Accretion Processes

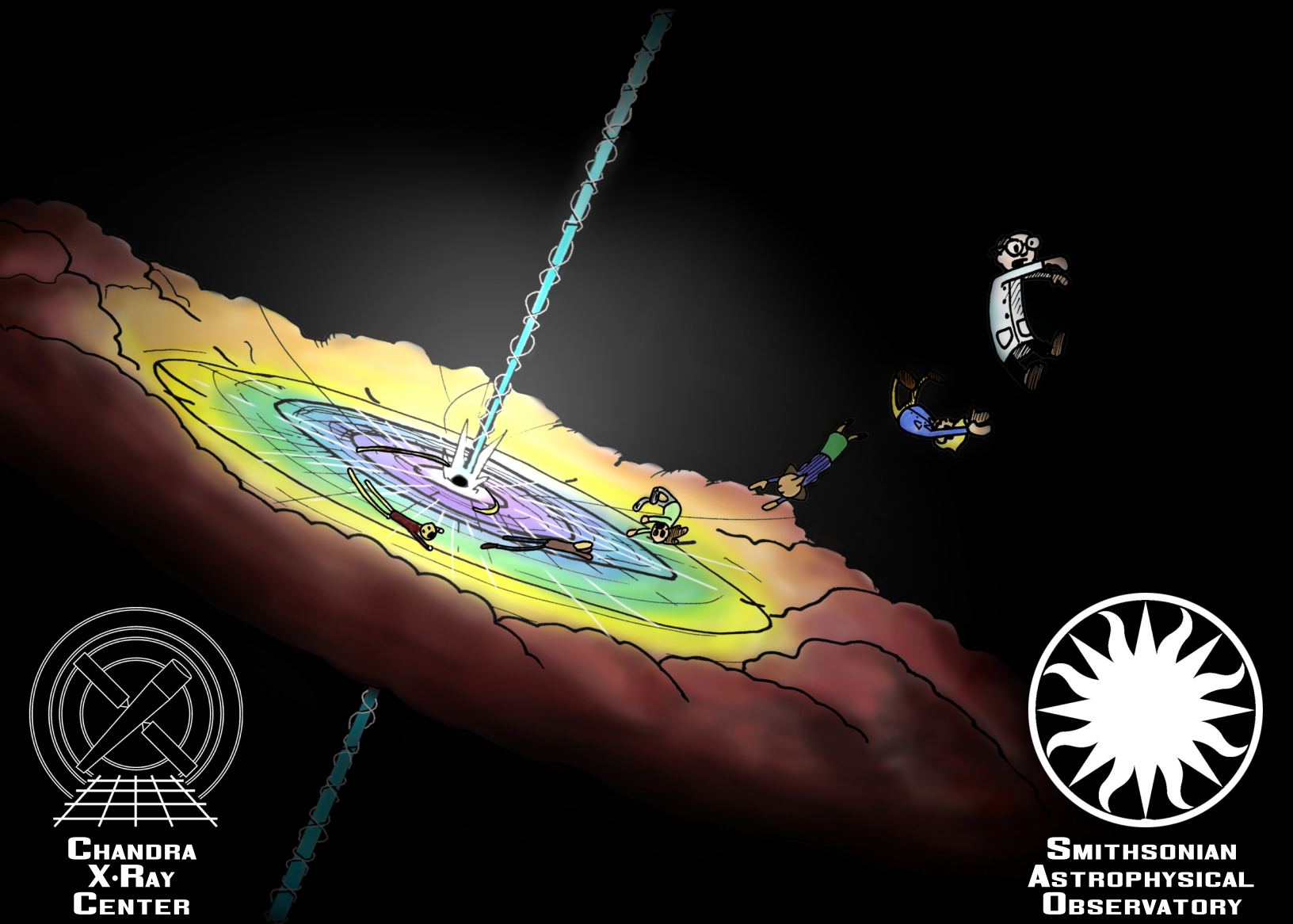
In X-Rays: From White Dwarfs to Quasars

July 13 - 15, 2010

Boston, Massachusetts

Boston Doubletree Guest Suites

Hosted by the Chandra X-Ray Center



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This Chandra science workshop is sponsored by the Chandra Directors Office (CDO) at the Chandra X-ray Center (CXC), part of the Smithsonian Astrophysical Observatory in Cambridge, MA.

Accretion Processes in X-Rays: From White Dwarfs to Quasars

July 13-15, 2010

Tuesday July 13

9:05 - 9:40 John Hawley
Simulations of Accretion Flows

9:40 - 10:15 Monika Moscibrodzka
Simulations of Low Luminosity Accretion Flows

10:15 - 10:35 Monica Young
Quasar Accretion Processes via Optical and X-ray Correlations

10:35 - 11:00 Coffee Break

11:00 - 11:35 Laura Brenneman
X-ray spectral signature of accretion onto a supermassive black hole

11:35 - 11:55 Thomas Boller
The relativistic reflection model interpretation for NLS1 soft X-ray lines

11:55 - 12:15 Kendrah Murphy
Modeling Compton Thick Obscuration in Accreting Supermassive Black Hole Systems

12:15-2:15 Lunch

2:15 - 2:50 Daniel Proga
Simulations of Outflows

2:50 - 3:10 Alexander Tchekhovskoy
Acceleration and Collimation of Relativistic Magnetized Jets

3:10 - 3:30 Posters - short presentations

3:30 - 4:00 Break / Posters

4:00 - 4:35 George Chartas
X-ray Signatures of Outflows in Quasars

4:35 - 4:55 Stuart Sim
The signatures of AGN accretion disk winds in X-ray spectra

4:55 - 5:15 Ryuichi Kurosawa
Large-Scale Radiation-Driven Outflows in Active Galactic Nuclei

5:15 - 5:35 Junfeng Wang
New Results from Chandra Imaging of Outflows in Seyfert Galaxies

5:35 - 5:55 Guido Risaliti
X-ray eclipses as probes of the inner structure of AGNs

Wednesday July 14

9:00 - 9:35 Barbara Ercolano
X-ray Irradiated Protoplanetary disks

9:35 - 9:55 Nancy Brickhouse
A New View of Accretion Shock Structure

9:55 - 10:15 Joel Kastner
Double (X-ray) Vision: the Close Binary, Accreting T Tauri System V4046 Sgr

10:15 - 10:35 Steven Cranmer
Testing Models of Coronal Heating, X-Ray Emission, and Winds from T Tauri Stars

10:35 - 11:00 Break / Posters

11:00 - 11:35 Chris Mauche
Accretion Processes in Magnetic CVs

11:35 - 12:10 Peter Wheatley
Accretion Processes in Non-magnetic CVs

12:10 - 12:30 Koji Mukai
Neither Thick Nor Thin: The Role of τ in Accreting White Dwarf Binaries

12:30 - 12:50 Manami Sasaki
Beam patterns and geometries of X-ray pulsars obtained from their pulse profiles

12:50 - 2:15 Lunch

2:15 - 2:50 Marina Romanova
Accretion onto magnetized stars

2:50 - 3:10 Akshay Kulkarni
Accretion through Instabilities and QPOs

3:10 - 3:30 Gerardo Luna
Hard X-ray Emission from the Accretion-Disk Boundary Layer in Symbiotic Binaries

3:30 - 4:00 Posters

4:00 - 4:20 Slavko Bogdanov
The Radio Millisecond Pulsar PSR J1023+0038: A Link to Low-Mass X-ray Binaries

4:20 - 4:40 Monika Balucinska-Church
The physics of the brightest low mass X-ray binaries and jet formation

4:40 - 5:00 Norbert Schulz
Accretion Phenomena in Accreting Neutron Stars - From Atoll to Z-Sources

5:00 - 5:20 Andreas Eckart
Signatures of Strong Gravity in the polarized infrared emission of Sagittarius A

5.30-7.30 Reception on the Roof

Thursday July 15

9:00 - 9:35 Phil Uttley
Variability and the Implications for Accretion

9:35 - 9:55 Jennifer Sokoloski
The Time Scales of Accretion-Disk Flickering

9:55 - 10:15 Ritaban Chatterjee
Disk-Jet Connection in the Radio Galaxies 3C 120 and 3C 111

10:15 - 10:35 Malgosia Sobolewska
Spectral States of AGN: Clues from Galactic X-ray Black Hole Binaries

10:35 - 11:05 Coffee Break

11:05 - 11:40 Randall Smith
The Potential of Future X-ray Missions

11:40 - 12:00 Gregory Sivakoff
A Treasure Trove of Transient X-ray Binaries in Centaurus A

12:00 - 1:30 Lunch

1:30 - 2:05 Jeroen Homan
Observational overview of states transitions in X-ray binaries

2:05 - 2:25 Julien Malzac
The X-ray corona and jet of Cygnus X-1

2:25 - 2:45 Michael Nowak
Cygnus X-1 as Simultaneously Observed by Every Flying X-ray Satellite

2:45 - 3:05 Anca Constantin
Empirical links between XRB and AGN accretion processes

3:05 - 3:30 Coffee

3:30 - 4:00 Omer Blaes - Summary

4:00 - 4:30 General discussion - John Raymond and Aneta Siemiginowska

Participant List

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Posters

- Laurent Bouchet - *INTEGRAL/SPI Observations Of X-Ray Binaries*
- Susmita Chakravorty - *Warm Absorbers Influenced By Soft Photons From AGN Accretion Disk*
- R . Di Stefano - *Progenitors Of Type Ia Supernova: Lessons From Chandra*
- Keigo Fukumura - *Modeling Of High-Velocity Ionized Outflows With MHD Accretion Disk Wind*
- Elena Gallo - *X-Raying Virgo: Down-Sizing In Black Hole Accretion*
- Javier Garcia - *Diagnostic Tools For X-Ray Observations Of Illuminated Accretion Disks*
- John Gizis - *X-Rays And Accretion In Young Brown Dwarfs*
- Daryl Haggard - *Accretion Activity In AGN: The X-Ray AGN Fraction To* $z = 0.7$ *From The ChaMP & SDSS*
- Takayuki Hayashi - *Discovery Of Spin-Modulated Central Energy Of A FeI K-Line From The IP V1223 Sgr*
- Margarita Karovska - *Unraveling Mira AB Accretion Mysteries*
- Brandon Kelly - *A Stochastic Model For The X-Ray Fluctuations Of Accreting Black Holes*
- Zhiyuan Li - *Chandra'S 10-Yr View Of The Supermassive Black Hole In M31*
- Min Long - *Complex Magnetic Geometry And Star-Disk Interaction*
- Anna Longinotti - *The Outflowing Gas In The Narrow Line Seyfert 1 Arakelian 564*
- Oliwia Madej - *A Broadened O VIII* Ly_α *Line In The UCXB 4U 0614+091*
- Herman Marshall - *Abundances In The Accreted Gas In SS 433*

- Michele Montgomery - *Connecting Accretion Disks To Earth-Moon-Sun System Via Retrograde Precession*
- Thomas Nelson - *Detection Of UV Flickering During The 2006 Outburst Of RS Oph*
- Thomas Rauch - *Model Atmospheres For Extremely Hot, Accreting White Dwarfs*
- Giuseppe Sacco - *Modeling The X-Ray Emission From Accretion Shock On CTTSs*
- Paul Sell - *The Discovery Of Diffuse X-Ray Nebulae Inflated By Jets From Circinus X-1*
- Mathieu Servillat - *The Nature Of Cataclysmic Variables In Globular Clusters*
- Roman Shcherbakov - *Quiescent X-Rays From Sgr A* Accretion*
- Alan Smale - *The Anomalous Low State Of LMC X-3: Traditional And Topological Analyses*
- Katrien Steenbrugge - *First Results From Our 2 Month Long Campaign On Mrk 509*
- Charles Steinhardt - *The Quasar Mass-Luminosity Plane*
- Alexander Tchekhovskoy - *Acceleration And Collimation Of Relativistic Magnetized Jets*
- Tim Waters - *Thermally Driven Winds From Stars And Disks*
- Lisa Winter - *X-Ray Outflows In The Swift BAT-Detected Seyfert 1s*
- Jingen Xiang - *The ADC And Disk Atmosphere Of 4U 1624-490 As Viewed By The Chandra HETGS*
- George Younes - *Chandra And XMM-Newton Observations Of NGC 4278. A LINER-Seyfert Connection?*

The Physics Of The Brightest Low Mass X-Ray Binaries And Jet Formation

Monika Balucinska-Church
University of Birmingham

A major test of whether we understand neutron star low mass X-ray binaries is whether we can explain the super-Eddington Z-track sources. We present a physical explanation of the sources based on assuming the extended nature of the accretion disk corona for which there is now considerable evidence. From extensive analysis we clearly identify radiation pressure and unstable nulear burning in addition to accretion physics. Strong radiation pressure diverts part of the accretion flow vertically so launching jets. Unstable nuclear burning in some cases combined with increasing mass accretion rate causes flaring. We identify the nature of the Island and Banana states in Atoll sources and of the differences between Atoll and Z-track sources.

The Radio Millisecond Pulsar PSR J1023+0038: A Link To Low-Mass X-Ray Binaries

Slavko Bogdanov
McGill Univeristy

It is commonly accepted that spin-up of neutron stars by accretion in low-mass X-ray binaries (LMXBs) leads to the formation of radio millisecond pulsars (MSPs). However, so far only circumstantial evidence has existed for the evolutionary connection between the two classes. The recently discovered binary MSP PSR J1023+0038 appears to be the long sought-after "missing link". Archival observations indicate that an accretion disk was present in this system as recently as 2001 but is absent now, suggesting the radio MSP has turned on after a recent LMXB accretion phase. I will present Chandra and XMM observations of this system and describe how they can offer unique insight into accreting neutron star systems and the poorly understood transition process from accretion to rotation power.

The Relativistic Reflection Model Interpretation For NLS1 Soft X-Ray Lines

Thomas Boller
MPE Garching

We have studied soft X-ray lines in Narrow-Line Seyfert 1 galaxies with XMM-Newton RGS data. Simple continuum models are ruled out, however, the relativistic reflection model by Ross & Fabian (2005) explains the data. The reflection component probes General Relativity in the strong gravity field limit. We need additional line emission from iron, oxygen, carbon or nitrogen to further improve the model. These lines probe General Relativity in the weaker field limit and extend the present Fe K studies. We show how to use GR effects to determine the location of the line emitting region. IXO is capable to extend the GR physics for the iron K lines to many lines in the soft X-ray band.

X-Ray Spectral Signatures Of Accretion Onto Supermassive Black Holes

Laura Brenneman
Harvard-Smithsonian Center for Astrophysics

The nature of accretion onto supermassive black holes is still not well understood. X-ray telescopes currently in orbit are providing us with some answers and even more questions. I will discuss recent X-ray observations of several active galaxies, focusing on spectral signatures of the accretion flow in the innermost disk, particularly the broad Fe K line. I will examine the prevalence of this emission feature in nearby AGN, as well as how we can use its morphology to determine the physical properties of the disk, and, in some cases, the angular momentum of the black hole. Finally, I will address correlations between the properties of the disk and the black hole, and the flow of gas into and out of these systems.

A New View of Accretion Shock Structure

Nancy Brickhouse
SAO

New results from the Chandra Large Program on TW Hydrae, a classical T Tauri star, reveal the impact of accretion on the structure of the stellar atmosphere. While the temperature and density at the accretion shock are in good agreement with simple accretion models, the expected post-shock settling gas has 30 times more mass than passed through the accretion front (Brickhouse et al. 2010, ApJ). Our discovery suggests a direct connection between accretion, coronal heating and perhaps acceleration of a young star's wind. In addition, line ratio diagnostics require at least two different absorption column densities. Assuming that the near-neutral accretion stream is the absorber, we derive the path length and constrain the geometry of the accreting system.

Warm Absorbers Influenced By Soft Photons From An AGN Accretion Disk

Susmita Chakravorty
Harvard Smithsonian CfA

A 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 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 the accretion disk spectrum.

X-Ray Signatures Of Outflows In Quasars

George Chartas
College of Charleston

We present results from the analysis of X-ray observations of quasars that confirm the presence of near-relativistic outflows. The signature of the fast outflow is revealed in X-ray broad absorption lines that appear significantly blueshifted. We have developed an outflow model that propagates the source flux through an outflowing plasma. Results from fits of this model to the X-ray spectra of BAL quasar APM08279 are presented. We confirm a correlation between the maximum outflow velocity and the X-ray photon index of APM08279 indicating that a likely driving mechanism is radiation pressure. We also use our outflow model to estimate the mass outflow rate and efficiency of the outflow of APM08279 and show that the quasar wind can significantly affect the formation of the host galaxy.

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

Ritaban Chatterjee
Yale University

In radio galaxies 3C120 and 3C 111, significant dips in the X-ray light curve are followed by ejection of superluminal knots. 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 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.

Empirical Links Between XRB And AGN Accretion Processes

Anca Constantin
James Madison University

An inflection in the relation between the X-ray photon index and the Eddington Ratio for nearby AGN was recently revealed independently by Constantin et al. (2009) and Gu & Cao (2009). Strikingly similar trends for X-ray binaries suggest analogous accretion physics across 6-7 orders of magnitude in black hole mass, and provide a novel tool for investigating accretion in the ambiguous low luminosity AGN. We present a fundamentally improved analysis of the Gamma-L/L_{Edd} relation for AGN with a sample of about 600 sources, based on the SDSS DR7 and the Chandra Source Catalog. Our refined optical and X-ray fits allow rigorous investigation of the consistency of multiple M_{bh} estimates and dependence on host parameters, and thus the best constraints of the Gamma-L/L_{Edd} relation.

Testing Models Of Coronal Heating, X-Ray Emission, And Winds From T Tauri Stars

Steven Cranmer
SAO

Pre-main-sequence stars exhibit complex magnetic activity, accretion, and various kinds of mass outflow. The impact of plasma onto the stellar surface from magnetospheric accretion streams, can be a dominant source of energy and momentum in the upper atmospheres of T Tauri stars. We present models in which turbulence is induced by these impacts, and waves then spread out over the surface to energize 3 distinct regions: (1) shocked plasmas directly under the accretion "hot spots," (2) stellar winds that are accelerated along open magnetic flux tubes, and (3) closed magnetic loops that resemble the Sun's coronal active regions. For 14 well-observed stars in the Taurus-Auriga region, model predictions for X-ray luminosities and mass loss rates are in general agreement with observations.

Progenitors of Type Ia Supernova: Lessons from Chandra

Rosanne DiStefano
CfA

Type Ia supernovae are triggered when a white dwarf reaches the Chandrasekhar mass. We show that all progenitor models require the white dwarf to pass through an epoch during which it accretes and burns mass. During this epoch, the white dwarf could have the appearance of a luminous supersoft X-ray source (SSS). A decade of extragalactic surveys with Chandra finds far too few SSSs to support progenitor models. We explore what this discrepancy tells us about nuclear burning white dwarfs and the search for Type Ia progenitors in our own and other galaxies.

Signatures of Strong Gravity in the Polarized Infrared Emission of Sagittarius A

Andreas Eckart
University of Cologne

Several simultaneous global campaigns have revealed millimeter to X-ray flare emission of the Sgr A* counterpart associated with the supermassive 4 million solar mass black hole at the Galactic Center. Using a matched filter approach we find that NIR polarimetry shows signatures of strong gravity that are statistically significant against randomly polarized red noise, allowing us to derive spin and inclination information. In addition the flare activity of SgrA* can fully be accounted for by a combined synchrotron self Compton (SSC) and adiabatic expansion model with source components peaking at a few THz.

X-ray irradiated Protoplanetary Discs

Barbara Ercolano
University of Exeter

Star and planet formation are intimately linked to the evolution and dispersal of protoplanetary discs. Accretion onto a young stellar object (YSO) is probably driven by magnetorotational instabilities (MRI) in the disk and planets form from the leftovers of this accretion process. X-rays from the YSO provide ionization which is a key ingredient for MRI to work, and determine the size and location of the dead-zone which is the likely site of terrestrial planet formation. The final disk dispersal is also likely due to X-ray irradiation via photoevaporation of the inner disk. I will present recent calculations of the ionization and thermal structure of discs, illustrating the key role played by X-ray irradiation in the evolution and dispersal of the these planetary nurseries.

Modeling of High-Velocity Ionized Outflows with MHD Accretion Disk Winds

Keigo Fukumura
UMBC/CRESST/NASA

We discuss X-ray-weak, optically-bright QSO absorbers with very dense, extremely high (if not relativistic) outflow velocities in the context of a self-similar MHD accretion-disk wind model. We find, under a typical QSO SED, that C iv and Fe xxv ions can be magnetically accelerated up to $0.1c$ and $0.6c$ respectively with very high column density on the order of $10^{23} - 10^{24}$ cm^{-2}, also showing correlations among X-ray spectral index, optical brightness, line of sight and so on.

X-raying Virgo: Down-Sizing in Black Hole Accretion

Elena Gallo
MIT

I will present new results from AMUSE-Virgo, a Chandra survey of early type galaxies in the Virgo cluster. After accounting for contamination from nuclear low mass X-ray binaries, we conclude that between 24-34 of the galaxies in our sample host a X-ray active supermassive black hole. This sets a firm lower limit to the black hole occupation fraction in nearby bulges within a cluster environment. Taking into account selection effects, we find that the average Eddington-scaled X-ray luminosity scales with black hole mass to the power -0.62. This represents the first observational evidence for down-sizing of black hole accretion: the fraction of active galaxies, defined as those above a fixed X-ray Eddington ratio, decreases with increasing host galaxy mass.

Diagnostic Tools for X-ray Observations of Illuminated Accretion Disks

Javier Garcia
CUA / NASA-GSFC

We present a grid of reflected spectra produced with new accretion disk models that can be used to analyze X-ray observations of accreting systems. Our models are calculated in high resolution, comparable to *Chandra* gratings. This preliminary set of models is provided as an XSPEC table covering different values of ionization parameter, Solar iron abundance and photon index for the illuminating spectrum. These models include the most complete and recent atomic data for the inner-shell of the iron and oxygen isonuclear sequences. Here we analyze simulated CCD observations from these models, and study the dependence of different spectral signatures on the various model parameters.

X-Rays and Accretion in Young Brown Dwarfs

John Gizis
University of Delaware

We have used Chandra to observe two young very low mass brown dwarfs in the 8 Myr old TW Hya Association, one of which is accreting from a circumstellar disk while the other is not. We combine our data with Chandra and XMM data on the other known association members to discuss X-ray emission from young brown dwarfs. We discuss the evidence that substellar X-ray emission is from a corona and that the accreting brown dwarfs have low X-ray luminosity. Accretion onto these 0.025 solar mass "stars" produces strong ultraviolet emission but not X-Rays.

Accretion Activity in AGN: the X-ray AGN Fraction to z=0.7 from the ChaMP & SDSS

Daryl Haggard
University of Washington

The most reliable signature of accretion in active galaxies is strong X-ray emission. To study the field AGN fraction (F_{AGN}) to z = 0.7, we employ $> 100,000$ SDSS galaxies and ∼1,600 Chandra X-ray detections. ChaMP volume completeness maps allow us to investigate F_{AGN} as a function of absolute magnitude, X-ray luminosity, redshift, and color/morphological type for samples complete in redshift and i-band magnitude (Mi). Conservatively defining AGN via $\log L_x(0.5-8\mathrm{keV}) > 42$, and weighting by the optical galaxy luminosity function, we find that about 1 in 150 galaxies with $-18 >$ Mi > -26 host an active nucleus. Such fractions pertain directly to the AGN duty cycle. For bins comparable to previous cluster studies, we find no significant difference between the field and cluster AGN fractions.

Simulations of Accretion Flows

John Hawley
University of Virginia

Observations are providing detailed evidence that black hole accretion systems are dynamic. X-ray binaries and AGN are strongly variable; the timescales are comparable to the dynamical times near the central black hole. This variability must arise from processes that occur within the disk. Numerical simulations provide a way to investigate the dynamics of accretion disks directly with far fewer limitations compared to analytic models. Simulation results to date have revealed details about the nature of the internal disk stress, time-dependent properties of disks, magnetic disk dynamos, and jet launching mechanisms. The observational implications of these simulations can be investigated using simple emission and absorption models coupled with relativistic ray tracing.

Discovery of Spin-Modulated Central Energy Of A FeI K-Line From The IP V1223 Sgr

Takayuki Hayashi
ISAS/JAXA

We report on our analysis of the *Suzaku* data of the intermediate polar V1223 Sagittarii. We sorted the data according to spin phase of the WD and fitted the spectra with a model including a 6.4 keV iron line. Owing to a large effective area and high energy resolution of XRT and XIS systems, we detected significant rotational modulation of its central energy. The energy shift is largest at the rotation-minimum phase of the X-ray intensity, where the iron line spectrum can be better reproduced with two narrow Gaussians; one is at 6.40 keV and the other is at $6.29^{+0.06}_{-0.04}$ keV with an equivalent width of 28^{+17}_{-12} eV. These components are interpreted as originating from the pre-shock accreting matter and the WD surface, respectively, produced via fluorescence.

An Observational Overview Of State Transitions In X-Ray Binaries

Jeroen Homan
MIT/MKI

I will present an overview of the various spectral and variability states as observed in neutron star and black hole X-ray binaries. These states are thought to reflect different modes of accretion onto compact objects. Particular attention is given to transient systems, which often show multiple state transitions during their outbursts as the result of large (orders of magnitude) changes in their mass accretion rates. The broad-band X-ray spectral evolution during outbursts will be the central topic of the talk and I will discuss how other properties, such as X-ray variability and jet/wind outflows, relate to this.

Unraveling Mira AB Accretion Mysteries

Margarita Karovska
SAO

Symbiotics are fascinating accreting binaries with a key evolutionary importance as potential progenitors of a fraction of PN, and SN type Ia. Mira AB is the nearest symbiotic with an AGB star and a wind accreting companion in which both components and the region of interaction can be studied using high-angular resolution. Observations from X-ray to radio separated the accretor from the AGB star, allowing detailed study of each component and of the accretion in the system. The results include a discovery of a "bridge" showing gravitational focusing of the AGB wind, whereby the components exchange matter directly. We discuss results from hydrodynamical models of focused wind accretion, and the impact on understanding of accretion processes in other interacting systems.

Double (X-ray) Vision: the Close Binary, Accreting T Tauri System V4046 Sgr

Joel Kastner
Rochester Institute of Technology

Over the past decade, Chandra and XMM-Newton X-ray gratings spectroscopy of young stars within ~ 150 pc of Earth have yielded key insight into low-mass, pre-main sequence (T Tauri) star accretion processes. The nearby (D ~ 70 pc) binary T Tauri system V4046 Sgr (age ~ 10 Myr, period ~ 2.4 days) is a particularly intriguing object in this regard. Its twin 0.9 Msun stars are evidently still actively accreting material from a dusty, circumbinary molecular disk. We have obtained a sequence of XMM/RGS observations covering the binary orbital period. This sequence provides high-quality X-ray spectral diagnostics of T Tauri accretion shocks and coronal emission, as well as the opportunity to ascertain the dependence of such diagnostics on emission region viewing geometry.

A Stochastic Model for the X-ray Fluctuations of Accreting Black Holes

Brandon Kelly
Harvard-Smithsonian CfA

I will present a new statistical model for the X-ray fluctuations of accreting black holes. Our model is consistent with the broken power-law form for power spectral densities of these objects. However, because the model is formulated in the time domain via a set of stochastic differential equations, fitting the model is also done in the time domain via a likelihood-based approach. This makes it superior to frequency-domain based methods, in that it is not biased by red noise leak, aliasing, irregular sampling, and measurement error. We apply our model to the RXTE X-ray lightcurves of 10 local AGN and show that our model is both a good fit to the data, and is able to recover previous results with increased accuracy.

Accretion Through Instabilities and QPOs

Akshay Kulkarni
CfA

We present 3D simulations of the Rayleigh-Taylor instability at the accretion disk-magnetosphere boundary. The instability produces tall, thin tongues of plasma that penetrate the magnetosphere in the equatorial plane, depositing matter much closer to the stellar equator than magnetospheric accretion does. It appears for relatively small misalignment angles ($<\sim$ 30 degrees) between the star's rotation and magnetic axes, and is associated with moderate to high accretion rates. The light curves during unstable accretion are much more chaotic than those during stable accretion, due to the stochastic behavior of the tongues. However, the power spectra show some signs of quasi-periodic variability, since the rotation frequency of the tongues is close to the inner-disk orbital frequency.

Large-Scale Radiation-Driven Outflows in Active Galactic Nuclei

Ryuichi Kurosawa
Cornell University

We present the results of multi-dimensional hydrodynamical simulations for slowly rotating gas under the influence of the gravity of a supermassive black hole and being irradiated by a thin UV accretion disk and a spherical X-ray corona of an AGN. The accretion luminosity of the system is coupled to the accretion rate which is assumed to be equal to the mass inflow rate at the radius of about 0.01 pc. We will discuss a possibility of a steady-state inflow-outflow solution with the mass inflow rate close to and even exceeding the Eddington limit. We will also briefly discuss the energy, momentum, and mass feedback efficiencies of the AGN outflow that is driven by radiation on a relatively large scale (from $\sim$ 0.01 to $\sim$ 10 pc).

Chandra'S 10-Yr View of the Supermassive Black Hole in M31

Zhiyuan Li
Smithsonian Astrophysical Observatory

M31 hosts a supermassive black hole (SMBH) that is well known for its extreme radiative quiescence. Over the past decade, the Chandra X-ray observatory has pointed to the center of M31 about 100 times and accumulated a total exposure of nearly 900 ks. Based on these observations, we present an X-ray study of the temporal behavior of the SMBH. We report an outburst on January 6, 2006, during which the SMBH became about 100 times brighter. After the outburst, the SMBH apparently entered a relatively active state, exhibiting an average X-ray luminosity about 7 times higher than before 2006. The outburst, similar in relative amplitude to those found in the SMBH of our Galaxy, may be explained by an episodic ejection of relativistic plasma inflated by magnetic fields in the accretion disk.

Complex Magnetic Geometry and Star-Disk Interaction

Min Long
University of Illinois at Urbana-Champaign

Magnetic field with significant non-dipolar components has been suggested to classical T Tauri stars, white dwarfs and accreting pulsars by recent measurements or modeling. We previously investigated accretion disk in quadruople field. Now we present results of the first simulations of disk accretion in octuople field. Matter flows along paths between loops of field lines and forms double ring accreting spots, leading to complex behavior of light curves. Two possible mechanisms for producing phase shifts in light curves are studied: (1) change of the stars intrinsic magnetic field and (2) variation of the accretion rate, causing the disk to interact with different magnetic components. The numerical model has been applied to CTTSs V2129 Oph and BP Tau for comparison with observations.

The Outflowing Gas in the Narrow Line Seyfert 1 Arakelian 564

Anna Longinotti
MIT Kavli Institute

Narrow Line Seyfert 1 Galaxies are thought to be powered by low mass supermassive black holes with high accretion rate. They present extreme properties in the X-ray domain (fast X-ray variability, steeper power law continua and spectral complexity in the Fe K band). Therefore these objects may provide insights on a particular regime of accretion. I will present the Chandra HETG spectra of one of the brightest NLS1, Arakelian 564, which shows a multi-component warm absorber, and I will discuss the results from our analysis in the contest of previous findings on this source and of the general properties of NLS1.

Hard X-ray Emission from the Accretion-Disk Boundary Layer in Symbiotic Binaries

Gerardo Luna
SAO/CfA

Until a few years ago, the paradigm established that symbiotic stars emit primarily soft or supersoft X-rays, based on the detection of 17 sources with ROSAT. However, this picture radically changed when INTEGRAL discovered hard X-ray emission up to at least 50 keV from RT Cru in 2005. The observed spectra of these extraordinary systems can be interpreted as optically thin emission from an accretion disk boundary layer. The high temperatures observed imply high masses for the accreting white dwarfs, making these systems candidates for SNIa progenitors. I will show results obtained from broad-band spectroscopy of RT Cru using Suzaku and variability over different time scales using a Swift monitoring program. I will discuss also the most recent discoveries from a Swift fill-in program.

A Broadened O VIII Ly_α line in the UCXB 4U 0614+091

Oliwia Madej
Astronomical Institute, Utrecht University

Ultra-compact X-ray binaries consist of a neutron star or black hole that accretes material from a white dwarf-donor star. In the case of 4U 0614+091 oxygen-rich material from a CO or ONe white dwarf is flowing to the neutron star. This oxygen-rich disk can reflect X-rays emitted by the neutron star giving a characteristic emission spectrum. We have analyzed RGS and MOS spectra of 4U 0614+091 obtained by the XMM-Newton satellite. We detect a broad emission feature at around 0.7 keV in both instruments. We interpret this feature as O VIII Ly_α emission caused by reflection of X-rays off highly ionized oxygen, in the strong gravitational field close to the neutron star.

The X-Ray Corona and Jet of Cygnus X-1

Julien Malzac
CESR (CNRS/Universit de Toulouse)

It is well known that the temperature and optical depth of the Comptonising electrons of the corona of black hole binaries can be measured using X-ray spectroscopy. We emphasize recent developments in the modeling of high energy radiation processes which allow us to constrain other important physical parameters of the corona, such as the strength of magnetic field, or the temperature of the ions. In the prototypical source Cygnus X-1, the results appear to challenge current accretion models.

Abundances in the Accreted Gas in SS 433

Herman Marshall
MIT Kavli Institute

Using the Chandra High Energy Transmission Grating Spectrometer, we have measured the abundances in the relativistic jets of SS 433. These abundances are likely to represent those in the accretion disk or the wind from the companion. We find super-solar abundances of most elements. Particularly interesting is that Ni is highly over-abundant. We suggest that the supernova that created the compact object deposited this Ni-rich material onto the surface of the companion star.

Accretion Processes in Magnetic Cataclysmic Variables

Christopher Mauche
LLNL

I will give a presentation based largely on X-ray spectroscopic observations of magnetic cataclysmic variables, interacting binaries in which the accretion flow is controlled by the $10^5 - 10^8$ G magnetic field of the white dwarf. I will necessarily concentrate on the relatively few systems for which we have good data (e.g., AM Her, EX Hya, AE Aqr) and physics aspects that are unique to such systems, such as high plasma densities, photoionization, and strong irradiation and fluorescence of the white dwarf surface.

Connecting Accretion Disks to Earth-Moon-Sun System via Retrograde Precession

Michele Montgomery
University of Central Florida

In this talk, we show how the net tidal torque by a secondary on a misaligned accretion disk, like the net tidal torque by the Moon and the Sun on the equatorial bulge of the spinning and tilted Earth, can be a source of retrograde precession in Cataclysmic Varable (CV), protostellar, protoplanetary, X-ray binary, quasar and black hole systems. To obtain accurate values of precession, the accretion stream and disk features need to be considered. From our 3D hydrodynamic simulations of non-magnetic CVs, we find that either an inner ring or an inner spiral density wave may be present and both produce nearly the same retrograde precessional value. Our recent work suggests that tidal torques should be common to a variety of systems, implying that other parallels may also exist.

Neither Thick Nor Thin: The Role of τ in Accreting White Dwarf Binaries

Koji Mukai
NASA/GSFC/CRESST & UMBC

The literature on X-ray emissions from accreting white dwarf binaries usually focuses on either the optically thin regime ($\tau \ll 1$) or the optically thick ($\tau \gg 1$) regime. Here we consider an emission region in the transitional regime ($\tau \sim 1$): what set of parameters would procduce such a region, and what would be the results? In particular, we argue that Compton cooling of a $\tau \sim 1$ region may play a significant role in shaping the X-ray spectra of some accreting white dwarf binaries, when external seed photons are present. We will discuss X-ray data on dwarf novae in outburst, and those of RS Oph and T CrB, two recurrent novae in a symbiotic system with contrasting X-ray properties, in this context.

Modeling Compton Thick Obscuration in Accreting Supermassive Black Hole Systems

Kendrah Murphy
MIT Kavli Institute

We introduce MYTorus, a spectral-fitting tool that self-consistently models the reprocessed X-ray emission from the putative torus in AGN. The model is constructed from fully relativistic Monte-Carlo calculations of absorption, scattering, and fluorescent line emission within the circumnuclear material, for column densities covering the Compton-thin to Compton-thick regimes. The X-ray reflection continuum and the equivalent width of the Fe K line core, as well as the shape and relative magnitude of its Compton shoulder, are important diagnostics of the geometry, column density, and inclination angle of the reprocessor. MYTorus allows one to extract such physical information from X-ray data of accreting supermassive black hole systems, which cannot be obtained via ad-hoc modeling.

Detection of UV flickering During the 2006 Outburst of RS Oph

Thomas Nelson
UMBC and NASA/GSFC

We present UV lightcurves of RS Oph obtained during the 2006 outburst with XMM-Newton. On April 08 (day 54), we detect brightness fluctuations on timescales of minutes, reminiscent of the optical accretion disk flickering observed in CVs. The power spectrum of this lightcurve can be characterized by a power law at low frequencies with Γ = -1.6 +/- 0.4. This value is consistent with those found for the optical flickering in T CrB and RS Oph in quiescence. We discuss possible origins of this variability, including that it is due to accretion disk flickering. If this is the case, then the disk in RS Oph must have reformed quickly after the nova. This would help resolve the apparent contradiction of accretion disk destruction and early jet production during the outburst.

Cygnus X-1 as Simultaneously Observed by Every Flying X-ray Satellite

Michael Nowak
MIT

In April 2008 we observed Cyg X-1 with every X-ray satellite: Chandra, XMM, Suzaku, RXTE, Swift, INTEGRAL. The resulting spectra constrain corona and X-ray jet models of black hole hard states. We examine if the > 10 keV spectral hardening is solely due to reflection, or whether it indicates a complex underlying continuum (non-thermal Comtponization or jet X-ray emission). We decompose the Fe line region into narrow wind emission and absorption, and relativistically broadened disk emission. We discuss often ignored complexities (i.e., variable and ionized absorption, dust scattering), and consider detector cross-calibration. We point out features that appear robust (e.g., a relativistically broadened line with inner radius $< 40GM/c^2$), and the issues that are still open for debate.

Simulations of Mass Outflows from Accretion Powered Sources

Daniel Proga
University of Nevada Las Vegas

X-rays emitted by many types of objects are best explained by mass accretion. However, we have very little, if any, direct observational evidence that gas indeed accretes. Instead we often observe the opposite, i.e., mass outflows. The outflows have been detected both directly, e.g., as "loud" radio jets and indirectly, e.g., as "quiet" winds absorbing in X-ray spectra lines. Therefore studying the outflows is one of the key routes to understanding accretion processes. Here, I briefly review theories of outflows. I will also show a few examples of simulations of the outflows and examples of synthetic X-ray spectra predicted by the simulations. I finish with a few remarks on applications of these theoretical results to YSOs, CVs, X-ray binaries, and QSOs.

Model Atmospheres for Extremely Hot, Accreting White Dwarfs

Thomas Rauch
Kepler Center for Astro and Particle Physics

Accreting white dwarfs in cataclysmic variables are extremely hot and, thus, very X-ray-luminous objects. Present X-ray missions like Chandra and XMM-Newton provide excellent spectra of these, e.g., in observations of burst phases of novae. A reliable spectral analysis of these white dwarfs requires adequate NLTE model atmospheres. The Tuebingen Non-LTE Model-Atmosphere Package (TMAP) can calculate such model atmospheres and spectral energy distributions (SEDSs) at a high level of sophistication. We present new grids of models, calculated in the relevant parameter range of novae and supersoft X-ray sources (SSS) and show some examples of their application.

X-Ray Eclipses as Probes of the Inner Structure of AGNs

Guido Risaliti
SAO

X-ray occultations due to clouds crossing the line of sight in time scale of a few hours are common among local AGNs. I will review the observational data supporting this scenario and discuss its two most relevant consequences: (1) the measurement of the size of the X-ray emitting region, and of the main physical parameters of the X-ray absorber, and (2) a new way of testing relativistic effects in AGN X-ray spectra by analyzing and comparing the emission (in particular, the iron Kalpha line) at different phases during the eclipses.

Accretion Onto Magnetized Stars

Marina Romanova
Cornell Universty

I will discuss different aspects of disk accretion onto stars with a dipole (or more complex) magnetic fields obtained in axisymmetric and global 3D MHD simulations, which can be applicable to different types of stars. I will show the magnetospheric flow pattern and discuss the properties of hot spots. If the magnetic flux is compressed by the disk into the x-type configuration, the outflows may blow out from the disk-magnetosphere boundary. Outflows can be one-sided if the star possesses a complex field. I will also show results of MRI-driven accretion onto magnetized stars, where X-ray flares are expected from the disk-magnetosphere boundary. Variability on a wide range of time-scales will be discussed.

Modeling the X-Ray Emission from Accretion Shock on CTTSs

Giuseppe Sacco
Rochester Institute of Technology

X-ray spectroscopic observations of classical T Tauri stars show the presence of a soft X-ray component produced by plasma at T=2-3 MK and $n_e = 10^{11} - 10^{13}$ cm^{-3}. This emission is probably due to the accretion process, but a physical model that explains all the observational results has not yet been formulated. We performed a large set of 1D HD simulations of the accretion shock on the surface of a young star with the aim of investigating the observability of the X-ray emission from the shock-heated plasma. We performed further 2D MHD simulations of the accretion stream impacting on the stellar surface to study the stability and the dynamics of the accretion shock for cases in which the plasma thermal pressure exceeds that of the magnetic pressure.

Beam Patterns and Geometries of X-Ray Pulsars Obtained from Their Pulse Profiles

Manami Sasaki
University of Tuebingen, Germany

We present energy- and luminosity-dependent beam patterns of the accreting neutron stars in the transient Be/X-ray binary systems A 0535+26, EXO 2030+375, and 4U 0115+63 and their geometries. We have analyzed the pulse profiles of these X-ray pulsars using the pulse profile decomposition method, which enables us to find two symmetric pulse profiles for the two magnetic poles of the neutron star. We find that the magnetic fields of the neutron stars are slightly distorted in all three systems. The beam patterns are interpreted in terms of a geometrical model of a hollow column that includes the formation of a halo around the accretion column and that takes relativistic light deflection into account.

Accretion Phenomena in Accreting Neutron Stars - From Atoll to Z-Sources

Norbert Schulz
MIT

High resolution X-ray spectra provide new evidence that accretion disks in neutron star binaries exhibit large variety of ionizations defining accretion geometry and feed back processes. Our analysis of line and edge properties reveal the outer and inner disk of the ultra-compact binary 4U 0614+091, a thin accretion disk atmosphere in 4U 1822-37, an extended ADC in Cyg X-2, and other distinct accretion disk emission and absorber properties in atoll and Z-sources, Our recent survey of narrow line Fe K shell fluorescence in X-ray binaries shows that Fe K emissions originate from mostly spherically distributed material and are rare in low-mass X-ray binaries. In conjunction with continuum properties these results allow us to draw a more coherent picture of mass accretion in these sources.

The Discovery of Diffuse X-ray Nebulae Inflated by Jets from Circinus X-1

Paul Sell
University of Wisconsin-Madison

We analyzed a deep Chandra imaging observation of the galactic neutron star X-ray binary, Circinus X-1, taken in 2009 while the source was in a very low flux state. This new high S/N observation reveals that earlier detections of faint extended features in a Chandra 2005 gratings observation are surface brightness peaks at the edges of two larger diffuse X-ray regions NW and SE of Circinus X-1. We will present detailed imaging and spectral analysis of the diffuse emission, leading us to the conclusion that this microquasar is driving a strong shock into the ISM as it blows up the large scale radio lobe surrounding it. On even larger scales, we recover the dust scattering halo of the point source and derive the scattering fraction and angular dependence of the scattering cross section.

The Nature of Cataclysmic Variables in Globular Clusters

Mathieu Servillat
Harvard-Smithsonian CfA

Globular clusters (GCs) are old, dense stellar systems which harbour an excess of X-ray sources. These are mainly close binaries and part of them can be produced through dynamical encounters in the dense core of GCs. The populations of cataclysmic variables (CVs) in GCs and in the field possibly show different properties (magnetic nature, mass of the white dwarf). I present here the Chandra observation of the GCs M13 and M22, and a multiwavelength analysis of 3 CV candidates hosted by those clusters. I will report the detection of a possible dwarf nova outburst in M13. Optical spectroscopy (VLT/FORS1) of 2 CV candidates in M22 confirms their CV nature. The short orbital period of CV1 (1h) possibly indicates the presence of a low metallicity secondary. CV2 could be an intermediate polar.

Quiescent X-rays from Sgr A* Accretion Flow: Model Fits Observations

Roman Shcherbakov
Harvard University

We propose an accretion model onto the Galactic Center (GC) black hole (BH), which incorporates feeding from stellar winds and conductive feedback. The surface brightness profile within 6 from Sgr A* is obtained from 1Ms Chandra observations of GC. The observations are matched well by the simulated brightness profile even given the small set of model parameters. Collisionless thermal conduction effectively limits the Sgr A* accretion rate to $< 1\%$ of the nave estimate. Thus the model reconciles the low accretion rate across Sgr A* horizon with the large amount of plasma available far from the BH. The point source likely produced by SSC is revealed in the center with high confidence. Its luminosity (several 10^{32} erg/s) provides additional constraint on the flow close to the BH.

The Signatures of AGN Accretion Disk Winds in X-Ray Spectra

Stuart Sim
MPA, Garching

Highly-ionized fast accretion disk winds have been suggested as an explanation for a variety of observed features in the X-ray spectra of Active Galactic Nuclei. Simple estimates suggest that these outflows have mass-loss rates sufficiently large to make them important for understanding the accretion process and perhaps even making the link between supermassive black holes and their host galaxies. However, properly quantifying the outflow signatures is a challenging task that requires realistic modelling of the spectrum. We will present calculations of synthetic spectra for both simply-parametrized outflow models and hydrodynamical simulations for line-driven AGN disk winds, focusing on how well such models reproduce the spectroscopic features observed in the X-ray spectra of real AGN.

A Treasure Trove of Transient X-ray Binaries in Centaurus A

Gregory Sivakoff
University of Virginia

Soft X-ray transients, a class of X-ray binaries (XRBs) whose compact objects are largely black holes, were expected to be common among bright XRBs in nearby galaxies; however observations of nearby early-type galaxies with Chandra revealed a population dominated by more persistent sources. As part of the Cen A Chandra Very Large Project, we have performed the deepest X-ray observations of XRBs in an early-type galaxy, revealing the largest active XRB population in any galaxy to date. We discuss the discovery of 10 transient XRBs in Cen A that may harbor black holes, ~ 40 weaker transient candidates, and another ~ 100 variable sources. After comparing their behaviors to XRBs in other galaxies, including our own, we consider prospects for studying extra-galactic XRBs in the next decade.

The Anomalous Low State of LMC X-3: Traditional and Topological Analyses

Alan Smale
NASA/GSFC

Archival RXTE data from LMC X-3 reveal a dramatic, extended low state in Dec'03-Mar'04, unprecedented in its low luminosity (4x fainter than any low/hard state) and long duration. During this anomalous low state (ALS) no significant variability is seen, and the spectrum is well fit using a powerlaw of index 1.7. We examine the long-term variability of LMC X-3 using conventional and topological methods, and show that - with the exception of the ALS itself - the source behavior can be described using a nonlinear dynamics system known as the Duffing oscillator, implying that the accretion disk in LMC X-3 is a driven, dissipative system with two solutions competing for control of its time evolution. We briefly discuss the value of this and other topological methods in accretion disk studies.

The Potential of Future X-ray Missions

Randall Smith
SAO

Accretion studies will be dramatically changed by the next generation of high-spectral resolution X-ray observatories such as Astro-H and the International X-ray Observatory (IXO). Astro-H will provide the first high-resolution data around the key 6 keV Fe K complex combined with a significantly larger area for spectroscopy at lower energies and simultaneous hard X-ray coverage. IXO will expand these capabilities with higher resolution across the entire 0.3 - 12 keV band combined with hard X-ray capabilities. Taken together, these capabilities will enable spectroscopic studies, including time-resolved studies, that are simply impossible today. I will discuss the mission parameters and some of the science of accretion disks expected to be revealed by these upcoming missions.

Spectral States of AGN: Clues from Galactic X-Ray Black Hole Binaries

Malgosia Sobolewska
SAO

We compare spectral energy distributions of AGN and Galactic X-ray black hole binaries (GBH). We introduce a α_{GBH} parameter defined for GBHs between 3 and 20 keV. It corresponds to the X-ray loudness, α_{OX}, used to describe spectra of AGN. The α_{GBH} clusters around 1, 1.5 and 2, which correspond to the hard, very high/intermediate and soft spectral states, respectively. We conclude that majority of the observed Type 1 AGN are in the spectral state corresponding to the very high/intermediate state of GBHs. The accretion disk/corona physics is similar in both AGN and GBHs. Based on a representative outburst of a GBH, GRO J1655-40, we simulate AGN spectra and show that LINERs may correspond to the hard state GBHs, while Type 1 quasars may be counterparts of the soft state GBHs.

The Time Scales of Accretion-Disk Flickering

Jeno Sokoloski
Columbia University

How much can one determine about the nature of an accreting object from a featureless power spectrum of its light curve? Using the accreting white dwarf in Mira AB as a case study, I will argue that the approximate Kepler frequency in the innermost accretion disk, and thus the nature of the compact object, can be determined from the RMS variability of the disk flickering within a particular range of time scales. I will discuss our results for Mira in the context of other accreting white dwarfs and briefly compare the flickering from accreting white dwarfs to that from X-ray binaries and AGN.

First Results from Our 2 Month Long Campaign on Mrk 509

Katrien Steenbrugge
Instituto de Astronomia, UCN

I will present the average RGS and LETGS spectrum obtained during a two month long high-spectral resolution monitoring campaign on Mrk 509 to detect spectral variability with varying X-ray luminosity. The RGS data were taken in multi-pointing mode, resulting in a spectrum with no gaps either due to bad pixels or CCD gaps. The average RGS spectrum is the deepest spectrum yet of a Seyfert 1 galaxy, allowing for a detailed study of the warm absorber and absorption from ISM of our own Galaxy. The accurate determination of the line width allows for a stringent comparison between the velocity structure observed in the UV and X-ray, as does the simultaneous obtained deep HST-COS spectrum. We do detect absorption from O I and Fe I, probably in the form of dust, from the host galaxy.

The Quasar Mass-Luminosity Plane

Charles Steinhardt
Harvard University

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.

Acceleration and Collimation of Relativistic Magnetized Jets

Alexander Tchekhovskoy
Harvard

Despite the enormous range of central compact object masses in active galactic nuclei, X-ray binaries, and gamma-ray bursts, all these systems can produce relativistic jets, with a wide range of Lorentz factors and opening angles. In my talk, I will discuss the physics of magnetized jet acceleration and will show that the acceleration and collimation of jets are intimately related.

Variability and the Implications for Accretion

Phil Uttley
University of Southampton

X-ray variability is an ubiquitous feature of accreting compact objects which conveys valuable information about the accretion process. I will discuss the evidence for an accretion origin of the variability in X-ray binaries and AGN, and show that much of this variability is generated in the "standard" optically thick accretion disk, even though the emission itself may originate from the optically thin corona or boundary layer (in the case of neutron star accretion). The fastest variations can now be used to map the accretion flow directly through X-ray reverberation, offering exciting new prospects for future large-area X-ray telescopes such as IXO.

New Results from Chandra Imaging of Outflows in Seyfert Galaxies

Junfeng Wang
Harvard-Smithsonian CfA

Both theoretical and observational evidence points to the importance of nuclear feedback in shaping the accretion onto the SMBHs at the nuclei of galaxies. New high resolution multiwavelength images (soft X-rays, HI, CO, optical, and H_2) are beginning to give us a full view of the multiphase ISM in the nuclear region, tracing both AGN feeding and its feedback. We present new results from high resolution Chandra imaging of nearby Seyfert galaxies, focussing on the study the X-ray morphology of NGC 4151 on spatial scales of 30 pc. We discuss evidence for thermal emission from interaction between a weak radio jet and the NLR clouds, and for an X-ray emitting photoionized nuclear wind.

Thermally Driven Winds from Stars and Disks.

Tim Waters
UNLV

Stellar and disk winds driven by thermal expansion have been extensively studied using analytic, numerical, and empirical methods. Although results from the previous studies have been compared, typically only gross properties have been considered. Here, we present results from the first step of our comprehensive and detailed comparison of properties of thermal winds in different geometries. We focus on analytical solutions to the spherical and axisymmetric wind problems. We discuss the similarities and differences of our solutions and assess whether the solutions agree with the results from detailed multi-dimensional numerical simulations.

Accretion Processes in Non-Magnetic Cataclysmic Variables

Peter Wheatley
University of Warwick

I will review X-ray observations of non-magnetic cataclysmic variables with the aim of demonstrating how the accretion process can be constrained. Non-magnetic cataclysmic variables transfer matter via an accretion disk, and the X-ray emission can be used to track the accretion rate through the disk. This is particularly valuable in the case of dwarf novae where the accretion discs are unstable. Eclipsing systems allow precise determination of the accretion geometry, and have revealed the presence of an extended X-ray component in outburst that is currently not understood. I argue that understanding disk accretion by white dwarfs is a prerequisite to understanding black hole accretion.

X-ray Outflows in the Swift BAT-detected Seyfert 1s

Lisa Winter
University of Colorado, Hubble Fellow

We present the results of our study of the X-ray warm absorbers in a sample of 51 Seyfert 1-1.5s detected in the Swift BAT hard X-ray (14-195 keV) survey. We have collected X-ray CCD data from Suzaku and XMM-Newton for our sample, determining the outflow fraction through the detection of O VII and O VIII edges. We compare the detection of outflows with additional properties of the sources, searching for correlations with the measured optical reddening, bolometric luminosity, and far-infrared luminosity. Additionally, we present results of a 100 ks XMM-Newton follow-up on a complex Sy 1.5 source in this sample, NGC 6860. The CCD and RGS spectra reveal a two component warm absorber, with the most prominent absorber features corresponding to the Fe M-shell UTA and a Ne IX absorption line.

The ADC and Disk Atmosphere of 4U 1624-490 as Viewed by the Chandra HETGS

Jingen Xiang
Harvard College Observatory

We present a Chandra HETGS spectral study of the "Big Dipper" 4U 1624-490 based on an observation over its 76 ks binary orbit. The variability studies of the observed strong Fe XXV and Fe XXVI absorption lines based on XSTAR photoionization modeling, reveal a highly ionized ($T \sim 3.0 \times 10^6 K$) component associated with an extended ADC of radius $R \sim 3x10^{10} cm$, and a less ionized ($T \sim 1.0 \times 10^6 K$) variable component coincident with the accretion disk rim. Our study based on the continuum spectrum also shows a possible quasi-sinusoidal T$\sim$ 43 ks modulation that is possibly attributed to changes in local obscuration. Based on these studies, a viewing geometry that is mapped to changes in plasma conditions over the 76 ks 4U 1624-490 orbital period is constructed.

Chandra and XMM-Newton Observations of NGC 4278. A LINER-Seyfert Connection?

George Younes
Strasbourg Observatory

Based on UV to X-ray and radio to UV flux ratios, some argue that LINERs/LLAGN are a scaled-down version of their more luminous predecessors Seyfert galaxies. Others, based on the lack of X-ray short time-scale variability, the non-detection of an Fe line at 6.4 keV, and the faint UV emission, suggest the truncation of the thin accretion disk in the inner regions of the AGN where a RIAF structure forms. We investigate the LINER-Seyfert connection by reporting X-ray timing and spectral study of seven Chandra and one XMM-Newton observations of the LINER galaxy NGC 4278. We find that NGC 4278 shows a high degree of X-ray variability on monthly time-scale. We also show that the NGC 4278 nucleus could exhibit both LINER-like and Seyfert-like nuclear activity depending on its X-ray strength.

Quasar Accretion Processes via Optical and X-ray Correlations

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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 ($L/L_{Edd} \sim 0.01$). We discuss these objects in the context of quasar turn-off, in which quasars begin the transition to a quiescent state.

Structure Function Analysis of the Variability of Sgr A*

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Light curve analysis of Sgr A* have shown that the duration of flares in multiple wavelengths are on hourly time scales. Using structure function analysis, we investigate the variability of Sgr A* on time scales ranging from a few seconds to several hours in radio, infrared and X-ray wavelengths. We present the evidence for minute time scale variability in radio wavelengths. The short time scale variability places a strong constraint on the size of the emitting region being less than 0.1AU. Assuming that rapid minute time scale fluctuations of the emission is optically thick in radio wavelength, light travel arguments require relativistic particle energy, thus suggesting the presence of outflow from Sgr A*.

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