NERQUAM-27 Thursday, May 18, at Boston University

Schedule

9:00 – 9:30 BREAKFAST SNACKS AND MORNING COFFEE ROOM 502

9:30 – 10:00 NERQUAM-RELATED NEWS ROOM 522

1. Martin Elvis (CfA): JPL interest in using Commercial Space to make missions less expensive
2. Herman Marshall (MIT): Imaging X-ray Polarization Explorer (IXPE): NASA's next X-ray mission
3. Dan Schwartz (CfA): LYNX study status
4. Belinda Wilkes (CfA): Chandra Source Catalog v. 2.0
5. Meg Urry (Yale U.): AAS activities and new policies

10:00 – 10:50 ORAL SESSION 1 ROOM 522

Fabrizio Nicastro (SAO/INAF-OAR) *"Once upon a time in the center of the Milky Way"*

Rudolph Schild (Harvard-Smithsonian Center for Astrophysics) *"SgrA* as a MECO at the Galaxy Center"*

Anna Barnacka (Harvard) "*Galaxies as High-Resolution Telescopes"*

Ashkbiz Danehkar (Harvard-Smithsonian Center for Astrophysics) *"Chandra Grating Spectroscopy of PG 1211+143: Evidence for an Ultra-fast Outflow"*

10:50 – 11:10 REFRESHMENTS AND POSTERS ROOM 502

11:10 – 11:40 INVITED TALK ROOM 522

Marek Sikora (N. Copernicus Astronomical Center) *"On Jet Production Efficiency in AGNs"*

11:40 – 12:30 ORAL SESSION 2 ROOM 522

Manasvita Joshi (Boston University) *"Hard-spectral state analysis of Mrk 421"*

Mason Keck (Boston University) *"Probing Blazar Jets on Parsec Scales with the VLBA"*

Nicholas MacDonald (Boston University) *"Faraday Conversion in Turbulent Blazar Jets"*

Alan Marscher (Boston University) *"Color-dependent Optical Polarization and Gamma-ray Flares in Blazars"*

12:30 – 14:00 LUNCH AND POSTERS ON YOUR OWN/ROOM 502

14:00 – 15:40 ORAL SESSION 3 ROOM 522

Dan Schwartz (Smithsonian Astrophysical Observatory) *"The X-ray jet in 4C+19.44: Dan Harris's 'Long Jet'"*

Aneta Siemiginowska (CfA) *"High Redshift X-ray Jets"*

Paul Nulsen (Harvard-Smithsonian Center for Astrophysics) *"The Cocoon Shocks of Cygnus A"*

Malgosia Sobolewska (SAO) *"Initial stages of a radio source expansion studied through X-ray absorption"*

Martin Elvis (Harvard-Smithsonian Center for Astrophysics) *"Constant Density Broad Emission Line Region Clouds"*

Peter Maksym (Harvard-Smithsonian Center for Astrophysics) *"Multi-wavelength Imaging of the Extended Narrow Line Region of NGC 3393"*

Susanna Bisogni (Harvard-Smithsonian Center for Astrophysics) *"Quasars as standard candles"*

Rozenn Boissay Malaquin (MIT Kavli Institute) *"A hard X-ray view of the soft excess in AGN"*

15:40 – 16:00 REFRESHMENTS ROOM 502

16:00 – 17:30 ORAL SESSION 4 ROOM 522

Francesca Fornasini (CfA - SAO) *"The cosmic history of X-ray binary and AGN emission in star-forming galaxies"*

Emmet Golden-Marx (Boston University) *"The High-Redshift Clusters Occupied by Bent Radio AGN (COBRA) Survey"*

Angelo Ricarte (Yale University) *"Semi-analytic Models of Supermassive Black Hole Evolution"*

Nico Cappelluti (Yale) *"New Measurements of the joint CXB vs CIB fluctuations: early BHs with 14 Ms data"*

Eric Roebuck (Tufts University) "*Informing IR AGN Fraction Estimates Through Simulations*"

Allison Kirkpatrick (Yale) *"Finding AGN with JWST at Cosmic Noon"*

Joanna Kuraszkiewicz (SAO) *"Obscuration in the Chandra observed sample of medium-redshift (0.5<z<1) 3CRR sources."*

17:30-18:30 RECEPTION ROOM 502

Oral Presentations with Abstracts

INVITED SPEAKER

Marek Sikora (N. Copernicus Astronomical Center)
"On Jet Production Efficiency in AGNs"
Marek Sikora

Recent results of studies of jet power in quasars and radio-galaxies are presented and discussed in the context of the MAD (Magnetically-Arrested -Disk) scenario. We show that the "observed" dependence of the jet production efficiency on the Eddington-ratio disagree with the one predicted by the MAD model: while observations suggest anti-correlation of these quantities, numerical simulations and some analytic analyses indicate their strong correlation. We investigate several possible reasons of this discrepancy and argue that the most promising is strong, long term modulation of the jet production. We also discuss the issue of the AGN radio-dichotomy, arguing that rarity of the jetted AGNs simply could be due to a difficulty to accumulate sufficiently large net magnetic flux to form the MAD.

PROGRAM SPEAKERS, LISTED ALPHABETICALLY

Anna Barnacka (Harvard)
"Galaxies as High-Resolution Telescopes"

Recent observations show a population of active galaxies with milliarcseconds offsets between optical and radio emission. Such offsets can be an indication of extreme phenomena associated with supermassive black holes including relativistic jets, binary supermassive black holes, or even recoiling supermassive black holes. However, the multi-wavelength structure of active galaxies at a few milliarcseconds cannot be fathomed with direct observations. I will describe how we can use strong gravitational lensing to elucidate the multi-wavelength structure of sources at milliarcsecond scales. When sources are located close to the caustic of lensing galaxy, even small offset in the position of the sources results in a drastic difference in the position and magnification of mirage images. I will demonstrate the power of cosmic lenses to amplify the angular offset in the position of the sources and the probability of finding lensed sources close to the caustic. I will discuss the potential of surveys like SKA and Euclid to elucidate multi-wavelength structure for a large ensemble of sources and study the physical origin of multi-wavelength emission, their connection to supermassive black holes, and their cosmic evolution.

Susanna Bisogni (Harvard-Smithsonian Center for Astrophysics)
"Quasars as standard candles"
S. Bisogni (CfA, INAF), G. Risaliti (University of Florence, INAF), E. Lusso (Durham University, INAF), M. Elvis (CfA)

Quasars are the brightest sources and the ones we can observe at the highest redshifts. However, the large variability in luminosity among the quasar population (and also within the same object) has never allowed to use them for cosmological purposes.

We now propose a new, powerful method to use quasars as standard candles, based on the non-linear relation between the X-ray and UV emissions. This allows us to measure distances at high redshift and explore the space of cosmological parameters in a redshift range never explored before by any other cosmological probe.

Rozenn Boissay Malaquin (MIT Kavli Institute)
"A hard X-ray view of the soft excess in AGN"
Rozenn Boissay (MKI), Claudio Ricci (Pontificia Universidad Catolica de Chile), Stéphane Paltani (University of Geneva)

A soft X-ray emission in excess of the extrapolation of the hard X-ray continuum is detected in many Seyfert 1 galaxies below 1 keV. To understand the uncertain nature of this soft excess, which could be due to warm Comptonization or to blurred ionized reflection, we consider the different behaviors of these models above 10 keV. We present the results of a study done on 102 Seyfert 1s from the Swift BAT 70-Month Hard X-ray Survey catalog. We have performed the joint spectral analysis of Swift/BAT and XMM-Newton data in order to get a hard X-ray view of the soft excess. We discuss the links between the soft-excess strength and the reflection at high energy, the slope of the continuum and the Eddington ratio. We compare our results to simulations of blurred ionized-reflection models and show that they are in contradiction. Indeed, we do not find the expected correlation between the reflection and the soft-excess strengths, neither in individual, nor in stacked spectra.

Nico Cappelluti (Yale)
"New Measurements of the joint CXB vs CIB fluctuations: early BHs with 14 Ms data"
Nico Cappelluti

I will present new results on the measurement of the coherent fluctuations of the CXB and CXB after sources removal down to Spitzer and deep Chandra flux limits. I will discuss the implications for studies of early BH populations.

Ashkbiz Danehkar (Harvard-Smithsonian Center for Astrophysics)
"Chandra Grating Spectroscopy of PG 1211+143: Evidence for an Ultra-fast Outflow"
Ashkbiz Danehkar (CfA)

We present X-ray time-averaged spectral analysis of 430 ks Chandra High Energy Transmission Grating Spectrometer observations of the Seyfert I galaxy PG 1211+143, which were simultaneously collected with UV observations using the Hubble Cosmic Origins Spectrograph and radio observations using the Jansky Very Large Array in April 2015. We modeled the continuum features by using an accretion disk model and a power-law, and the absorption profiles by applying XSTAR photoionization models constrained by the UV-X-ray ionizing spectral energy distribution. We find that the blue-shifted absorption features are consistent with an ultra-fast outflow with the line-of-sight velocity of about 0.06 speed of light. We used a Markov-chain Monte Carlo method to constrain the physical conditions of the X-ray ultra-fast outflow. Additionally, the UV observations taken with the Hubble Cosmic Origins Spectrograph reveals a broad blue-shifted absorption Lyman-alpha feature with an outflow velocity of about 0.06, which could be a potential counterpart to the X-ray ultra-fast outflow.

Martin Elvis (Harvard-Smithsonian Center for Astrophysics)
"Constant Density Broad Emission Line Region Clouds"
Martin Elvis (CfA)

If the quasar broad emission line region (BELR) forms due to a 2-phase medium then constant density clouds are a consequence. This result leads to natural explanations for several correlations related to the BELR that I will present and contrast with the Locally Optimally Emitting (LOC) cloud model.

Francesca Fornasini (CfA - SAO)
"The cosmic history of X-ray binary and AGN emission in star-forming galaxies"
Francesca Fornasini (CfA-SAO), Francesca Civano (CfA-SAO), Giuseppina Fabbiano (CfA-SAO)

We present the preliminary results of an investigation of the redshift evolution of the X-ray emission of star-forming galaxies in the COSMOS field. The Chandra COSMOS Legacy survey provides 180 ks of Chandra exposure over 2 square degrees. This large survey allows us to study the X-ray emission of 123,000 star-forming galaxies with uniformly measured stellar masses (M), star formation rates (SFR), and photometric redshifts (z), the largest such sample to be used in an X-ray study of star-forming galaxies to date. The galaxies in our sample have z = 0.1-5, log(M) = 9-12, and SFR = 0.01 to 1000 $M_{\odot}\,yr^{-1}$. Since these galaxies are not individually detected by Chandra, we stack the X-ray data of galaxies grouped into z, M, and SFR bins to obtain statistically significant detections. We find that the average X-ray luminosity (LX) of star-forming galaxies at higher redshifts is higher than expected based on local relations for X-ray binaries (XRBs). This suggests either a redshift evolution of LX/SFR and LX/M for XRB populations, an increase in low-luminosity AGN activity with redshift, or both. We explore these scenarios, comparing our results to previous studies of the redshift evolution of XRBs and the evolution of the AGN luminosity function.

Emmet Golden-Marx (Boston University)

"The High-Redshift Clusters Occupied by Bent Radio AGN (COBRA) Survey"

Emmet Golden-Marx (BU), Elizabeth Blanton (BU), Rachel Paterno-Mahler (UMich), Matthew Ashby (CfA), Joshua Wing (CfA), Mark Brodwin (UMKC), & Gagandeep Anand (BU)

Galaxy clusters are the largest gravitationally bound structures in the universe. Though there are many spectroscopically confirmed low-redshift clusters, few have been confirmed at high redshifts. To probe the earliest eras of cluster formation, samples of high-redshift clusters with a variety of morphological states and masses are needed. Bent radio AGN can be used as efficient tracers for discovering new, high-z clusters. Here, we present results from the Clusters Occupied by Bent Radio AGN (COBRA) Survey. The COBRA survey includes 646 bent, double-lobed radio sources selected from the VLA FIRST Survey, infrared observations from Spitzer, and optical observations from the Discovery Channel Telescope. The COBRA survey spans the redshift range $0.5 < z < 3.0$ and includes clusters with a wide range of masses and dynamical states. The bent radio morphology of the AGN results from interactions between the AGN host galaxy and the surrounding intracluster medium; the relative motion results in ram pressure acting on the lobes, bending them. Using our IR and optical data, we measure galaxy excesses, locate red sequence galaxies, and determine photometric redshifts. We find that ~ 40% of our high-z bent radio sources are found in clusters or protoclusters. Additionally, we measure galaxy surface densities to trace out the large-scale cluster morphologies and estimate dynamical states.

Manasvita Joshi (Boston University)

"Hard-spectral state analysis of Mrk 421"

Manasvita Joshi (Boston U.), Biswajit Banerjee (SINP), and Pratik Majumdar (SINP), Karen Williamson (Boston U.), Svetlana Jorstad (Boston U.), Alan Marscher (Boston U.)

Multiwavelength variability and spectral energy distribution (SED) of blazars form a powerful suite of tools to probe the acceleration of particles and the time-dependent interplay of radiation mechanisms responsible for shaping the observed emission.

Here, we use the MUlti-ZOne Radiation Feedback (MUZORF) model of Joshi et al. (2014) to reproduce various spectral states of the blazar Mrk 421 observed between 15 - 18 February 2010. During this time, the source was observed to be in a very hard X-ray spectral state from 16 February onward. The transition from soft to hard X-ray spectral state took place within a day. The goal of our study is to understand the role of various input parameters that were responsible for the transition and how do profiles of corresponding spectral variability patterns (SVPs), across various energy bands, compare for these spectral states.

Mason Keck (Boston University)
"Probing Blazar Jets on Parsec Scales with the VLBA"
M. L. Keck (Boston University), A. P. Marscher (Boston University), S. G. Jorstad (Boston University)
We present VLBA total and polarized intensity images of ten blazars obtained simultaneously at 22, 43, and 86 GHz in 2014 April. We study the Faraday rotation measure and degree of polarization at the location of the 86 GHz VLBI core, closer to the black hole than previous analyses that used lower frequency data. We probe the nature of the Faraday rotation screen and structure of the magnetic field geometry in the inner parsec-scale jet. Through alignment of the total intensity maps at different frequencies, we analyze the shape of the jet closer to its base.

Allison Kirkpatrick (Yale)
"Finding AGN with JWST at Cosmic Noon"
I discuss optimal MIRI color selection techniques to identify AGN, particularly in strongly star forming galaxies, at z=1-2. I demonstrate the clear improvement over IRAC techniques by estimating the numbers of galaxies with low Eddington ratios that MIRI colors will be able to identify. I also discuss how MIRI observations can be used to calculate the infrared luminosity of AGN in star forming host galaxies.

Joanna Kuraszkiewicz (SAO)
"Obscuration in the Chandra observed sample of medium-redshift (0.5<z<1) 3CRR sources."
J. Kuraszkiewicz (SAO), B. Wilkes (SAO), A. Atanas (SAO), M. Haas (Ruhr-Universitat Bochum), P. Barthel (Kapteyn Astron. Institute), S. P. Willner (SAO), D. M. Worrall (Univ. of Bristol), M. Birkinshaw (Univ. of Bristol), R. Antonucci (UCSB), M. L. N. Ashby (SAO)
Despite their intrinsically bright, multi-wavelength emission, an unknown fraction of AGN is hidden from our view due to orientation-dependent obscuration by massive amounts of material. One way to select AGN samples that are orientation-unbiased (although limited to radio-loud sources) is low frequency radio, where the selection is based on extended, optically thin radio lobes. Radio data also provide an independent estimate of orientation via the radio core fraction.

We extend our studies of a complete, 178 MHz radio flux-limited, Chandra observed sample of high-redshift (1<*z*<2) 3CRR sources (Wilkes et al. 2013) to medium redshifts (0.5<*z*<1). This medium-*z*, flux-limited and orientation unbiased sample includes: 13 quasars, 22 narrow-line radio galaxies (NLRGs) and one low-excitation radio galaxy (LERG), with matched radio luminosities (log L_r(178MHz)~43.5-44.7). The quasars show high X-ray luminosities L_x(0.5-8keV)~44.8-45.9, soft hardness ratios (HR<0), and high radio core fraction, which indicates low obscuration (log N_H < 22) and face-on inclination. NLRGs, have lower observed X-ray luminosities (L_x~42.8-45.1), a wide range of hardness ratios, and lower radio core fraction, indicating a range of obscuration (log N_H > 21) and edge-on inclinations. These properties together with the observed trend of increasing NH with decreasing radio core fraction are roughly consistent with orientation-dependent obscuration as in Unification models. At least 8 NLRGs show Compton-thick (or borderline) [OIII]/L(2-8keV) and/or low L_x(0.5-8keV)/L_r(178MHz). The unobscured (log N_H<22) to obscured (log N_H>22) source ratio is 1, where ~25% of sources are Compton-thick (similar to the fraction in the high-*z* 3CR sample).

Nicholas MacDonald (Boston University)
"Faraday Conversion in Turbulent Blazar Jets"
Nicholas MacDonald (Boston University), Alan Marscher (Boston University)

Low (< 3%) levels of circular polarization (CP) detected at radio frequencies in the relativistic jets of some blazars can provide insight into the underlying nature of the jet plasma. CP can be produced through linear birefringence, in which initially linearly polarized emission produced in one region of the jet is altered by Faraday rotation as it propagates through other regions of the jet with various magnetic field orientations. Marscher has recently begun a study of jets with such magnetic geometries with the Turbulent Extreme Multi-Zone (TEMZ) model, in which turbulent plasma crossing a standing shock in the jet is represented by a collection of thousands of individual plasma cells, each with distinct magnetic field orientation. Here we develop a radiative transfer scheme that allows the numerical TEMZ code to produce simulated images of the time-dependent linearly and circularly polarized intensity at different radio frequencies. In this initial study, we produce synthetic polarized emission maps that highlight the linear and circular polarization expected within the model.

Peter Maksym (Harvard-Smithsonian Center for Astrophysics)
"Multi-wavelength Imaging of the Extended Narrow Line Region of NGC 3393"
W. Peter Maksym (CfA), Giuseppina Fabbiano (CfA), Martin Elvis (CfA), Margarita Karovska (CfA), Alessandro Paggi (CfA), John Raymond (CfA), Junfeng Wang (Xiamen U.), Thaisa Storchi-Bergmann (UFRGS)

NGC 3393 is a Compton-thick Swift BAT AGN at only 53 Mpc, with $L_X(15\text{-}55\ keV)>10^{42}$ erg/s, a spatially-resolved sub-kpc radio outflow, and evidence for multi-component AGN feedback. The angular scale is sufficient to spatially resolve the outflow and the surrounding NLR simultaneously with HST, Chandra and the VLA. Excellent spatial resolution allows us to tease out the different components of a multiphase NLR, and we discuss multi-wavelength evidence for outflow-driven shocks enabled by high-resolution spatial discrimination from the photoionized NLR.

Alan Marscher (Boston University)
"Color-dependent Optical Polarization and Gamma-ray Flares in Blazars"
Alan P. Marscher & Svetlana G. Jorstad (Boston University)

Gamma-ray flares in some BL Lac objects have coincided with a flattening of the optical polarized flux spectrum relative to the total flux spectrum. This time-variable color dependence of the polarization implies that the magnetic field is more ordered in the (presumably smaller) emission region at higher optical frequencies. The connection with gamma-ray flares suggests that acceleration of GeV electrons depends on magnetic field direction, as expected in models involving shock acceleration of turbulent plasma in blazar jets. We are currently testing this with a systematic observing program.

Fabrizio Nicastro (SAO/INAF-OAR)
"Once upon a time in the center of the Milky Way"
F. Nicastro
Evidence that the supermassive black hole at the center of our Galaxy, was active and generously fed with large amount of gas, few million years ago, is growing. Here I present one of these indirect pieces of evidence, which, in turns, helps to close the census of baryons in our Galaxy.

Paul Nulsen (Harvard-Smithsonian Center for Astrophysics)
"The Cocoon Shocks of Cygnus A"
Paul Nulsen (CfA), Bradford Snios (CfA), Michael Wise (ASTRON) and the Cygnus A Collaboration
Very deep Chandra X-ray observations of Cygnus A have been used to assess the speed and strength of its cocoon shocks. The results show that the shocks are driven by a nearly uniform pressure throughout most of the cocoon. Independent pressure determinations for shocked gas within the cocoon give consistent results, although suggesting that the pressure is about 30% high in the eastern lobe than in the western lobe. I will discuss some implications for the jet properties. In particular, the jets do not appear to be kinetic energy dominated on large scales.

Angelo Ricarte (Yale University)
"Semi-analytic Models of Supermassive Black Hole Evolution"
Priya Natarajan
Semi-analytic models attempt to combine everything known about black hole formation, fueling, and feedback in hopes of generating a self-consistent picture of their evolution. In our work, we model the growth of black holes starting from their seed formation (z>15) to present day. The growth rates of the population are constrained by bolometric luminosity functions, while the local mass function and M-sigma relation provide boundary conditions. We find that stochasticity on a variety of time-scales, including flickering within a Myr, is necessary to explain the evolution of black holes. In addition, we strain our models to match the high-luminosity end of the high-redshift luminosity functions. Finally, I will discuss prospects of disentangling seeding mechanisms as we push past our current redshift horizon.

Eric Roebuck (Tufts University)

"Informing IR AGN Fraction Estimates Through Simulations"

Eric Roebuck (Tufts), Anna Sajina (Tufts), C.C. Hayward (Center for Computational Astrophysics), Alexandra Pope (UMass Amherst), Allison Kirkpatrick (Yale), Lars Hernquist (CfA), Lin Ya (Caltech)

A key question in extragalactic studies is the determination of the relative roles of stars and active galactic nuclei (AGNs) in powering dusty galaxies at z~1-3 where the bulk of star formation and AGN activity took place. We use hydrodynamic simulations with dust radiative transfer of isolated and merging galaxies to determine how IR AGN (to stellar) fractions relate to the UV-mm AGN fraction. We compare directly these results to a sample of 336 24 μm selected (Ultra)Luminous Infrared Galaxies, (U)LIRGs, at z~0.3-2.8, with empirically derived IR AGN fractions. We find that: (1) IR AGN fraction estimates based on simulations are in qualitative agreement with the empirical values when host reprocessing of the AGN light is considered; (2) for star-forming galaxy (SFG)-AGN composites our empirical methods may be underestimating the role of AGN, as our simulations imply >50% AGN fractions, ~3× higher than previous estimates; (3) 6% of our empirically classified SFGs have AGN fractions ≳50%. While this is a small percentage of SFGs, if confirmed it would imply that the true number density of AGNs may be underestimated; (4) this comparison depends on the adopted AGN template—those that neglect the contribution of warm dust lower the empirical fractions by up to two times; and (5) the IR AGN fraction is only a good proxy for the intrinsic UV-mm AGN fraction when the extinction is high (AV≳ 1 or up to and including coalescence in a merger).

Rudolph Schild (Harvard-Smithsonian Center for Astrophysics)

"SgrA as a MECO at the Galaxy Center"*

Rudolph Schild

The SOFIA / Forecast 30 micron infrared image of SgrA* has been thoroughly examined and commented on and found to have "unexplained asymmetrical central structure." We show that the observed structure is predicted by MECO models of massive compact objects. The toroidal structure is the dusty torus and the luminous asymmetrical structure is the synchrotron emission from electrons Larmouring along force-free magnetic field lines of a magnetic propeller predicted for the MECO model.

This identification of the luminous structures allows us to predict the expected polarization pattern, which will be complicated with circular right- and left- but adjoining regions of linear polarized synchrotron radiation. These are presently being observed and would confirm the applicability of the MECO mode, which is the only model that can explain the strong magnetic fields observed from such sources.

Dan Schwartz (Smithsonian Astrophysical Observatory)
"The X-ray jet in 4C+19.44: Dan Harris's 'Long Jet'"
D. E. Harris (SAO), N. P. Lee (SAO), D. A. Schwartz (SAO), A. Siemiginowska (SAO), F. Massaro (UniTO, INFN-To, INAF-AO To), M. Birkinshaw (Bristol), D. M. Worrall (Bristol), C. C. Cheung (NRL), J. M. Gelbord (Eureka Scientific), Svetlana G. Jorstad (BU), Alan P. Marscher (BU), H. Landt (Durham), H. Marshall (MIT), E. S. Perlman (FIT), L. Stawarz (Jagiellonian, INAF-AO To), Y. Uchiyama (Rikkyo), and M. Urry (Yale, Bristol)

We present arcsecond-resolution images of the quasar, jet, and lobes of 4C+19.44 (=PKS 1354+195) in the radio, IR, visible, and X-ray bands. We have radio images with half to one arcsecond angular resolution at 3 frequencies, plus HST and Spitzer data. The deep Chandra image of this system allows us to estimate the X-ray spectral index in 10 distinct regions along the 18'' jet and compare with the radio index. The comparison of the X-ray and radio spectra show that both are consistent with an index 0.7 for the integrated jet. The X-ray jet structure to the south extends beyond the prominent radio jet and connects to the southern radio lobe, and there is extended X-ray emission in the direction of the unseen counter jet and coincident with the northern radio lobe. This target was chosen because of the jet length and because it appears to be relatively straight. The latter implies that the geometrical factors are constant along the jet, although their values are uncertain. Using the model of inverse Compton scattering of electrons on the cosmic microwave background (IC/CMB), we find that the magnetic field strengths and Doppler factors are relatively constant along the jet.

Aneta Siemiginowska (CfA)
"High Redshift X-ray Jets"

X-ray studies of relativistic jets require (sub)-arcsec angular resolution to detect and resolve their structure. Chandra is currently the only X-ray telescope capable of mapping X-ray jets in nearby Active Galactic Nuclei and resolving X-ray jets associated with powerful quasars at high redshifts. Before Chandra only a few extragalactic X-ray jets have been studied. Now, after 16 years of Chandra observations many new X-ray jets have been discovered and the X-ray Jets web page contains about 100 jets associated with radio galaxies and quasars. However, until now quasar jet surveys with Chandra have been shallow (<10 ksec exposures), at low redshift (median at z<1) and focused on discovering the X-ray jets. Our knowledge of the most powerful quasar jets is based on 45 published quasars with short exposures and only 5 deep (>100 ksec) observations to date. These existing observations demonstrate that the quasar jets have complex dynamics, X-ray emission processes, trends along the jet and trends with redshift that we understand only poorly. We argue that future X-ray studies of jets with Chandra are necessary for making progress in understanding jets.

Malgosia Sobolewska (SAO)

"Initial stages of a radio source expansion studied through X-ray absorption"

Malgosia Sobolewska (SAO), Aneta Siemiginowska (SAO), Giulia Migliori (CEA-Saclay), Matteo Guainazzi (European Space Research and Technology Centre), Martin Hardcastle (University of Hertfordshire), Luisa Ostorero (Universita degli Studi di Torino and Istituto Nazionale di Fisica Nucleare), Lukasz Stawarz (Astronomical Observatory of Jagiellonian University)

Compact Symmetric Objects (CSOs) are thought to be among the progenitors of large-scale radio galaxies. They show radio features typically observed in large-scale radio galaxies (jets, lobes, and hot spots), but contained within the central region (<1 kpc) of the host galaxy. Because the CSOs are symmetric and not affected by beaming, the source linear radio size can be directly translated into the source age if one measures the expansion velocity of the radio source. However, if the jet expansion is disturbed, e.g. by a dense interstellar medium, the ages derived using this method may be biased. Until now we did not have a way to discriminate between confined and non-confined radio sources. Here, we present our X-ray studies of CSOs performed with Chandra and XMM-Newton. For the first time, the data reveal the evidence in favor of the hypothesis that in a sub-population of CSOs the medium is Compton Thick and the radio jets may be confined, and thus their kinematic ages may be underestimated. We discuss the implications of our results on the high energy emission models of the earliest stages of the radio source evolution, jet interactions with the interstellar medium, diversity of the environments in which the jets expand, and jet-galaxy co-evolution.

Poster Presentations with Abstracts

Rosamaria Carraro (Yale University, U. Valparaiso)
"Co-evolution of black hole accretion and star formation in galaxies at different cosmic epochs"
Cassata P. (U. Valparaiso), Rodighiero G. (U. Padova), Brusa M. (U. Bologna)

We investigate the co-evolution between black hole accretion rate (BHAR) and star formation rate (SFR). We take advantage of new Chandra X-ray COSMOS-Legacy survey which allows to exploit the unique depth/area combination of the COSMOS field in its entirety in combination with the new COSMOS2015 catalogue, comprising the new UVista Ultra-deep observations in COSMOS. This allows to make an X-ray stacking analysis in the broadest redshift interval so far ($0.1<z<3.5$) with unprecedented statistics for normal star forming and quiescent galaxies. We estimate the SFR from the far-IR and study the average SFR-stellar mass (M*) relation and compare it with the BHAR-M* relation. We also study the specific SFR and specific BHAR evolution with redshift. Our results support the idea that the same secular processes feed and sustain both star formation and black hole accretion in normal star-forming galaxies while starburst and quiescent galaxies show an average higher and lower BHAR respectively. We also find interesting evidence showing that the BH accretion process is more efficient than the SF.

Yasaman Homayouni (University of Connecticut)
"Light Echoes of Black Hole Growth"
Yasaman Homayouni (University of Connecticut)

It is observationally established that almost all massive galaxies have a supermassive black hole(SMBH) at their center. With results showing a tight correlation between black hole and galaxy mass it is of significant importance to study SMBH to learn about galaxy evolution. Despite the recent progress in observation of active galaxies, the physics of accretion onto SMBH remains poorly understood. The reverberation mapping(RM) is a technique for directly measuring the inner accretion flow of the SMBHs, It can provide well-measured black hole masses(~0.3dex) and is currently the most promising method to find properties of highly-accreting SMBHs with $\eta>0.1$. In this work, the Sloan Digital Sky Survey Reverberation Mapping project (SDSS-RM) will be presented which is the first-ever multi-object spectroscopic RM campaign that is monitoring 849 quasars from Jan-June since 2014 with supported photometry from 3.6m Canada-France-Hawaii Telescope and Steward observatory 2.3m Bok telescope, aiming to detect lags variability of broad absorption lines.

Svetlana Jorstad (Boston University)
"BU Optical Monitoring Program of Gamma-Ray Bright Blazars "
S.G. Jorstad, A.P. Marscher, K.E. Williamson, & M. Joshi

The Boston University blazar group carries out photometric (BVRI) and polarimetric (R band) monitoring of a sample of 37 γ-ray sources with the Perkins Telescope of Lowell Observatory (Flagstaff, AZ). During 2010-2013 we observed the sample with the Liverpool Telescope (La Palma, Canary Islands) as well. We combine optical photometric and polarimetric curves with γ-ray light curves from the Large Area Telescope of the Fermi Gamma-ray Space Telescope, and X-ray light curves from the XRT of the Swift satellite, which we calculate in a manner described in Williamson et al. (2014, ApJ, 789, 135). We present here the multi-wavelength light curves of all sources in our sample during the Fermi era to demonstrate the richness of the data and variety of behavior across the sample.

Alan Marscher (Boston University)
"VLBA-BU-Blazar Monitoring Program"
A.P. Marscher, S.G. Jorstad & K.E. Williamson

We present examples of the data available from the VLBA-BU-BLAZAR monitoring program. Since June 2007, the Boston University (BU) blazar group has been monitoring bright γ-ray AGNs with the Very Long Baseline Array (VLBA) at 43 GHz. Currently, we monitor 21 flat radio spectrum quasars (FSRQs), 13 BL Lac objects (BLLacs), and 3 radio galaxies (RGs), 7 of which were added after the start of the program. We perform optical multi-band photometric and R-band polarimetric observations of the sample at the Perkins telescope of Lowell Observatory (Flagstaff, AZ). We combine the optical data with publicly available data from the Steward Observatory (Tuscon, AZ), SMARTS consortium, and four partner observatories. We calculate γ-ray and X-ray light curves using data provided by the Large Area Telescope of the Fermi Gamma-ray Space Telescope and X-ray and UV data from the Swift satellite. The fully calibrated VLBA data and images, multi-wavelength light curves, and plots of optical polarization vs. time can be found at our website: https://www.bu.edu/blazars.

Participants

Name	Talk/ Poster	Institution	Email Address
Adam Atanas		Harvard University	adamatanas@gmail.com
Tim Barker		Wheaton College	tbarker@wheatonma.edu
Anna Barnacka	T	Harvard	abarnacka@cfa.harvard.edu
Susanna Bisogni	T	Harvard-Smithsonian Center for Astrophysics	susanna.bisogni @cfa.harvard.edu
Elizabeth Blanton		Boston University	eblanton@bu.edu
Rozenn Boissay Malaquin	T	MIT Kavli Institute	rboissay@space.mit.edu
Nico Cappelluti	T	Yale	n.cappelluti@yale.edu
Carie Cardamone		Wheelock College	ccardamone@gmail.com
Rosamaria Carraro	P	Yale University, U. Valparaiso	rosamaria.carraro@yale.edu
Francesca Civano		SAO	fcivano@cfa.harvard.edu
Ashkbiz Danehkar	T	Harvard-Smithsonian Center for Astrophysics	ashkbiz.danehkar @cfa.harvard.edu
Martin Elvis	T	Harvard-Smithsonian Center for Astrophysics	melvis@cfa.harvard.edu
Francesca Fornasini	T	CfA - SAO	francesca.fornasini @cfa.harvard.edu
Antonella Fruscione		SAO	afruscione@cfa.harvard.edu
Emmet Golden-Marx	T	Boston University	emmetgm@bu.edu
Yasaman Homayouni	P	University of Connecticut	yasaman.homayouni @uconn.edu
Mackenzie Jones		Dartmouth College	Mackenzie.L.Jones.GR @Dartmouth.edu
Manasvita Joshi	T	Boston University	mjoshi@bu.edu
Mason Keck	T	Boston University	keckm@bu.edu
Allison Kirkpatrick	T	Yale	allison.kirkpatrick@yale.edu
Nick Krefting		Tufts University	Nicholas.krefting@tufts.edu

Joanna Kuraszkiewicz	T	SAO	Jkuraszkiewicz @cfa.harvard.edu
Daniel Lange-Vagle		Tufts University	daniel.lange_vagle @tufts.edu
Nicholas MacDonald	T	Boston University	nmacdona@bu.edu
Dipankar Maitra		Wheaton College	maitra_dipankar @wheatoncollege.edu
Peter Maksym	T	Harvard-Smithsonian Center for Astrophysics	walter.maksym @cfa.harvard.edu
Cemile Marsan		Tufts University	cemilemarsan@gmail.com
Alan Marscher	T,P	Boston University	marscher@bu.edu
Herman Marshall		MIT	hermanm@space.mit.edu
Muhammad Zain Mobeen		Boston University	drmzain@bu.edu
Joey Neilsen		MIT	jneilsen@space.mit.edu
Fabrizio Nicastro	T	SAO/INAF-OAR	fnicastro@cfa.harvard.edu
Paul Nulsen	T	Harvard-Smithsonian Center for Astrophysics	pnulsen@cfa.harvard.edu
Meredith Powell		Yale	meredith.powell@yale.edu
Angelo Ricarte	T	Yale University	angelo.ricarte@yale.edu
Eric Roebuck	T	Tufts University	eric.roebuck@tufts.edu
Rudolph Schild	T	Harvard-Smithsonian Center for Astrophysics	rschild@cfa.harvard.edu
Dan Schwartz	T	SAO	das@cfa.harvard.edu
Aneta Siemiginowska	T	CfA	Asiemiginowska @cfa.harvard.edu
Marek Sikora	T	N. Copernicus Astronomical Center	sikora@camk.edu.pl
Malgosia Sobolewska	T	SAO	Msobolewska @cfa.harvard.edu
Meg Urry		Yale University	meg.urry@yale.edu
John Wardle		Brandeis	wardle@brandeis.edu
Belinda Wilkes		SAO	bwilkes@cfa.harvard.edu
Karen Williamson		Boston University	kwilliam@bu.edu