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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 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.

Could you please let me know if your email address changes as I have had to remove several names from the distribution list after recurring delivery problems.

Many thanks, Matt Redman

Abstracts of recently accepted papers

Physical Conditions in the Inner Narrow-Line Region of the Seyfert 2 Galaxy NGC 1068

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The physical conditions in the inner narrow line region (NLR) of the Seyfert 2 galaxy, NGC 1068, are examined using ultraviolet and optical spectra and photoionization models. The spectra are *Hubble Space Telescope* (*HST*) archive data obtained with the Faint Object Spectrograph (FOS). We selected spectra of four regions, taken through the $0''.3$ FOS aperture, covering the full FOS 1200 Å to 6800 Å waveband. Each region is approximately 20 pc in extent, and all are within 100 pc of the apparent nucleus of NGC 1068. The spectra show similar emission-line ratios from wide range of ionization states for the most abundant elements. After extensive photoionization modeling, we interpret this result as an indication that each region includes a range of gas densities, which we included in the models as separate components. Supersolar abundances were required for several elements to fit the observed emission line ratios. Dust was included in the models but apparently dust to gas fraction varies within these regions. The low ionization lines in these spectra can be best explained as arising in gas that is partially shielded from the ionizing continuum.

Although the predicted line ratios from the photoionization models provide a good fit to the observed ratios, it is apparent that the model predictions of electron temperatures in the ionized gas are too low. We interpret this as an indication of additional collisional heating due to shocks and/or energetic particles associated with the radio jet that traverses the NLR of NGC 1068. The density structure within each region may also be the result of compression by the jet.

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preprint available at http://www.acad.cua.edu/iacs/crenshaw/crenshaw.html

Supermassive Black Holes in Galactic Nuclei: Observational Evidence and Some Astrophysical Consequences

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I review the status of observational determinations of central masses in nearby galactic nuclei. Results from a variety of techniques are summarized, including ground-based and space-based optical spectroscopy, radio VLBI measurements of luminous water vapor masers, and variability monitoring studies of active galactic nuclei. I will also discuss recent X-ray observations that indicate relativistic motions arising from the accretion disks of active nuclei. The existing evidence suggests that supermassive black holes are an integral component of galactic structure, at least in elliptical and bulge-dominated galaxies. The black hole mass appears to be correlated with the mass of the spheroidal component of the host galaxy. This finding may have important implications for many astrophysical issues.

To appear in *Observational Evidence for Black Holes in the Universe*, ed. S. K. Chakrabarti (Dordrecht: Kluwer).

Preprint can be retrieved from http://xxx.lanl.gov/find/astro-ph (astro-ph/9803307)

Quasars, accretion disks, and pregalactic enrichment of galaxies and IGM

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There are strong observational evidences for metallicities larger than solar in the central few parsecs of quasars up to $z > 4$. This enriched material is flowing out of the central regions with a high velocity. I propose that the enrichment and the outflows are produced in the accretion disk fueling the black hole, in an "intermediate" region between 0.01 and 10 pc, where the disk is locally but not globally gravitationally unstable. Star formation is likely to occur in this part of the disk, which is dense and stays molecular in spite of central irradiation. The newly formed stars accrete gas at a high rate and evolve towards the stage of supernovae. A self-regulated accretion disk made of stars and gas, where the gas is marginally unstable and where the transport of angular momentum is provided by supernovae, is then shown to be a possible solution for the intermediate region. It works for small forming black holes and for powerful quasars accreting near their critical rate, whether the abundances are primordial or not. A large fraction of the supernova shells break out of the disk, and the overabundant gas flows out of the nuclear region, enriching in heavy elements the forming host galaxy and the intergalactic medium. I propose that this could be the starting point of heavy element formation in the Universe. Provided that black holes form earlier than stars, this process could explain the abundances observed in the oldest stars of the Galactic halo and in the intergalactic medium at high z, and it could also trigger starbursts in massive galaxies.

Proceedings of the Conference "From atomic nuclei to galaxies", held in Haifa, Israel, 12-15 January 98, to be published in Physics Reports

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Influence of the metallicity and of the irradiation on the structure of accretion disks around massive black holes

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We discuss the structure of the outer regions of accretion disks around massive black holes, up to about one parsec from the center. In the gravitationally stable region, we assume the standard α-prescription for the viscosity but we take into account self-gravitation. Beyond about 10^4 gravitational radii, self-gravitation is larger than central gravitation, and the disk becomes gravitationally unstable. We then assume that it is maintained in a state of marginal instability such that the Toomre parameter stays of the order of a few units, as proposed by Paczynski (1978). The specificity of this prescription is that the midplane density is imposed as a function of the radius and depends only on the central mass. We demonstrate that the gas metallicity is of fundamental importance for the disk structure by considering two extreme cases: a pure hydrogen-helium mixture (i.e. a primordial gas), and a gas with solar abundances. In particular, the gravitationally unstable regions are optically thin in the case of primordial abundances while they remain optically thick for solar abundances. A consequence is that the midplane

temperature is almost constant in the case of primordial abundances, so the disk is “flaring”. Irradiation of the disk by the central UV-X source should thus be taken into account. We study the influence of the irradiation on the structure of a flaring disk, as well as in several other cases. Since the midplane density is imposed, irradiation by the central source does not modify strongly the radial profile. We compute the column density of the ionized and atomic layers due to the irradiation, and show that they are much smaller than the column density of the disk. Both for the non irradiated and for the irradiated disk, and for the primordial and for the solar metallicity cases, we give analytical expressions which can be helpful to approximate the radial profile of an accretion disk in the molecular region. When applied to the masing disk of NGC 4258, these expressions show that the irradiation flux becomes dominant between 0.1 and 1 pc, depending on the value of accretion rate.

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The X-ray jet in the merging galaxy system Markarian 266

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We present deep ROSAT X-ray images of the double nucleus galaxy Mrk 266 in combination with optical images and spectra. The high spatial resolution (HRI) X-ray morphology can be divided into four components: two nuclei of the merging galaxies, a diffuse galactic component and a strong northern jet coincident with very strong optical line emission. This jet component is decoupled from the rest of the merging system considering the internal kinematics. The luminous X-ray jet is excited by hot postshock gas with respect to its morphology, the high excitation emission lines and the kinematics.

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Are the Nuclei of Seyfert 2 Galaxies Viewed Face-On?

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We show from modeling the Fe Kα line in the *ASCA* spectra of four X-ray bright narrow emission line galaxies (Seyfert types 1.9 and 2) that two equally viable physical models can describe the observed line profile. The first is discussed by Turner et al. and consists of emission from a nearly pole-on accretion disk. The second, which is statistically preferred, is a superposition of emission from an accretion disk viewed at an intermediate inclination of $\sim 48^\circ$ and a distinct, unresolved feature that presumably originates some distance from the galaxy nucleus. The intermediate inclination is entirely consistent with unified schemes and our findings challenge recent assertions that Seyfert 2 galaxies are preferentially viewed with their inner regions face-on. We derive mean equivalent widths for the narrow and disk lines of $< \mathrm{EQW_N} >= 60$ eV and $< \mathrm{EQW_D} >= 213$ eV, respectively. The X-ray data are well described by a geometry in which our view of the active nucleus intersects and is blocked by the outer edges of the obscuring torus, and therefore do not require severe misalignments between the accretion disk and the torus.

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Disseration abstracts

Polarization and Structure of Broad Absorption Line Quasi-Stellar Objects

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This thesis is a spectropolarimetric survey of broad absorption line quasi-stellar objects (BAL QSO). We observed 36 BAL QSO at the Palomar and W. M. Keck Observatories.

BAL QSO have higher polarization than other quasars, reinforcing the view that they are normal quasars viewed from an equatorial aspect. However, there is a wide distribution of polarization values, which may be due to intrinsic differences in the geometry or optical depth to scattering. No correlations are found among emission line or broad absorption line properties and continuum polarization, suggesting that these properties are regulated by internal differences unrelated to viewing angle. The continuum polarization of BAL QSO is weakly wavelength-dependent after correction for emission line dilution. In most objects, the polarization rises to the blue, suggesting that dust scattering or absorption may be important.

Broad emission line photons are polarized less than the continuum; and the position angle of the electric vector is rotated with respect to the continuum. The semi-forbidden C III] emission line is polarized differently than the C IV emission line, suggesting resonance scattering in the C III] emission line region. Resonantly scattered photons from the broad absorption line region are detected at high velocities red-ward and blue-ward of the C IV line center in the spectra of some objects. These photons are negatively polarized with respect to the continuum photons, showing that the broad absorption line region and the continuum scattering region are oriented perpendicular to each other.

The polarization increases in the BAL troughs, due mainly to partial coverage of the central source by the broad absorption line region. The geometry of the intervening BAL clouds is skewed with respect to the continuum scattering region, which results in position angle rotations in the BAL. The variation of polarization with velocity in the BAL is consistent with a non-radial, accelerating outflow of ionized gas. Our polarimetry observations are consistent with a model which unifies BAL QSO and non-BAL QSO. The BAL wind appears to occupy a narrow range of equatorial latitudes. When we view a QSO through this outflow, we see the characteristic troughs in BAL QSO.

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