Abstracts of topics in alphabetical order:

William Alston (Institute of Astronomy, Cambridge University) - ***Understanding the X-ray reverberation in accreting black holes.***

The high frequency X-ray variability from Active Galactic Nuclei (AGN) provides a direct probe of the curved spacetime around black holes. Understanding the causal connection between the variable emission components will allow us to directly measure the two fundamental properties of black holes: mass and spin. The recent discovery of X-ray reverberation provides us with a model independent view of the X-ray emission processes. In this talk I will present various studies aimed at better understanding the X-ray time delays, both the intrinsic and reverberation processes. In particular I will present recent work on the connection between the QPO and reverberation delays in RE J1034+396.

Tek Prasad Adhikari (CAMK) - ***Effect of warm absorber on Fe-line profile of AGNs***

We present the modeling of warm absorber in Seyfert galaxy mrk 509 using photoionization codes CLOUDY and TITAN. We calculate and compare the structure of the absorbing gas from both codes. Also the comparison between the grid of clouds with constant density and single cloud with constant pressure is done. The transmitted spectrum contains significant absorption around 6.4 keV which might be responsible for modifying the relativistically broadened iron line.

Cosimo Bambi (Fudan University) - ***Testing the nature of astrophysical black hole candidates***

Astrophysical black hole candidates are thought to be the Kerr black holes predicted in general relativity, but the actual nature of these objects has still to be verified. The study of the properties of the electromagnetic radiation emitted by the gas in the accretion disk can potentially test the geometry of the space-time around these bodies and confirm the Kerr black hole paradigm. While some exotic solutions can already be ruled out by current data, it is intrinsically difficult to probe the metric around black hole candidates, because non-Kerr objects may mimic the features of Kerr black holes with different spin parameter.

Stefano Bianchi (Università degli Studi Roma Tre) - ***CHEESES: Constraining the High Energy Emission Source and the Environment of Supermassive black holes***

The gravitational energy released by the accreting gas around super-massive black holes is generally thought to be dissipated partly in UV as thermal heating in an optically thick ”cold” disk and partly in X-rays in a hot and optically thin corona. Both cold and hot phases are expected to be radiatively linked one with each other. Simultaneous information in the UV and X-rays band is needed to constrain the nature of the different processes acting in the different phases.
With the main goal of investigating the physical processes and geometrical environment of SMBHs, we started a systematic and detailed spectral variability analysis of the best quality data of a sample of unobscured AGNs.
Our sample is composed of sources with multiple good quality observations with both pn and OM aboard of XMM-Newton. Among the sample we selected the objects with daily spaced observations and reproduced the SED with a realistic comptonization model. The observed spectral variability in the UV and X-ray band is interpreted in terms of physical quantities, like the temperature and optical depth of the corona, and the luminosity ratio between the cold and warm phases.

Michal Bursa (Astronomical Institute Ondrejov) - ***High-Frequency QPOs from disk-corona interactions***

We investigate a model, where high-frequency QPOs arise from interaction between an accretion disk and a corona. The corona has a form of an oscilating torus that is partially obscured by inner edge of the accretion disk. The model should test some specific properties od HFQPO modes.

Bozena Czerny (CAMK) – ***Outflow and apparent spin changes for high Eddington sources***

Fits to the black hole spin for a series of spectra corresponding to an increasing Eddington ratio show an apparent decrease of the spin with an increase of the luminosity. On the other hand, Pounds & King (2003) argued that the super-Eddington accretion is accompanied by a strong radiatively-driven outflow close to the black hole. Some outflow may be starting even before the source reaches the Eddington rate, due to some contribution from the magnetic field. Therefore we perform a simple study of the influence of an outflow close to the ISCO on the Novikov -Thorne disk spectra. We search for a parameter range which may lead to the observed phenomenon of an apparent spin decrease.

Michal Dovciak (Astronomical Institute AS CR) – ***Reverberation mapping in the lamp-post geometry of the compact corona illuminating a black-hole accretion disc in AGN***

The X-ray reverberation mapping of the inner parts of the accretion disc might be used to distinguish between different geometries of the corona. The basic properties of the reverberation mapping in the lamp-post geometry of the compact corona where the ionisation of the disc due to its illumination is taken into account are studied. The theoretical lag versus frequency and energy are shown for different model parameters such as the height of the corona, inclination of the observer, disc ionization profile and black hole spin. The influence of these parameters on the measured time lags are discussed. The results presented here will be tested by a future large X-ray observatory like Athena.

Anastasios Epitropakis (University of Crete) - ***The continuum/iron-line time-lags in MCG-6-30-15, Mrk766 and NGC4051***

I will present preliminary results from a study of the time-lags between the continuum (2-4 keV) and iron-line (5-6.3 keV) energy bands for three X-ray bright AGN: MCG-6-30-15, Mrk766 and NGC4051. The data used to estimate the time-lags were taken from the ASCA, Suzaku and XMM-Newton X-ray satellites. First I will briefly mention the methods used to estimate time-lags as well as their reliability (based on the use of extensive simulations). I will then present the results from the study of the time lags between the X-ray continuum and the iron line in these objects, I will relate them to the the results to previous works, and I will discuss their implications regarding the possible presence of reverberation signatures in the time-lag spectra.

Morgane Fortin (CAMK) – ***Thermal evolution of neutron stars and constraints on their internal properties***

Quasi-persistent neutron star X-ray binaries exhibit two distinct phases. During the outbursts, lasting years to decades and characterized by a high luminosity (of the order of 10^36-10^39 erg s^-1), the neutron star accretes matter. Then, in the quiescent phase, when accretion significantly decreases, the luminosity is significantly lower (less than ~10^34 erg s^-1).
In the deep crustal heating scenario, during the outbursts, the accreted matter sinks deeper into the crust as new material is accreted and it undergoes a series of nuclear reactions. In quiescence, the heat released by the reactions propagates through the neutron star and is radiated away. The subsequent cooling enables to constraint the properties of neutron stars.
I will present an ongoing project for the modeling of the thermal relaxation of these Soft X-ray

Transients.

Javier Garcia (Harvard-Smithsonian Center for Astrophysics) - ***New Generation of X-ray Reflection Models from Ionized Accretion Disks around Black Holes***

Reflection models from accretion disks are a key component in the interpretation of the X-ray spectra from compact accreting sources. These are used to constrain important physical information about the disk itself, such as the degree of ionization of the material, elemental abundances, and inner radius, which can ultimately be used to derive the spin of the black hole. I will present a new and complete library of synthetic spectra to model the reprocessed and reflected X-ray radiation from illuminated accretion disks, using our reflection code XILLVER. Additionally, we have directly connected XILLVER with the relativistic blurring code RELLINE to produce a complete description of the reflection near compact objects. The new model, RELXILL, includes relativistic reflection with full angular solutions, high-energy
cutoff for the illumination, and the reflection fraction. I will discuss the current state of these models, our current and future efforts to improve them, and their implication in the analysis of X-ray observations.

Matteo Guainazzi (ESA) - ***FERO: the Astro-H perspective***

The FERO project was originally triggered by the need to put the study of X-ray relativistic spectroscopy on a statistically sound observational basis. Despite intense observational efforts using XMM-Newton and Suzaku by several groups, the number of objects on which accurate measurements of the relativistic accretion flow and of the BH spin is lower than two dozens, and the fully uncontroversial measurements are probably just a few. Astro-H offers the possibility of making a substantial step forward, thanks to its unprecedented combination of broad-band coverage and high-resolution at the energies of iron atomic transitions. Is an Astro-H-based FERO Project conceivable?

Erin Kara (Institute of Astronomy, University of Cambridge) - ***X-ray reverberation around accreting black holes***

X-ray reverberation lags offer a unique, model-independent approach to studying the strong gravitational effects around accreting black holes. By measuring the light travel time delays between the primary emission produced in the corona and the reflected emission off the ionized accretion disc, we can measure the geometry and kinematics of the accretion flow in physical units. The best constraints with this method can be made by measuring the reverberation associated the relativistically broadened iron K alpha line, where the gravitationally-redshifted wing of the line (produced at small radii) is seen to respond before the line centroid from larger radii. In this talk, I will present our most recent results on iron K reverberation lags in AGN, which have been found in nine sources thus far. We find that for all sources with maximally spinning black holes (as suggested from spectral modeling of an extremely broad iron K line), the reverberation signature in the iron band is similarly broad. Whereas in one AGN, SWIFT J2127.4+5654, which appears to have an intermediate black hole spin as evidenced by its narrower iron K emission line, the reverberation signature is narrower. These are model-independent results showing that on short timescales the iron K emission line lags begind the continuum. Converting the amplitude of this lag into a light travel distance shows us that the reflected iron K emission is coming from within a few gravitational radii for maximally spinning black holes, and from slightly larger radii for the source with an intermediate black hole spin. I will also discuss further observations of SWIFT J2127.4+5654 taken with the NuSTAR telescope, which allows us to probe reverberation lags above 10~keV, revealing the time lags from the reflected Compton hump.

Vladimr Karas (Astronomical Institute, Academy of Sciences) – ***Emergence of chaos in the motion of particles in a black hole magnetosphere***

While the motion of particles near a rotating, electrically neutral (Kerr) as well as charged (Kerr-Newman) black hole is strictly regular, perturbations to the gravitational or the electromagnetic field generally lead to chaos. Transition from regular to chaotic dynamics is relatively gradual if the system preserves axial symmetry, whereas asymmetries induce chaos more efficiently. We study the development of chaos in an oblique magnetosphere of a magnetized black hole. Besides the strong gravity of the massive source (Kerr metric) we consider the presence of a weak, ordered large-scale magnetic field (Wald solution). Our primary concern with this contribution is to find how sensitive the system of bound particles is to the inclination of the field. We find that even a small misalignment induces chaotic motion. This contribution based on a recent paper, Kopacek & Karas (2014), ApJ, 787, 117 (arXiv:1404.5495).

Lukas Ledvina (Institute of Theoretical Physics, Charles University) - ***Modeling of Changes in Shape of the Iron Line During the Microlensing Event***

In quasar microlensing the flux from a quasar is modulated by the gravitational lensing effect of individual stars in a galaxy lying in the foreground along the line of sight. The stars form a network of caustics that scan the surface of the quasar accretion disk passing in the background. Here we illustrate the effects of microlensing on the neutral iron $\rm K_\alpha$ line emitted from the innermost disk. Changes in the line profile were most clearly observed by Chartas et al. (2012) in the lensed quasar RX J1131--1231. We use a fully relativistic Kerr metric thin disk model (Dovčiak et al. 2004) to demonstrate the connection between features of the line profile and the caustic position on the emission map of the quasar. In the future this method may prove to be a very powerful technique for spatially resolving the X-ray emission from the innermost accretion disk.

Giorgio Matt (Universita' Roma Tre) - ***The AGN Physics NuSTAR program***

I will review the main results from the NuSTAR observing program devoted to study the physics of (radio-quiet) AGN.

Barbara De Marco (Max Planck Institute for Extraterrestrial Physics) - ***Soft X-ray lags***

I will review the state-of-the-art in the study of soft X-ray reverberation lags in compact objects, and discuss properties which may suggest that the same triggering mechanism is at work in sources of widely different sizes.

Andrea Marinucci (Università degli Studi Roma Tre) - ***Black hole spin measurements with NuSTAR***

The broad energy range of NuSTAR (3-80 keV) offers a unique opportunity to probe the physics of the innermost regions of AGN. Simultaneous observations with NuSTAR and lower-energy X-ray telescopes provides the best S/N across the broadband X-ray spectrum ever achieved, enabling us to investigate the continuum, absorption and reflection components of these AGN with unprecedented detail. We will present a detailed study of the simultaneous XMM+NuSTAR observations of the nearby Seyfert 1 galaxies MCG—6-30-15, SWIFT J2127.4+5654 and NGC 1365, showing a broad Iron Ka line and an intense Compton Hump. The broadband spectral analysis allowed us to measure a high value for the black hole spin in MCG--6-30-15 ($a=0.91^{+0.07}_{-0.07}$) and NGC 1365 ($a>0.97$) while an intermediate value is measured in SWIFT J2127.4+5654 ($a=0.58^{+0.11}_{-0.17}$).
These sources showed intense relativistic effects from the innermost regions of the accretion disk and the implications of this scenario will be discussed.

Iosif Papadakis (University of Crete) – ***Variability signals for rotating bright arcs near black holes***

I will present results from a Fourier resolved spectroscopy study of a few, X-ray bright AGN, using XMM and Suzaku data, addressing the spectral and iron line variability of these objects.

Alessandra De Rosa (IAPS/INAF) - ***Unveiling multiple AGN activity in galaxy mergers***

The existence of pairs of black holes (BHs) in galaxies forming during a merger is a relatively recent discovery and represents an important aspect of this feedback between the SMBHs and their host galaxy. There is growing evidence that galaxy mergers are the way through which massive BHs can form and evolve. Identifying active pairs and binary BHs in all stages of galaxy merging, and measuring their properties, is central to our understanding of the BH assembly history and demography. Over the last decade, several nearby dual and multiple Active Galactic Nuclei (AGNs) on kpc scales have been found serendipitously in local interacting galaxies. Although a significant number of candidates have been pre-selected so far only a few of them have been confirmed unambiguously. In this talk we will present a project focused on the detection and study of dual and multiple SMBHs with the aim at investigating the physical properties of multiple AGN candidates in interacting/disturbed systems from both an observational and a theoretical point of view. The project included the study of several samples of dual AGNs, extracted from different wavebands, supplied by an extensive set of multiwavelength observations, already available in the radio/optical/X-ray archives. These data have been interpreted within the most common theoretical scenarios of merging. Some preliminary results of the project are presented in this talk.

Agata Różańska (CAMK) – ***Warm, soft corona above an accretion disks in AGN***

We study the possibility of existence the warm dissipative corona above an accretion disk around black hole. The emission from warm optically thick corona cooled by Compton scattering is a required to explain UV/Soft-X-ray observations of many accreting objects. This research is done to show that if we assume additional constant dissipation in the outer layer of a disk atmopshere, warm corona can form and stay in radiative equilibrium with disk. We address this question using a very simple analytical model. We show, that the disk embedded in the hotter optically thick medium indeed does not heat up more than in the case of no optically thin surrounding corona discussed in a basic paper of Haardt & Maraschi 1993.

Małgosia Sobolewska (CAMK) – ***Stochastic modeling of AGN variability***

I will review a model to quantify stochastic variability of the AGN lightcurves (Kelly et al. 2009, 2011, 2014). This tool accounts for arbitrary sampling and observation lengths, measurement error, and is based on the likelihood function of the data. It uses Bayesian framework and thus produces the probability distribution of the variability parameters given the data. The model has a power spectral density (PSD) that can be expressed as a sum of Lorentzian functions, and thus it constitutes a flexible tool to estimate the PSDs of the measured AGN lightcurves. We successfully applied this method to the optical and X-ray lightcurves of nearby AGN, and the gamma-ray lightcurves of the Fermi blazars. I will review these results and present new preliminary results regarding broad-band (radio-to-gamma) variability properties of the quasar 3C 273

Ladislav Subr (Astronomical Institute, Charles University) - ***Catch me if you can***

Intermediate-mass black holes still represent a class of speculative objects. In my talk I will review an astrophysically plausible process of their formation via "runaway" process of stellar collisions in

dense star clusters. As a particular example I will present a model of a nearby young star cluster, the Orion Nebula Cluster, with an option of the runaway process playing its role.

Jiri Svoboda (Astronomical Institute of the Academy of Sciences of Czech Republic) - ***On the X-ray variability of a polar-scattered Seyfert 1 galaxy Fairall 51***

Fairall 51 is a representative source of polar-scattered Seyfert 1 galaxies that are believed to represent a bridge between obscured type 2 and unobscured type 1 objects. In archival X-ray data, Fairall 51 was found to be highly variable. I will present new timing and spectroscopy results that we obtained with our recent monitoring programme using the Suzaku satellite. Our findings suggest that the most variable spectral component is due to a low-ionised absorber with a roughly week-long time scale for its variability. This implies that the absorber is located at the broad line region or even closer to a super-massive black hole. We also found that the spectra are best described by models that also include reflection component smeared by the relativistic effects.

Frederic Vincent (CAMK) – ***Ray traicing iron line spectra***

I will present ray-traced spectra of iron lines in accretion disks surrounding black holes and discuss the relativistic effects imprinted on these features.

Michal Zajacek (Astronomical Institute, Academy of Sciences, Prague) - ***Neutron stars near the Galactic centre: their interaction modes and observable effects***

Streams of gas and dust in the innermost parsec of the Milky Way form a distinct feature known as the Mini-spiral, which has been studied in radio (mm/cm) and infrared wavebands (Kunneriath et al. 2012). A large fraction of the Mini-spiral gas is ionized by ultraviolet radiation of massive OB stars present in the Nuclear Star Cluster (NSC). Based on the inferred dynamic mass in the central parsec (approx. 10^6 Solar masses), it is estimated that at least 10^4 neutron stars should move in the sphere of influence of the Sgr A* SMBH (Zajacek, M., Master thesis 2014). According to our simulations, a fraction of this unexplored population propagates through denser ionized medium concentrated along three arms of the Mini-spiral. Based on the density and the temperature of the gaseous environment inferred from observations, we analyse interaction regimes of neutron stars passing through this medium. Spectral features are expected to develop within the Mini-spiral due to non-thermal emission from bow shocks of strongly magnetized stars. We evaluate whether these features could be revealed with current X-ray instruments and/or using the resolution of mm-interferometers, mainly ALMA. The results and the procedure may be applied to other galactic nuclei hosting NSC and the resulting distribution of interaction regimes is expected to vary with the changing activity of the nucleus.

Piotr Życki (CAMK) - ***The Lense-Thirring precession model of the low-frequency QPO***

The Lense-Thirring precession model is an attractive model for the low-f QPO observed in accreting sources, as it is able to fit into the overall geometrical scenario for these sources. I am going to present results of Monte Carlo simulations of the properties of the QPO, mainly their energy dependencies, and compare them with data.