20TH ANNUAL NEW ENGLAND REGIONAL QUASAR/AGN MEETING, 18 MAY 2010

ABSTRACTS

POSTER PRESENTATIONS in alphabetical order of first author

S. Jorstad, A. Marscher, F. D'Arcangelo, and B. Harrison (Boston University)

Connection between Gamma-Ray Variations and Disturbances in the Jets of Blazars

Abstract: We perform monthly total and polarized intensity imaging of a sample of γ -ray blazars (33 sources) with the Very Long Baseline Array (VLBA) at 43 GHz with the high resolution of 0.1 milliarcseconds. From Summer 2008 to October 2009 several of these blazars triggered Astronomical Telegrams due to a high γ- the Fermi Large Area Telescope (LAT): AO 0235+164, 3C 273, 3C 279, PKS 1510-089, and 3C 454.3. We have found that 1) γ-ray flares in these blazars occur during an increase of the flux in the 43 GHz VLBI core; 2) strong γ-ray activity, consisting of several flares of various amplitudes and durations (weeks the propagation of a superluminal knot in the inner jet, as found previously for BL Lac (Marscher et al. 2008); 3) coincidence of a superluminal knot with the 43 GHz core precedes the most intense γ-ray flare by 36$\pm$24 days. Our results strongly support the idea that the most dramatic γ-ray outbursts of blazars originate in the vicinity of the mm-wave core of the relativistic jet. These results are preliminary and should be tested by future monitoring with the VLBA and Fermi.

A.P. Marscher, S.G. Jorstad, I. Agudo, B. Harrison, & H. Stone (Boston U.), V.M. Larionov (St. Petersburg State U., Russia), M.F. Aller & H.D. Aller (U. Michigan), A. Lhteenmki (Metshovi Radio Obs., Finland), P.S. Smith (Steward Obs.), V. Strelnitski & G. Walker (Maria Mitchell Obs.), and I. M. McHardy (U. Southampton, UK)

Comprehensive Multiwaveband Monitoring of Gamma-ray Blazars

Abstract: Our comprehensive multi-waveband monitoring program of blazars uses correlations and times lags to determine the locations of gamma-ray flares in the relativistic jets of blazars. Our observations of 33 objects include monitoring of (1) the emission and polarization structure of the jet at 43 GHz with the VLBA, (2) mapping of the finer scale structure at 86 GHz with the GMVA, (3) monitoring of the optical polarization, and (4) densely-sampled light curves at radio, optical/near-IR, X-ray, and gamma-ray frequencies. A number of blazars have already exhibited flares observed in sufficient detail to infer where the high-energy emission arises. Many of the flares are associated with superluminal knots propagating down the jet. A knot produces one or more gamma-ray and/or X-ray flares as it travels down the jet toward the compact, stationary bright spot seen on the VLBA images (mm-wave "core"), and also during its passage through the core and as it continues downstream. We infer that the core consists of one or more standing oblique shocks. Some of the flares are caused by an increase in the number of relativistic electrons, while others require rapid changes in the seed photon field as the knot moves down the jet. We use this information plus systematic changes (often rotations) of the optical linear polarization vector to infer the physics of the inner jet regions.

D.A. Schwartz (Harvard-Smithsonian Center for Astrophysics), H. L. Marshall (Kavli Institute, MIT), D. Worrall, M. Birkinshaw (University of Bristol), E. S. Perlman (F.I.T.), J. Lovell (U. Tas), D. Jauncey (ATNF/CSIRO), D. Murphy (JPL), G. Bicknell, L. Godfrey (ANU/MSO), S. Jester (MPIA), J. M. Gelbord (U. Durham)

A Chandra X-ray Survey of Radio Jets

Abstract: We have been carrying out a survey of X-ray emission from powerful radio jets (Marshall et al 2005). Our primary objectives were to explore correlations to the radio and optical jet emission to elucidate the predominant emission mechanism(s), and to find objects of interest for follow-up Chandra studies. We present here observations of the final 17 objects, (including 3 from the Chandra archive), which complete the data set of 56 survey objects. With six definite and four marginal detections, this last sample yields just under the 60success rate found in our previous 5 to 10 ks Chandra observations (Marshall et al. 2005; Marshall et al, in preparation). We are averaging less than 10ks Chandra observing time per jet detected – almost a factor of two less time than other exploratory jet surveys (e.g., Sambruna et al. 2004).

Belinda Wilkes (Harvard-Smithsonian Center for Astrophysics) Joanna Kuraszkiewicz (SAO), Martin Haas (Bochum), S.P. Willner (SAO), Matt Ashby (SAO), Margaret Yellen (SAO), Christian Leipski (UCSB), R. Antonucci (UCSB), P. Barthel (Kapteyn Institute), Mark Birkinshaw (Bristol), Rolf Chini (Bochum), G.G. Fazio (SAO), F. Heymann (ESO), C. R. Lawrence (JPL), P. Ogle (Spitzer, Science Center), Bernhard Schulz (IPAC), D.M. Worrall (Bristol)

Orientation Effects in the X-ray Properties of High-z, 3CRR Quasars

Abstract: A critical problem in understanding active galaxies is separation of intrinsic physical differences from observed differences due to orientation. Relativistic motion in powerful radio sources produces a significant level of anisotropic emission at all but the lowest frequencies. Obscuration is also anisotropic and strongly frequency-dependent. Combined, these two effects result in complex selection effects for observations in most wavebands, and there are few ways to select a sample that is sufficiently unbiased to test orientation effects as predicted by unification models.

Low-frequency radio emission is one way to select an orientation- unbiased sample, albeit limited to the minority of AGN with strong radio emission. Chandra observations of a complete, flux-limited sample of 38 high-redshift 3CRR sources, 1¡z¡2 with Chandra. Of these, 21 are quasars and 17 galaxies. According to unification models, the galaxies are viewed edge-on while the quasars are relatively face-on. The quasars have soft X-ray hardness ratios, high radio core-dominance and high X-ray to radio luminosity ratios. These are all indicators of relatively low obscuration, as expected for their relatively face-on orientation in unification models. The galaxies have a wide range of X-ray hardness ratio, lower core dominance and lower luminosity ratios, again consistent with unification. A subset of galaxies have soft X-ray emission, suggestive that these sources are Compton thick with purely scattered AGN light visible in X-rays (as in NGC1068). A few sources have contradictory properties inconsistent with straight-forward classification, as has been observed in many previous studies. These sources offer the potential to explore physical reason(s) for the transition between the various AGN classes.

Monica Young (Boston University/Harvard-Smithsonian Center for Astrophysics)

Disk-Corona Coupling in the SDSS/XMM-Newton Quasar Survey

Abstract: The SDSS/XMM-Newton Quasar Survey finds correlations between a number of optical and X-ray properties: optical-to-X-ray slope, optical luminosity, X-ray slope and luminosity, and Eddington ratio. By testing the observed correlations in a population study, we can determine which correlations are intrinsic and which are induced by selection effects or other correlations. Examining the correlations together rather than in isolation, we are able to constrain disk-corona physics. We also present the rare sub-population of intrinsically red quasars, a sample of 7 objects which have red colors but no significant absorption, and low accretion rates (L/Ledd 0.01). We discuss these objects in the context of quasar turn-off, in which quasars begin the transition to a quiescent state.

ORAL PRESENTATIONS in alphabetical order of first author

Wystan Benbow (Harvard-Smithsonian Center for Astrophysics)

VERITAS Observations of AGN

Abstract: In the past few years, the catalog of AGN known to emit VHE (E¿100 GeV) gamma-rays has grown from just a few sources, to more than 30 objects, primarily blazars. With the detection of 20 of these sources, including the discovery of nine, the VERITAS array of four atmospheric-Cherenkov telescopes has been at the forefront of this growth. VERITAS is currently the most-sensitive VHE gamma-ray observatory in the world, and a major portion (40of the VERITAS observation budget is devoted to the study of AGN. Recent highlights from VERITAS AGN observations will be presented.

Laura Brenneman (Harvard-Smithsonian Center for Astrophysics)

COMPLEX ABSORPTION AND A BROAD IRON LINE IN NGC 3783

Abstract: The Seyfert galaxy NGC 3783 has long been known to harbor complex intrinsic "warm" absorption as well as a robust, broad iron line. An ongoing Suzaku Key Project has observed NGC 3783 in July 2009 for 200 ks, the deepest non-grating X-ray exposure to date. This observation, along with the 900 ks HETG data in the Chandra archive, has allowed us to measure the properties of the continuum, warm absorber, and iron line region with unprecedented precision. Though the continuum flux varies by a factor of two over a 35 ks period, we do not observe any significant variation in the warm absorber during the Suzaku observation. This is consistent with previous results that indicate absorber variability timescales on the order of a month. By contrast, both distant and inner disk reflection components do vary during the observation. These variations allow us to place constraints on the locations of the reflecting material, and strongly indicate that the accretion disk emits well within the Schwarzschild radius of marginal stability, implying that the supermassive black hole at the core of NGC 3783 possesses significant angular momentum. I will expand on these results, focusing in particular on both the time-averaged and time-resolved Suzaku spectra.

Carie Cardamone (Yale University)

Dust-corrected colors of AGN host galaxies reveal two modes of AGN activity at z 1

Abstract: Using new highly accurate photometric redshifts from the MUSYC medium-band survey in the Extended Chandra Deep Field South (ECDF-S), we use synthetic stellar populations models to compare AGN host galaxies to galaxies at $0.8 \leq z \leq 1.2$. We find that AGN lie predominantly in massive host galaxies that are on the red sequence and in the green valley of the color-mass diagram. Because both passive and dusty galaxies can appear red in optical colors, we use the rest-frame near-infrared colors to separate passively evolving stellar populations from galaxies that are reddened by dust. As with the overall galaxy population, $\sim$25% of the 'red' AGN host galaxies and $\sim$75% of the 'green' AGN host galaxies have colors consistent with young stellar populations reddened by dust. Their dust-corrected colors are the blue colors of star forming galaxies, which implies that these AGN hosts are not passively aging to the red sequence. At $z \sim 1$ there are two modes of AGN activity: black holes growing and heating up the gas in red, passively evolving host galaxies preventing future episodes of

star formation, and black holes in dust-reddened young galaxies, which may eventually heat gas and shut down star formation.

Susmita Chakravorty (Harvard-Smithsonian Center for Astrophysics)

Constraints from thermal stability of warm absorbers in AGN

Abstract: Warm absorber (WA) is the ionized gas in the line of sight to the central region of the active galactic nuclei (AGN). The thermal properties and the ionization state of the WA is determined by the atomic interactions between the ionizing continuum and the ions present in the medium whose signatures are found as absorption edges and lines in the soft X-ray spectra at 0.5 - 1.3 keV. We have investigated the influence of the chemical composition of the absorbing material, the radiation from the accretion disk at $\sim$ 50 eV and the so-called *soft excess* at $\sim$ 0.5 keV on the nature of the WA. The results will be presented highlighting the constraints that we derive on the WA properties as a function of the shape of these physical parameters.

Ritaban Chatterjee[1,2], Alan P. Marscher[2], & Svetlana G. Jorstad[2] (1. Yale University; 2. Boston University)

Disk-Jet Connection in the Radio Galaxies 3C 120 and 3C 111

Abstract: In radio galaxies 3C120 and 3C 111, significant dips in the X-ray light curve are followed by ejection of superluminal knots. X-ray flux and high frequency radio flux over the past 5 years show an anti-correlation with X-ray leading the radio counterpart. This implies that in these radio galaxies, the radiative state of accretion disk plus corona system has a direct effect on the events in the jet. The X-ray power spectral densities of these two objects show breaks, i.e., the slope steepens above a certain frequency and the "break-frequency" is proportional to the mass of the central black hole. Both of the above properties are similar to that of the stellar mass black hole X-ray binaries (BHXRBs) and provide support to the paradigm that BHXRBs and active galactic nuclei (AGNs) are fundamentally similar with characteristic time and size scales linearly proportional to the mass of the central black hole. Strong correlation between the X-ray and optical variations in both 3C 120 and 3C 111 implies that a significant fraction of the optical emission in these two objects arises from the accretion disk as thermal black body radiation. During some part of the monitoring the optical emission in 3C 111 shows a significant polarization implying that part of the optical emission is generated in the jet as synchrotron radiation.

Francesca D'Arcangelo (Lincoln Laboratory MIT/BU)

Multiwavelength Polarization Study of a Sample of Blazars

Abstract: We discuss multiwavelength polarimetric and photometric observations of a sample of 20 blazars, taken during two intensive ten-day campaigns in 2005 and 2006. Optical and near-infrared observations are compared to high-resolution 43 GHz images of each blazar jet, taken with the Very Long Baseline Array (VLBA). A correlation is then made between the unresolved optical emission and a location in the resolved parsec-scale jet, using comparisons in flux density, percent polarization, and electric vector position angle (EVPA) at each wavelength. For many blazars, we demonstrate

correlations between both the values and behavior of the optical and 43 GHz EVPA. In this presentation, we discuss the overall conclusions of the study, including the general location of optical emission in the 43 GHz parsec-scale jet and the common magnetic field structures seen in the sample.

E.M. Douglass (Boston University)

The Cluster Environment of Wide Angle Tail Radio Sources

Abstract: Due to their frequent association with galaxy clusters and their connection to intracluster medium ram pressure, wide angle tail (WAT) radio sources have proven to be reliable tracers of high-density environments at a range of redshifts, as well as possible indicators of dynamical activity within their host systems . To better understand the degree to which WATs trace their environmental conditions, we have performed an in depth analysis of the X-ray properties of two WAT clusters of differring X-ray and radio morphologies (Abell 562, Abell 1446). We conclude that merger induced ICM ram pressure is the likely cause of the bending of both WAT sources. In an effort to determine whether the X-ray properties of WAT clusters define them as a population, we have examined a sample of 11 WAT clusters observed with the Chandra X-ray Observatory, which are publicly available in the archive. Many of these clusters are found to display both merger signatures and evidence of cool gas coincident with the WAT host galaxy, suggesting a possible relation between the formation of WATs and the presence of perturbed cool cores. To examine if there is a distinction between the X-ray properties of WAT clusters and WAT-less clusters we compare the results with those of an identical analysis of an archival sample of cool core and non-cool core clusters in which WAT radio sources are not present.

Dan Evans (MIT)

Do AGN Outflows Cease Star Formation? New Results Based on Ultradeep Chandra HETG Observations of NGC 1068

Abstract: AGN outflows are widely invoked as the key mediators between the co-evolution of black holes and their host galaxies. Yet, the key question remains: do the outflows actually deliver enough power to their environments to alter evolution in a meaningful way? To address this, we present results from a new 440-ks Chandra HETG GTO observation of the kpc-scale ionization cone in the canonical Seyfert 2 galaxy NGC 1068. We perform the first spatially resolved, sub-arcsecond scale, high-resolution X-ray spectroscopy of an AGN environment, and use the sensitive line diagnostics offered by the HETG to measure the outflow rate, ionization state, density, and temperature at discrete points along the ionized NLR. We investigate evidence for any velocity gradients in the outflow, and describe our next steps in modeling the NLR as a multiphase biconical outflow. Our results have key implications for the role of galactic-scale outflows in AGN as moderators of galaxy evolution.

Vincent L. Fish (MIT Haystack Observatory)

Millimeter VLBI Observations of the Galactic Center

Abstract: Efforts are underway to link millimeter-wavelength telescopes into a VLBI network to observe the emission surrounding the 4 million solar mass black hole in the Galactic center at a resolution of a few Schwarzschild radii. Last year, our group reported on detections on a baseline between Hawaii

and Arizona, demonstrating the existence of detectable structure on scales less than 50 microarcseconds. This year, we report on more recent observations, including detections on a baseline between Hawaii and California. We discuss the significance of these detections in terms of the morphology of the emitting region as well as structural similarities between quiescent and flaring phases.

Paul J. Green (Harvard-Smithsonian Center for Astrophysics)

Spectacular Luminous Binary Quasar Discovered in a Face-On Galaxy Merger

Abstract: We present the first luminous, spatially resolved binary quasar that clearly inhabits an ongoing galaxy merger. SDSS J125455.09+084653.9 and SDSS J125454.87+084652.1 (SDSS J1254+0846 hereafter) are two luminous z=0.44 radio quiet quasars, with a radial velocity difference of just 215 km/s, separated on the sky by 21 kpc in a disturbed host galaxy merger showing obvious tidal tails. The pair was targeted as part of a complete sample of binary quasar candidates with small transverse separations drawn from SDSS DR6 photometry. We present follow-up optical imaging which shows broad, symmetrical tidal arm features spanning some 75 kpc at the quasars' redshift. Semi-analytic modeling suggests that the system consists of two massive disk galaxies prograde to their mutual orbit, caught during the first passage of an active merger. More such mergers should be identifiable at higher redshifts using binary quasars as tracers, or by probing disturbed galaxies using Chandra.

Heng HAO (Harvard-Smithsonian Center for Astrophysics)

Hot Dust Poor Type 1 AGN in COSMOS Survey

Abstract: The spectral energy distributions (SEDs) of active galactic nuclei (AGNs) are essential to understand the physics of the supermassive black holes (SMBHs). We present a detailed study of the evolution of AGN SED shapes in the optical-near-IR for 406 X-ray selected Type 1 AGNs from the COSMOS Survey as a function of luminosity, redshift and Eddington ratio. We define an index-index ('colour-colour') diagram to investigate the mixture of AGN continuum, reddening and host galaxy contribution.

We found that most of the sample lie on the mixing curves between the Elvis et al. (1994) mean AGN SED (E94), E94, and a host galaxy, with only the modest reddening expected in type 1 AGNs. Lower luminosity and Eddington ratio objects have more host galaxy. The E94 template is remarkably good in describing the SED shape in the 0.3-3micron decade. There is however a group of AGNs, which seem more prominent at high redshift/luminosity which have weak or non-existent near-IR bumps, suggesting a lack of hot dust. We investigate the other properties of this sample compared with more typical AGNs. These hot dust poor objects might be AGNs in a different evolutionary stage compared to normal AGNs.

Manasvita Joshi (Boston University), Markus Boettcher (Ohio University), Alan Marscher, Svetlana Jorstad (Boston University)

Spectral Modeling of Blazar Jets in Internal Shock Model Scenario

Abstract: We discuss the time-dependent radiation transfer mechanisms in blazar jets using the internal shock model. We aconsider a single inelastic collision between two relativistic shells of plasma

with different mass and energy, and moving at different speeds. The collision results in the formation of a forward shock (FS) and a reverse shock (RS) that convert the ordered bulk kinetic energy into magnetic field energy and accelerate the particles. We calculate synchrotron and Synchrotron Self Compton (SSC) emissions from the accelerated particles. We use the multi-zone radiation feedback scheme to address the issue of inhomogeneity in the photon density throughout the cylindrical emission region. Here we present the effects of varying relevant parameters on the simulated spectral energy distrbution (SED) of a generic blazar.

Brandon C. Kelly (Harvard-Smithsonian CfA)

Constraints on Black Hole Growth, Quasar Lifetimes, and Eddington Ratio Distributions from the SDSS Broad Line Quasar Black Hole Mass Function

Abstract: I will present an estimate of the black hole mass function (BHMF) of broad line quasars (BLQSOs), and the distribution of their Eddington ratios, using a method that self-consistently corrects for incompleteness and the statistical uncertainty in the mass estimates, based on a sample of 9886 quasars at 1 ¡ z ¡ 4.5 drawn from the Sloan Digital Sky Survey DR3. I will also discuss the constraints that our estimated mass function enables us to place on the estimated lifetime of the broad line quasar phase, present an estimate for the mass of the most massive black hole implied by our mass function, and discuss our results within the context of self-regulated black hole growth models.

Joanna Kuraszkiewicz (Harvard-Smithsonian CfA)

SED and emission line properties of red 2MASS AGN

Abstract: The IR-to-X-ray spectral energy distributions (SEDs) of the red (J-Ks > 2) AGN selected from the 2MASS survey are red with little or no blue bump. The near-IR color selection isolates the reddest subset of AGN that can be classified optically. The 2MASS AGN optical colors are strongly affected by reddening, host galaxy emission, redshift, and in few, highly polarized objects, also by scattered AGN light. The levels of optical, X-rays, and far-IR obscuration estimated from our detailed modeling, are all consistent and imply $N_H < 10^{23}$ cm^{-2}. This, combined with the [OIII]5007 emission line equivalent widths, suggest a predominance of inclined objects in which obscuration/inclination allows us to see/study weaker emission components which are generally swamped by the direct AGN light. PCA analysis of the SED and emission line properties showed that, while the parameters listed above are important, the dominant cause of variance in the sample (eigenvector $\sim$1) is the L/Ledd ratio. This analysis also distinguishes two sources of obscuration: the host galaxy and a circumnuclear absorption.

Anna Lia Longinott (MIT)

A test for obscuring gas clouds in the Seyfert 1 Galaxy H0557-385

Abstract: Recent X-ray observations prove capable to reveal material at sub-pc scale in Active Galaxies. The Seyfert 1 H0557-385 was observed in different flux states by XMM-Newton over a 4 years time scale. The variation was interpreted as an effect of intervening line-of-sight gas clouds with high column density, possibly located in the optical Broad Line Region. I will present preliminary results

from an ongoing monitoring program of the source that has just started with Swift last April.

Herman Marshall (MIT Kavli Institute)

Planning GEMS Observations of AGN and Blazars

Abstract: The Gravitation and Extreme Magnetism SMEX (GEMS) is a NASA project currently in phase B of development for a 2014 launch. Its goal is to detect and measure the polarization fractions and position angles of many types of astrophysical sources in the 2-6 keV bandpass. I will give an overview of the plan to observe several active galaxies and blazars.

Michael Malmrose[1], Robert Nikutta[2], Svetlana Jorstad[1], Alan Marscher[1], Moshe Elitzur[2] (1. Boston University; 2. University of Kentucky)

Spitzer Detection of a Clumpy Dust Torus in the Gamma-ray Blazar PG 1222+216 (4C21.35)

Abstract: In the standard AGN model, Gamma rays are produced by inverse compton scattering of seed photons to higher energies. It has been shown that scattering of accretion disk photons alone, cannot adequately explain the source of observed gamma ray spectrum of many blazars. In an attempt to account for the source of gamma rays, various models for a ∼1000 K dusty torus orbiting the central engine at a distance of several pc have been proposed. We use observations from the Spitzer Space Telescope with MIPS, IRAC, and IRS in two epochs to search for signatures of dust emanating from four AGN: PG 1222+216, PKS 1510-089, ON231, and CTA102 with z = 0.435, 0.361, 0.102, and 1.037 respectively. After modeling the spectral energy distribution with a power law, a clumpy torus model is fit to the residuals of PG 1222+216. We present the preliminary results of this analysis.

Paul Nulsen (Harvard-Smithsonian CfA)

The remarkable X-ray jet of Cygnus A

Abstract: The X-ray jet of the nearest FRII radio source, Cygnus A, does not coincide with its radio jet. This has significant implications for the operation of the radio source which will be discussed.

Alessandro Paggi (Dipartimento di Fisica, University of Rome "Tor Vergata", Harvard-Smithsonian Center for Astrophysics)

Power for dry BL Lacs

Abstract: Is it significant that the intrinsic outputs of several BL Lacs are observed to level off at values of about 10^{46} erg s^{-1}? In searching for an answer, we compare gamma-ray observations by the AGILE satellite of the BL Lac S5 0716+714 with those of Mrk 421 and Mrk 501. These dry BL Lacs show no evidence of accreting or surrounding gas; so the spectral distributions of their pure non-thermal radiations are effectively represented by the synchrotron self-Compton process. We find for S5 0716+714 a total jet power of about 3×10^{45} erg s^{-1}, which makes it one of the brightest dry BL Lacs so far detected in gamma rays. With a Kerr hole of around 5×10^{8} M_{sun}, the source is significantly gauged in terms of the maximal power around 4×10^{45} erg s^{-1} extractable via the Blandford-Znajek mechanism;

other dry BL Lacs observed in gamma rays remain well below that threshold. These findings and those forthcoming from Fermi-LAT will provide a powerful test of electrodynamics in the surroundings of the hole, dominated by GR effects.

Anil Seth (Harvard-Smithsonian Center for Astrophysics)

Hunting for the Lowest Mass Black Holes

Abstract: While most massive galaxies are known to have black holes, the presence of black holes at the centers of abundant, lower-mass galaxies is unknown. I will discuss our survey of the nearest galaxy nuclei with adaptive optics observations to dynamically constrain the presence of black holes in these systems. I will present two apparent detections of black holes with masses ¡=106 Msol, and discuss the very low luminosity accretion signatures seen in these systems.

Aneta Siemiginowska (Harvard-Smithsonian Center for Astrophysics)

Quasar-Cluster Bound: 3C 186 quasar in a massive cluster at high redshift

Abstract: We present Chandra observation of an X-ray cluster associated with the high-redshift, $z = 1.063$, compact-steep-spectrum radio-loud quasar 3C 186. The powerful quasar, $L \sim 10^{47}$ erg s^{-1}, is located at the core of the cluster. The temperature profile indicates that this is a cooling-core cluster with $kT = 3.11^{+0.91}_{-0.64}$ keV in the central cooler regions of the cluster. We measure a high cooling rate within the core of about $464^{+114}_{-78} M_{\odot}$year^{-1}, and a cooling time of $(7.1 \pm 1.4) \times 10^8$ years. The cooling gas is able to supply enough fuel to support growth of the supermassive black hole and to power the luminous quasar. The kinematic power of the central radio source is a factor of $\sim$10 lower than the quasar radiative power. This suggests that the radiation may provide greater heating in this cluster than the mechanical power of a radio source.

Charles L. Steinhardt & Martin Elvis (Harvard-Smithsonian Center for Astrophysics)

The Quasar Mass-Luminosity Plane

Abstract: We use the SDSS DR5 quasar catalog with virial black hole mass estimates (Shen et al., 2008, 62185 objects) to explore the black hole mass - luminosity (M-L) plane for quasars as a function of redshift. The 2-D M-L plane shows more complex and surprising features than can be seen in either 1-D projection: the quasar luminosity or mass function. Quasars accrete near at a mass- and redshift-dependent characteristic luminosity, typically sub-Eddington. The most massive quasars show a more highly synchronized demise than would be expected from the dynamics of their host galaxies. Statistical uncertainties in virial mass estimation are also shown to be smaller than previously reported. We use the M-L plane to limit evolutionary tracks for individual quasar masses and luminosities.

Sumin Tang, Jonathan Grindlay, & Martin Elvis (Harvard-Smithsonian Center for Astrophysics)

A Relationship between Supermassive Black Hole Masses and Their Host Galaxy Morphologies in Nearby Active Galactic Nuclei

Abstract: We find a tight correlation between the masses of supermassive Black Holes (SMBHs)

in nearby active nuclei and their host galaxy morphologies, where more massive SMBHs preferentially reside in earlier-type galaxies. The result is based on a sample of 54 galaxies with reliable black hole (BH) mass measurements and host galaxy morphology classifications compiled by Ho 2002, and is consistent with the picture that late-type galaxy mergers lead to active early-type galaxies. The relation is surprisingly much tighter for galaxies with active nuclei than the whole sample, and there is no such correlation for galaxies with inactive nuclei. This in turn strongly suggests the growth and co-evolution of current active nuclei with host galaxies are different from those of inactive nuclei, in contrast with the view that active galactic nuclei (AGN) are just a phase phenomenon through which every SMBH evolves. This relation might be related to both the correlation between SMBH masses and host galaxy bulge masses, and the correlation between the bulge masses and galaxy morphologies. The unexpected strong correlation between SMBH or bulge masses and host galaxy morphologies in active nuclei also implies that the central active SMBH is strongly linked with the properties of the host galaxies on a much larger scale. We also find that in elliptical galaxies more massive SMBHs reside in galaxies with older stellar ages, consistent with the 'downsizing' picture.

Junfeng Wang (Harvard-Smithsonian Center for Astrophysics)

Chandra Imaging of Seyfert 1 Galaxy NGC 4151

Abstract: New high resolution multiwavelength images (soft X-rays, HI, CO, optical, and H2) are beginning to give us a full view of the multiphase ISM in the nuclear region of NGC 4151, tracing both AGN feeding and its feedback. We present new results from deep Chandra imaging of NGC 4151, focussing on the X-ray morphology of NGC 4151 on spatial scales of $\sim$30 pc to $\sim$3 kpc. We discuss scientific impact of subpixel resolution imaging, and evidence for the presence of either thermal emission from interaction between the outflows and the HI bar or X-ray emitting photoionized gas from a nuclear outburst in the past.

Joshua Wing (Boston University)

Galaxy Cluster Environments of Radio Sources

Abstract: Double-lobed radio sources exhibiting some degree of bending between components are likely to be found in galaxy clusters. Often this radio emission is associated with a cD or giant elliptical galaxy at the center of the cluster. We identified bent double-lobed radio sources as well as straight double-lobed sources in the Faint Images of the Radio Sky at Twenty Centimeters (FIRST) catalog. We have cross-correlated these radio sources with the Sloan Digital Sky Survey (SDSS) catalog and measured the richness of their cluster environments. This has lead to the discovery and classification of a large number of galaxy clusters out to a redshift of z$\sim$0.6. We find that bent double-lobed radio sources are located in rich clusters more frequently than straight double-lobed radio sources and all extended, double-lobed, radio sources are more often located in rich cluster environments than non-extended radio sources. Many of the radio sources in our samples without optical counterparts to the magnitude limit of the SDSS are candidates for even higher-redshift clusters. We have deeply imaged (to m_r $\sim$24) many of these bent-lobed radio sources with the 1.8 m telescope at Lowell Observatory. We find that a large fraction of these sources are associated with galaxy clusters at magnitudes too faint to be detected in the SDSS. Our sample has the potential to reveal hundreds of high-redshift clusters

that can be used for studies of galaxy evolution and cosmology.