph/0201185.html,
high-res figures at http://www.astronomy.ohio-state.edu/ pogge/CfA/

Observational Evidence for a Multiphase Outflow in QSO FIRST J1044+3656

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Spectral absorption features in active galactic nuclei (AGNs) have traditionally been attributed to outflowing photoionized gas located at a distance of order a parsec from the central continuum source. However, recent observations of QSO FIRST J104459.6+365605 by de Kool and coworkers, when intepreted in the context of a single-phase gas model, imply that the absorption occurs much farther ($\approx$ 700 pc) from the center. We reinterpret these observations in terms of a shielded, multiphase gas, which we represent as a continuous low-density wind with embedded high-density clouds. Our model satisfies all the observational constraints with an absorbing gas that extends only out to $\sim$ 4 pc from the central source. The different density components in this model coexist in the same region of space and have similar velocities, which makes it possible to account for the detection in this source of absorption features that correspond to different ionization parameters but have a similar velocity structure. This model also implies that only a small fraction of the gas along the line of sight to the center is outflowing at the observed speeds and that the clouds are dusty whereas the uniform gas component is dust free. We suggest that a similar picture may apply to other sources and discuss additional possible clues to the existence of multiphase outflows in AGNs.

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preprint available at http://xxx.lanl.gov/abs/astro-ph/0201268

Average Quasar Spectra in the Context of Eigenvector 1

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Recent work has shown that it is possible to systematize quasar spectral diversity in a parameter space called "Eigenvector 1" (E1). We present median AGN spectra for fixed regions of the E1 (optical) parameter space (FWHM(Hβ) vs. equivalent width ratio R_{FeII}=W(FeII λ4570)/W(Hβ). Comparison of the median spectra for different regions show considerable differences. We suggest that an E1-driven approach to median/average spectra emphasizes significant differences between AGN, and offers more insights into AGN physics and dynamics than a single population median/average derived from a large and heterogeneous sample of sources. We find that the Hβ broad component line profile changes in shape along the E1 sequence both in average centroid shift and asymmetry. While objects with FWHM(Hβ_{BC}) $\lesssim$ 4000 km s^{-1} are well fitted by a Lorentz function, AGN with FWHM(Hβ_{BC}) $\gtrsim$ 4000 km s^{-1} are well fitted if two broad line components are used: a broad (the "classical" broad line component) and a very broad/redshifted component.

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E-mail contact: giacomo@merlot.astr.ua.edu, preprint astro-ph/0201362

On Core Collapse Supernovæ in Normal and in Seyfert Galaxies

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This paper estimates the relative frequency of different types of core-collapse supernovæ, in terms of the ratio $\mathcal{S}$ between the number of type Ib–Ic and of type II supernovæ. We estimate $\mathcal{S}$ independently for all normal and Seyfert galaxies whose radial velocity is $\leq$14000 km s^{-1}, and which had at least one supernova event recorded in the Asiago catalogue from January 1986 to August 2000. We find that the ratio $\mathcal{S}$ is $\approx 0.23\pm0.05$ in normal galaxies. This value is consistent with constant star formation rate and with a Salpeter Initial Mass Function and average binary rate $\approx$ 50%. On the contrary, Seyfert galaxies exceed the ratio $\mathcal{S}$ in normal galaxies by a factor ≈ 4 at a confidence level $\gtrsim 2\sigma$. A caveat is that the numbers for Seyferts are still small (6 type Ib-Ic and 6 type II supernovae discovered as yet). Assumed real, this excess of type Ib and Ic with respect to type II supernovae, may indicate a burst of star formation of young age ($\tau \lesssim$ 20 Myr), a high incidence of binary systems in the inner regions (r $\lesssim 0.4$R$_{25}$) of Seyfert galaxies, or a top-loaded mass function.

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E-mail contact: bressan@pd.astro.it, preprint: http://xxx.lanl.gov/abs/astro-ph/0201085

Stellar Velocity Dispersion and Black Hole Mass in the Blazar Markarian 501

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The recently discovered correlation between black hole mass and stellar velocity dispersion provides a new method to determine the masses of black holes in active galaxies. We have obtained optical spectra of Markarian 501, a nearby γ-ray blazar with emission extending to TeV energies. The stellar velocity dispersion of the host galaxy, measured from the calcium triplet lines in a 2×3.7 arcsec aperture, is 372 ± 18 km s^{-1}. If Mrk 501 follows the $M - \sigma$ correlation defined for local galaxies, then its central black hole has a mass of $(0.9 - 3.4) \times 10^9 M_\odot$. This is significantly larger than some previous estimates for the central mass in Mrk 501 that have been based on models for its nonthermal emission. The host galaxy luminosity implies a black hole of $\sim 6 \times 10^8 M_\odot$, but this is not in severe conflict with the mass derived from σ because the $M_{\rm BH} - L_{\rm bulge}$ correlation has a large intrinsic scatter. Using the emission-line luminosity to estimate the bolometric luminosity of the central engine, we find that Mrk 501 radiates at an extremely sub-Eddington level of $L/L_{\rm Edd} \approx 10^{-4}$. Further applications of the $M - \sigma$ relation to radio-loud active galactic nuclei may be useful for interpreting unified models and understanding the relationship between radio galaxies and BL Lac objects.

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CHANDRA Discovery of a 300 kpc X-ray Jet in the GPS Quasar PKS1127-145

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We have discovered an X-ray jet with Chandra imaging of the z=1.187 radio-loud quasar PKS1127-145. In this paper we present the Chandra X-ray data, follow-up VLA observations, and optical imaging using the HST WFPC2. The X-ray jet contains 273+/-5 net counts in 27ksec and extends 30 arcsec, from the quasar core, corresponding to a minimum projected linear size of $330h_{50}^{-1}$ kpc. The evaluation of the X-ray emission processes is complicated by the observed offsets between X-ray and radio brightness peaks. We discuss the problems posed by these observations to jet models. In addition, PKS1127-145 is a Giga-Hertz Peaked Spectrum radio source, a member of the class of radio sources suspected to be young or "frustrated" versions of FRI radio galaxies. However the discovery of an X-ray and radio jet extending well outside the host galaxy of PKS1127-145 suggests that activity in this and other GPS sources may be long-lived and complex.

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Keck Absorption-Line Spectroscopy of Galactic Winds in Ultraluminous Infrared Galaxies

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In this paper, we present moderately-high resolution (~ 65 km s^{-1}) spectroscopy, acquired with ESI on Keck II, of 11 ultraluminous infrared ga laxies at $z < 0.3$ from the IRAS 1 Jy sample. The targets were chosen as good candidates to host galaxy-scale outflows, and most have infrared lu minosities dominated by star formation. We use a χ^2 minimization to fit one- to three-component profiles to the Na ID interstellar absorption doublet in each object. Assuming that gas blueshifted by more than 70 km s^{-1} relative to the systemic velocity of the host is outflowing, we detect outflows in 73% of these objects. We adopt a simple model of a mass-conserving free wind to infer mass outflow rates in the range $\dot{M}_{\rm tot}(\rm H) = 13 - 133$ $M_\odot$ yr^{-1} for galaxies hosting a wind. These values of $\dot{M}_{\rm tot}$, normalized to the corresponding global star formation rates inferred from infrared luminosities, are in the range $\eta \equiv \dot{M}_{\rm tot}/{\rm SFR} = 0.1 - 0.7$. This is on average a factor of only 10 less than η from recent measurements of nearby dwarfs, edge-on spirals, and lower-luminosity infrared galaxies. Within our sample, we conclude that η has no dependence on the mass of the host (parameterized by host galaxy kinematics and absolute R- and K'-band magnitudes). We also attempt to estimate the average escape fraction $\langle f_{\rm esc} \rangle \equiv \sum \dot{M}^i_{\rm esc} / \sum \dot{M}^i_{\rm tot}$ and "ejection efficiency" $\langle \delta \rangle \equiv \sum \dot{M}^i_{\rm esc} / \sum {\rm SFR}^{\rm i}$ for our sample, which we find to be $\sim 0.4 - 0.5$ and ~ 0.1, respectively. The complex absorption-line properties of Mrk 231, an ultraluminous infrared galaxy which is optically classified as a Seyfert 1, are discussed separately in an appendix.

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E-mail contact: drupke@astro.umd.edu; preprint available on astro-ph/0201371

Identification of Galactic Wind Candidates using Excitation Maps: Tunable-Filter Discovery of a Shock-Excited Wind in the Galaxy NGC 1482

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Multi-line imaging of the nearby disk galaxy NGC 1482 with the Taurus Tunable Filter (TTF) on the Anglo-Australian Telescope reveals a remarkable hourglass-shaped [N II] λ6583/Hα excitation structure suggestive of a galactic wind extending at least 1.5 kpc above and below the disk of the host galaxy. Long-slit spectroscopy confirms the existence of a large-scale outflow in this galaxy. The entrained wind material has [N II] λ6583/Hα ratios in excess of unity while the disk material is characterized by H II region-like line ratios indicative of a starburst. Expansion velocities of order 250 km s^{-1} are detected in the wind material, and a lower limit of 2×10^{53} ergs is derived for the kinetic energy of the outflow based on the gas kinematics and the amount of ionized material entrained in the outflow. This is the first time to our knowledge that a galactic wind is discovered using excitation maps. This line ratio technique represents a promising new way to identify wind galaxy candidates before undergoing more time-consuming spectroscopic follow-ups. This method of selection may be particularly useful for samples of galaxies at moderate redshifts.

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Spectroscopic Diagnostics for AGNs

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A review of the spectroscopic tools needed to characterize AGNs is presented. This review focusses on ultraviolet, optical and infrared emission-line diagnostics specifically designed to help differentiate AGNs from starburst-dominated galaxies. The strengths and weaknesses of these methods are discussed in the context of on-going and future AGN surveys.

Invited review, to appear in the proceedings of IAU Colloquium #184 "AGN Surveys" held at the Byurakan Observatory, Armenia in June 2001

E-mail contact: veilleux@astro.umd.edu; preprint available on astro-ph/0201118

Observational Requirements for High-Fidelity Reverberation Mapping

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We present a series of simulations to demonstrate that high-fidelity velocity-delay maps of the emission-line regions in active galactic nuclei can be obtained from time-resolved spectrophotometric data sets like those that will arise from the proposed *Kronos* satellite. While previous reverberation-mapping experiments have established the size scale R of the broad emission-line regions from the mean time delay $\tau = R/c$ between the line and continuum variations and have provided strong evidence for supermassive black holes, the detailed structure and kinematics of the broad-line region remain ambiguous and poorly constrained. Here we outline the technical improvements that will be required to successfully map broad-line regions by reverberation techniques. For typical AGN continuum light curves, characterized by power-law power spectra $P(f) \propto f^{-\alpha}$ with $\alpha = -1.5 \pm 0.5$, our simulations show that a small UV/optical spectrometer like *Kronos* will clearly distinguish between currently viable alternative kinematic models. ¿From spectra sampling at time intervals Δt and sustained for a total duration $T_{\rm dur}$, we can reconstruct high-fidelity velocity-delay maps with velocity resolution comparable to that of the spectra, and delay resolution $\Delta\tau \approx 2\Delta t$, provided $T_{\rm dur}$ exceeds the BLR crossing time by at least a factor of three. Even very complicated kinematical models, such as a Keplerian flow with superimposed spiral wave pattern, are cleanly resolved in maps from our simulated *Kronos* datasets. Reverberation mapping with *Kronos* data is therefore likely deliver the first clear maps of the geometry and kinematics in the broad emission-line regions 1–100 microarcseconds from supermassive black holes.

Submitted to PASP.

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Is There a Metallicity–Luminosity Relationship in AGN? The Case of Narrow-Line Seyfert 1 Galaxies

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The well known relationship between metallicity and luminosity in AGN is addressed by introducing new metallicity measurements (based on the method of Hamann & Ferland 1993; HF93) for a sample of narrow-line Seyfert 1 (NLS1) galaxies. Our new results, based on a sample of 162 AGN, including 9 NLS1s, indicate that, while broad-line AGN trace a metallicity–luminosity power law with an index of ~ 0.2, NLS1s deviate significantly from this relationship at low luminosities. Adopting the HF93 method based on the N V/C IV line ratio, we find that NLS1 metallicities are similar to those of some high-redshift high-luminosity quasars. We also examined the N IV]/C IV line ratio and compared it with N V/C IV in a sample of 30 sources including several NLS1s. We find that the two do not give a consistent answer regarding the N/C abundance ratio. This result is marginal because of the quality of the data. We suggest two alternative explanations to these results: 1) The HF93 metallicity–luminosity dependence is not a simple two-parameter dependence and there is an additional hidden variable in this relationship that has not yet been discovered. The additional parameter may be the accretion rate, the age of the central stellar cluster or, perhaps, something else. 2) The strong line ratios involving N V λ1240, suggested by HF93, are not adequate metallicity indicators for NLS1s and perhaps also other AGN, for reasons that are not yet fully understood.

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preprint available at http://arXiv.org/abs/astro-ph/0201437

Most Supermassive Black Holes must be Rapidly Rotating

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We use the integrated spectrum of the X-ray background and quasars Spectral Energy Distribution to derive the contribution of quasars to the energy output of the Universe. We find a lower limit for the energy from accretion onto black holes of 6%, of the total luminosity of the Universe and probably more, with 15% quite possible. Comparing these values with the masses of black holes in the center of nearby galaxies we show that the accretion process must be on average very efficient: at least 15% of the accreted mass must be transformed into radiated energy. This further implies that most supermassive black holes are rapidly rotating.

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The contribution of Quasars to the Far Infrared Background

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Recent observational results obtained with SCUBA, COBE and ISO have greatly improved our knowledge of the infrared and sub-mm background radiation.

These limits become constraining given the realization that most AGNs are heavily obscured and must reradiate strongly in the IR/sub-mm. Here we predict the contribution of AGNs to the IR/sub-mm background, starting from measurements of the hard X-ray background. We show that an application of what we know of AGN Spectral Energy Distributions (SEDs) and the IR background requires that a significant fraction of the 10-150 μm background comes from AGNs. This conclusion can only be avoided if obscured AGNs are intrinsically brighter in the X-rays (with respect to the optical-UV) than unobscured AGNs, contrary to "unified schemes" for AGNs, or have a dust to gas ratio much lower (≤ 0.1) than Galactic. We show that these results are rather robust and not strongly dependent on the details of the modeling.

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UV Imaging Polarimetry of the peculiar Seyfert 2 galaxy Mrk 477

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We present the results of UV imaging polarimetry of the Seyfert 2 galaxy Mrk 477 taken by the Faint Object Camera onboard the Hubble Space Telescope (HST). From a previous HST UV image ($\lambda \sim 2180$Å), Mrk 477 has been known to have a pointlike bright UV hotspot in the central region, peculiar among nearby Seyfert 2 galaxies. There are also claims of UV/optical variability, unusual for a Seyfert 2 galaxy. Our data show that there is an off-nuclear scattering region $\sim 0.''6$ ($\sim$ 500 pc) NE from the hotspot. The data, after the subtraction of the instrumental effect due to this bright hotspot region, might indicate that the scattered light is also detected in the central $0''.2$ radius region and is extended to a very wide angle. The hotspot location is consistent with the symmetry center of the PA pattern, which represents the location of the hidden nucleus, but our data do not provide a strong upper limit to the distance between the symmetry center and the hotspot. We have obtained high spatial resolution color map of the continuum which shows that the nuclear spiral arm of $0.''4$ scale ($\sim$ 300pc) is significantly bluer than the off-nuclear mirror and the hotspot region. The nature of the hotspot is briefly discussed.

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preprint available at http://xxx.lanl.gov/abs/astro-ph/0112520

A Survey of Extended Radio Jets in AGN with Chandra and HST: First Results

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We present the first results from an X-ray and optical survey of a sample of AGN radio jets with Chandra and HST. We focus here on the first six sources observed at X-rays, in four of which a bright X-ray jet was detected for the first time. In three out of four cases optical emission from the jet is also detected in our HST images. We compare the X-ray morphology with the radio as derived from improved processing of archival VLA data and we construct spectral energy distributions (SED) for the most conspicuous emission knots. In most cases the SEDs, together with the similarity of the X-ray and radio morphologies, favor an inverse Compton origin of the X-rays. The most likely origin of the seed photons is the Cosmic Microwave Background, implying the jets are still relativistic on kiloparsec scales. However, in the first knot of the PKS 1136-135 jet, X-rays are likely produced via the synchrotron process. In all four cases bulk Lorentz factors of a few are required. The radio maps of the two jets not detected by either Chandra or HST suggest that they are less beamed at large scales than the other four detected sources. Our results demonstrate that, at the sensitivity and resolution of Chandra, X-ray emission from extragalactic jets is common, yielding essential information on their physical properties.

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E-mail contact: rms@physics.gmu.edu,
preprint available at http://xxx.lanl.gov/abs/astro-ph/0201412

Thesis Abstracts

Gravitational Microlensing of Quasar Clouds : Detectability in a Worst-Case Scenario

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Cand. Scient. degree (Master's equivalent) awarded: February 2002

It is assumed that the Broad Emission Line Region of Quasars consists of discrete clouds. Due to the suspected small size of a cloud, the radiation from clouds may be strongly amplified by gravitational microlensing.

It is shown that under some conditions, it is possible to detect gravitational microlensing even in a situation where the position and the velocity of clouds are non-correlated.

Recommendations are made with respect to planning of observations, based on whether one has knowledge as to the number of clouds or not. If one knows that there are approximately 1 million clouds, there is good chance to detect lensing. If one has no knowledge of the number of clouds, one should choose instruments and objects that can provide the strongest lines and resolve it into as many as 1000 bins.

Linear regression is used to derive relations that can be used for prediction of conditions where lensing can be detected.

This thesis will be permanently archived at `<URL:http://urn.nb.no/URN:NBN:no-2021>`, and the full text can be accessed directly at `<URL:http://www.digbib.uio.no/publ/astrofysikk/2002/2801/index.pdf>` (3.6 MB).

Jobs

Research Fellowship

at the XMM-Newton Science Operations Centre
Villafranca near Madrid, Spain

The European Space Agency offers Astronomers and Space scientists the possibility of Post-doctoral Research Fellowships. Details of the program can be found at: http://ssd.esa.int/resources/staffvacancies/RF.htm

Within this program an ESA Internal Research Fellowship will be available at the XMM-Newton Science Operations Centre (http://xmm.vilspa.esa.es, Villafranca near Madrid). It is expected that the successful candidate carries out research projects based on public data of XMM-Newton.

Applicants for this post should have a PhD in astrophysics or equivalent qualification in a relevant discipline. Experiences with medium to high resolution X-ray specroscopy and/or Active Galactic Nuclei are highly desirable.

Contact N. Schartel (nscharte@xmm.vilspa.esa.es) or J. Clavel, XMM-Newton SOC, Villafranca

The Active Galaxies Newsletter is available on the World Wide Web. You can access it via the University of Manchester home page :- http://www.ast.man.ac.uk/~rb/agn/
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