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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

On the geometrical origin of periodicity in blazar-type sources

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Periodicities in blazar light curves may be related to helical trajectories in extragalactic radio jets by differential Doppler boosting effects. We consider ballistic and non-ballistic (i.e., radial) trajectories and discuss three possible periodic driving mechanisms for the origin of helical jet paths, namely, orbital motion in a binary black hole system (BBHS), jet precession, and intrinsic jet rotation. It is shown that precessional-driven ballistic motion is unlikely to result in observable periods of less than several tens of years. We demonstrate that for non-ballistic helical motion the observed period is generally strongly shortened relative to the real physical driving period because of light-travel time effects. Internal jet rotation may thus account for observed periods $P_{\rm obs} \leq 10$ days. Periodicity due to orbital-driven (non-ballistic) helical motion, on the other hand, is usually constrained to periods of $P_{\rm obs} \geq 10$ days, while Newtonian-driven precession is unlikely to be responsible for periodicity on a timescale $P_{\rm obs} \leq 100$ days but may well be associated with periods of $P_{\rm obs} \geq 1$ yr.

ApJ Letters in press

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Shear acceleration in relativistic astrophysical jets

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We consider the acceleration of energetic particles due to a velocity shear in the relativistic background flow containing scattering centers. Three possible acceleration sites for astrophysical jets are identified: (1) gradual velocity shear parallel to the jet axis such as a velocity profile decreasing linearly outward with radial coordinate, (2) gradual velocity shear perpendicular to the jet axis such as intrinsic jet rotation, and (3) non-gradual/discontinuous, longitudinal velocity shear at the jet side boundary. We determine the characteristic acceleration timescales, specify the conditions for efficient acceleration and discuss observational features with respect to each process. In particular, it is shown that in the case of (2) the higher energy emission is expected to

be concentrated closer to the jet axis, while in the case of (1) and (3) the higher energy particles are likely to be located near the edges of the jet thus possibly leading to some form of limb-brightening.

ApJ in press

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Chandra measurement of the X-ray spectrum of a quasar at z=5.99

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We report the first measurement of the X-ray spectrum of the z = 5.99 quasar SDSSp J130608.26+035626.3 from a 120 ks observation by the *Chandra* ACIS-S instrument. Between 0.5 and 7 keV, corresponding to 3.5 to 49 keV in the quasar rest frame, we find an energy index of 0.86 ± 0.2, consistent with the typical indices found for radio quiet quasars at lower redshifts, and inconsistent with the index required to match the diffuse X-ray background. We have an indication of a redshifted Fe-K line at about 93% confidence. In comparing the counting rate between an earlier, short observation and the longer observation reported here, we find evidence for source variability at the 99.9% confidence level. We note that other nearby X-ray sources would bias the measured $\alpha_{\rm ox} = 1.70$ by -0.09, if the X-ray flux were determined from within a 60" extraction circle. Our results for the energy index and the $\alpha_{\rm ox}$ are consistent with no strong evolution in the AGN emission mechanism with redshift out to $z \approx 6$, and therefore with the picture that massive black holes have already formed less than 1 Gyr after the big bang.

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preprint available at http://arXiv.org/abs/astro-ph/0410124

Very Light Jets II:
Bipolar large scale simulations in King atmospheres

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Hydrodynamic jets, underdense with respect to their environment by a factor of up to 10^4, were computed in axisymmetry as well as in 3D. They finally reached a size of up to 220 jet radii, corresponding to a 100 kpc sized radio galaxy. The simulations are "bipolar", involving both jets. These are injected into a King type density profile with small stochastic density variations. The back-reaction of the cocoons on the beams in the center produces armlength asymmetries of a few percent, with the longer jets on the side with the higher average density. Two distinguishable bow shock phases were observed: an inner elliptical part, and a later cylindrical, cigar-like phase, which is known from previous simulations. The sideways motion of the inner elliptical bow shock part is shown to follow the law of motion for spherical blast waves also in the late phase, where the aspect ratio is high, with good accuracy. X-ray emission maps are calculated and the two bow shock phases are shown to appear as rings and elongated or elliptical regions, depending on the viewing angle. Such structures are observed in the X-ray data of several radio galaxies (e.g. in Abell 2052 and Hercules A), the best example being Cygnus A. In this case, an elliptical bow shock is infered from the observations, a jet power of 10^{47} erg/s is derived, and the Lorentz factor can be limited to $\Gamma > 10$. Based on the simulation results and the comparison to the observations, the emission line gas producing the alignment effect in radio galaxies at high redshift is suggested to be cooled gas entrained over the cocoon boundary.

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Comparison of Radio Observations and Numerical Simulations of the Radio Lobes of Cygnus A

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We present a comparison of radio observations of the archetypal powerful radio galaxy Cygnus A and 2-D numerical hydrodynamical simulations. We characterize some global trends in the observed radio properties and compare them with the properties of a simulated radio source. The observational results are the following. The width of the observed surface brightness distribution perpendicular to the source axis can be well characterized by a Gaussian over most of the length of the source. The ratio of the Gaussian FWHM to the second moment is fairly constant along the source with an average value of about 2.5 indicating that they give roughly consistent measurements of the source width. The average observed surface brightness, estimated pressure, and estimated minimum energy B field decrease with distance from the hot spots. We find evidence for significant structure in the estimated cross-sectional slices of emissivity. The numerical results are the following. Jets propagating in a constant density atmosphere will decelerate with time. Thus, the estimated dynamical age of the source will be greater than the actual age of the source. For a source similar to Cygnus A the difference will be about a factor of 2. The second moment gives an accurate representation of the "true" width of the simulated source. The Gaussian FWHM tends to be about 40% larger than the true width and can be systematically in error if the surface brightness exhibits multiple peaks. We suggest that the ratio of the Gaussian FWHM to the second moment may be a diagnostic of the emissivity profile in the lobes. The simulations can qualitatively reproduce the overall observed morphology and the behavior of the cross-sections in surface brightness, the decline in surface brightness with distance from the hot spots, and the width of the lobes. This suggests that the 2-D simulations give a reasonable representation of the properties of Cygnus A.

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or http://arxiv.org/abs/astro-ph/0406212

The radio-ultraviolet spectral energy distribution of the jet in 3C273

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We present deep VLA and HST observations of the large-scale jet in 3C 273 matched to 0.3" resolution. The observed spectra show a significant flattening in the infrared-ultraviolet wavelength range. The jet's emission cannot therefore be assumed to arise from a single electron population and requires the presence of an additional emission component. The observed smooth variations of the spectral indices along the jet imply that the physical conditions vary correspondingly smoothly. We determine the maximum particle energy for the optical jet using synchrotron spectral fits. The slow decline of the maximum energy along the jet implies particle reacceleration acting along the entire jet. In addition to the already established global anti-correlation between maximum particle energy and surface brightness, we find a weak positive correlation between small-scale variations in maximum particle energy and surface brightness. The origin of these conflicting global and local correlations is unclear, but they provide tight constraints for reacceleration models.

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Sloan Digital Sky Survey Quasars in the SWIRE ELAIS N1 Field: Properties and Spectral Energy Distributions

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We present a mid-infrared analysis of 35 quasars with spectroscopic redshifts selected from the Spitzer Wide-area InfraRed Extragalactic Survey (SWIRE). We discuss their optical and mid-infrared (MIR) colors, and show that these quasars occupy well defined regions in MIR color-color space. We examine the issue of type-I AGN candidate selection in detail and propose new selection methods based on mid-IR colors. The available multi-band data allows us to construct two new, well-sampled quasar templates, covering wavelengths from the ultraviolet to the MIR.

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X-ray Insights Into Interpreting C IV Blueshifts and Optical/UV Continua

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We present 0.5–8.0 keV *Chandra* observations of six bright quasars that represent extrema in quasar emission-line properties — three quasars each with small and large blueshifts of the C IV emission line with respect to the systemic redshift of the quasars. Supplemented with seven archival *Chandra* observations of quasars that met our selection criteria, we investigate the origin of this emission-line phenomenon in the general context of the structure of quasars. We find that the quasars with the largest C IV blueshifts show evidence, from joint-spectral fitting, for intrinsic X-ray absorption ($N_{\rm H}\sim 10^{22}\,{\rm cm}^{-2}$). Given the lack of accompanying C IV absorption, this gas is likely to be highly ionized, and may be identified with the shielding gas in the disk-wind paradigm. Furthermore, we find evidence for a correlation of $\alpha_{\rm uv}$, the ultraviolet spectral index, with the hardness of the X-ray continuum; an analysis of independent Bright Quasar Survey data from the literature supports this conclusion. This result points to intrinsically red quasars having systematically flatter hard X-ray continua without evidence for X-ray absorption. We speculate on the origins of these correlations of X-ray properties with both C IV blueshift and $\alpha_{\rm uv}$ and discuss the implications for models of quasar structure.

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Sub-arcsecond observations of the radio continuum and neutral hydrogen in the Medusa merger

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We present new MERLIN observations of both the radio continuum and neutral hydrogen absorption against NGC 4194, "the Medusa Merger". These observations are the highest angular resolution observations, made to date, of the neutral gas within this source. In presenting this new data we discuss the nuclear radio continuum structure of this very efficient starburst galaxy, as well as a further investigation of the dynamics and distribution of HI in the galaxy's nucleus. We conclude by placing these results into the context of other observations of this source, for example high resolution observations of CO emission, with the intention of further understanding the cold neutral and molecular ISM of this source; the fuel for the ongoing starburst.

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A possible radio supernova in NGC 3310

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As part of an ongoing radio supernova monitoring program, a compact, variable, steep spectrum radio source has been discovered ∼65 arcsec (∼4 kpc) from the centre of the starburst galaxy NGC 3310. If the source is at the distance of NGC 3310, then its 5-GHz luminosity is $\sim 3 \times 10^{19}$ W Hz^{-1}. The source luminosity, together with its variability characteristics, compact structure (¡ 17 mas) and its association with a group of HII regions suggests that it is a previously uncatalogued Type II radio supernova. There is also evidence of an X-ray source coincident with the radio position.

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OH in Messier 82

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Several new main line OH masers have been detected in the nearby starburst galaxy M82. Eight masers have been detected to 5σ, six of which are new detections. Observations covering both the 1665 and 1667 MHz lines with both the Very Large Array (VLA) and the Multi-Element Radio Linked Interferometer Network (MERLIN) have been used to accurately measure the positions and velocities of these features. Following analysis of the data, another six objects below 5σ, but with velocities consistent with the distribution inferred from the more certain detections, have been detected. These are classified as possible detections.

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