ULXs and their environments

Registrants Book

Table of contents

Prof. AKYUZ, Aysun 1

Ms. AMBROSI, Elena 2

Mr. ATAPIN, Kirill 3

Dr. BACHETTI, Matteo 4

Dr. BELCZYNSKI, Krzysztof 5

Dr. BOIRIN, Laurence 6

Mr. BRORBY, Matthew 7

Prof. FABRIKA, Sergei 8

Prof. FENG, Hua 9

Dr. HAMEURY, Jean-Marie 10

Dr. HEIDA, Marianne 11

Mr. KOBAYASHI, Shogo 12

Dr. KOLEHMAINEN, Mari 13

Dr. KUBOTA, Aya 14

Prof. KÖRDING, Elmar 15

Prof. LIU, Jifeng 16

Mrs. LOPEZ, Kristhell 17

Dr. MAPELLI, Michela 18

Dr. MIDDLETON, Matthew 19

Prof. MINESHIGE, Shin 20

Dr. MOTCH, Christian 21

Dr. OHSUGA, Ken 22

Dr. PAKULL, Manfred 23

Dr. PINTO, Ciro 24

Dr. PINTORE, Fabio 25

Mr. PRIAJANA, I Gede Putu Mahadipa 26

Dr. ROBERTS, Tim 27

Dr. SHIDATSU, Megumi 28

Dr. SORIA, Roberto 29
Dr. SUTTON, Andrew 30
Dr. SWARTZ, Douglas 31
Dr. TAKAHASHI, Hiroyuki 32
Mr. URQUHART, Ryan 33
Dr. VINOKUROV, Alexandr 34
Prof. WEBB, Natalie 35
Mr. WIKTOROWICZ, Grzegorz 36
Dr. WOLTER, Anna 37
Dr. YOSHIDA, Tessei 38
Dr. ZAMPIERI, Luca 39
Dr. ZOLOTUKHIN, Ivan 40

Registrant ID : 22

Prof. AKYUZ, Aysun

Email: aakyuz@cu.edu.tr

Institution: Faculty of Science and Letters

City: Adana

Country: Turkey

Abstract Title: The X-ray and Optical Properties of M106 X-6

Abstract: We study the X-ray and optical properties of Ultraluminous X-ray source (ULX) X-6 in the nearby galaxy M106 (NGC 4258) based on the archival XMM-Newton, Chandra, Swift, and HST observations. The source has a peak luminosity of $L_{x} \sim 2 \times 10^{39}$ erg s^{-1} in the XMM-Newton observation of 2004 June. Throughout the X-ray observations, the source seems to exhibit possible spectral variations by considering the hardness ratios and the spectral model parameters. In the HST/ACS images, three optical sources have been identified as counterpart candidate within the 1σ error radius of 0.3$\arcsec$. The brighter one has an absolute magnitude of M$_{V} \approx$ $-$-7.0 and shows extended structure. The remaining two sources have absolute magnitudes of M$_{V} \approx$ $-$5.8 and $-$5.3 mag. The counterparts of the X-ray source possibly belong to a young star cluster. Both the standard disk model and the slim disk model do not provide a firm evidence to determine the spectral characteristics of ULX X-6. We argue that the mass for the compact object lies in the range $10-15M_{\sun}$ indicating that the compact source is most likely a stellar-mass black hole.

Registrant ID : 26

Ms. AMBROSI, Elena

Email: elena.ambrosi.1@studenti.unipd.it

Institution: University of Padua

City: Padua

Country: Italy

Abstract Title: Modelling the multiwavelength emission of Ultraluminous X-ray sources above the Eddington limit

Abstract: E. Ambrosi, L. Zampieri, M. Mapelli

We explore the possibility that Ultraluminous X-ray Sources (ULXs) are stellar-mass or massive stellar Black Holes accreting above the Eddington limit. The existence of BHs more massive than 25-30 solar masses has been recently proven through the direct detection of gravitational waves with the Advanced LIGO. A natural question is then: are ULXs linked to these BHs, as suggested in recent years? To tackle this and other crucial questions on the ULX engine, we compute the optical-through-X-ray emission of ULX binary systems following the approach of Patruno & Zampieri (2008, 2010), but considering the possibility that a non-standard disc sets in when the mass transfer rate becomes highly super-Eddington. We compare the color-magnitude diagrams with those obtained previously and find significant differences in the post main sequence evolution, that are relevant when comparing simulated tracks with observations. When the donor is on the main sequence and the mass transfer rate is mildly super-Eddington, the behaviour of the system is similar to what found by Patruno & Zampieri. In contrast, when the donor star leaves the main sequence and the mass transfer rate becomes highly super-Eddington, the optical luminosity of the system is systematically larger and the colors show a markedly different evolution, that depends on the varying screening of the outer disc and donor induced by the changing inner disc structure. This emission model is applied to self-consistent ULX binary configurations computed through N-body simulations.

Registrant ID : 23

Mr. ATAPIN, Kirill

Email: atapin.kirill@gmail.com

Institution: Special Astrophysical Observatory

City: Nizhnij Arkhyz

Country: Russian Federation

Abstract Title: Stochastic variability of SS 433 and ULXs: evidence of the super-Eddington accretion

Abstract: We analyze a stochastic X-ray variability of ULXs using a sample of 12 objects. Recently we have found that the power spectrum of SS433 can be fitted by broken power law with a flat spectrum between 10^{-5} and 10^{-3} Hz. A similar flat power spectra are shown in ultraluminous X-ray sources NGC 5408 X-1, NGC 6946 X-1 and M82 X-1. These objects also have QPO near 0.01 Hz. We suppose that such a type of variability may be related to the structure of supercritical disk and it may be an evidence of the supercritical accretion in these sources.

Registrant ID : 13

Dr. BACHETTI, Matteo

Email: bachetti@oa-cagliari.inaf.it

Institution: INAF/Osservatorio Astronomico di Cagliari

City: Selargius

Country: Italy

Abstract Title: Ultraluminous X-ray sources above 10 keV

Abstract: The launch of NuSTAR in 2012 opened a new era for hard X-ray observations of faint sources, like extragalactic ULXs. In this talk I will review the large program of ULX observations performed by NuSTAR, often simultaneous with other satellites like XMM-Newton, Suzaku, Swift and Chandra. This program showed a general consistency of ULX spectra above 10 keV, with ubiquitous cutoffs, and a behavior difficult to reconcile with most well-known Galactic black hole binaries. Moreover, the discovery of an ultraluminous pulsar during this program added a new unexpected twist to the investigation of the ultraluminous X-ray source population.

Registrant ID : 45

Dr. BELCZYNSKI, Krzysztof

Email: chrisbelczynski@gmail.com

Institution: Astronomical Observatory Warsaw

City: Warsaw

Country: Poland

Registrant ID : 41

Dr. BOIRIN, Laurence

Email: laurence.boirin@astro.unistra.fr

Institution: Observatoire astronomique de Strasbourg

City: Strasbourg

Country: France

Registrant ID : 33

Mr. BRORBY, Matthew

Email: matthew.brorby@gmail.com

Institution: University of Iowa

City: Iowa City

Country: United States

Abstract Title: Metallicity Effects on Ultraluminous X-ray Sources

Abstract: The number and luminosity of X-ray sources at the highest redshifts imprints significant effects on the morphology and amplitude of the heating and reionization of primordial gas in the early Universe. The heating and reionization that occurred after the formation of the first metal-poor stars and galaxies will be measured in the coming decade with a variety of radio telescopes. A number of studies have found that the metal content of a star-forming region correlates with the number of ULXs it contains normalized to the star formation rate. We review these observational studies along with proposed mechanisms. We discuss the role metallicity takes in single star evolution, binary evolution, and direct collapse black holes. We review spectral studies of ULXs with special attention given to the observed spectral properties and spectral states in relation to the metallicity of their surrounding environments and to recent high-quality spectra obtained with the NuSTAR and XMM-Newton joint observing program. Understanding the influence metallicity has on the formation of ULXs will allow us to infer a more complete picture of the pre-Reionization era of the early Universe.

Registrant ID : 16

Prof. FABRIKA, Sergei

Email: fabrika@sao.ru

Institution: Special Astrophysical Observatory

City: Nizhnij Arkhyz

Country: Russian Federation

Abstract Title: Optical counterparts of ULXs

Abstract: We present optical spectroscopy of ULX counterparts. Almost all the counterparts demonstrate a WNLh-type spectrum (late WN stars with hydrogen) implying very hot and dense winds. The main features in the spectra are the broad He II and hydrogen lines. The spectra are similar to those of X-ray transients, however, in the heated accretion disks of the X-ray transients (and probably in IMBHs) the He II line is notably broader than hydrogen lines. An opposite situation is observed in ULXs, where the hydrogen lines are formed farther than the He II line. This may mean an extended wind and a single photosphere. A study of the nebulae surrounding ULXs suggests that they are dynamically disturbed and ionized by UV radiation. The UV-optical spectral energy distributions of the ULX counterparts are consistent with the scenario of winds heated by X-rays; however, optical variability is appreciably smaller than that in X-rays.

Registrant ID : 20

Prof. FENG, Hua

Email: hfeng@tsinghua.edu.cn

Institution: Tsinghua University

City: Beijing

Country: China

Abstract Title: An extension of the ultraluminous state: the supersoft ultraluminous regime

Abstract: I will show recent observations of the ULX in NGC 247, which is found to make transitions between the supersoft ultraluminous regime with a spectrum dominated by a cool (~0.1 keV) blackbody component and the soft ultraluminous regime with comparable luminosities shared by the blackbody and power-law components. We suggest that the supersoft ultraluminous regime is an extension of the ultraluminous state toward the high accretion end. Sources in the soft ultraluminous regimes may transition to the supersoft ultraluminous regime at an higher accretion rate, or vice versa.

Registrant ID : 39

Dr. HAMEURY, Jean-Marie

Email: jean-marie.hameury@astro.unistra.fr

Institution: Observatoire de Strasbourg

City: Strasbourg

Country: France

Registrant ID : 9

Dr. HEIDA, Marianne

Email: mheida@caltech.edu

Institution: Caltech

City: Pasadena

Country: United States

Abstract Title: Near-infrared spectroscopy of ULXs

Abstract: Dynamical mass measurements of ULXs are crucial to determine the nature of their compact objects, but these have proven to be very difficult to obtain. ULXs with a red supergiant (RSG) as mass donor are excellent candidates for dynamical mass measurements using near-infrared (NIR) observations because RSGs are very bright in that part of the spectrum and will likely outshine the accretion disc. Our NIR photometric survey of nearby ULXs is almost finished (see abstract by Kristhell Lopez for details and results) and our spectroscopic follow-up campaign is well underway. We have identified several candidate RSG donor stars, which we will continue to monitor spectroscopically to search for radial velocity variations. We have also found nebular emission lines in several objects, opening up new ways to study ULX nebulae, how they are formed, and the importance of outflows in these systems.

Registrant ID : 35

Mr. KOBAYASHI, Shogo

Email: kobayashi@juno.phys.s.u-tokyo.ac.jp

Institution: the University of Tokyo

City: Tokyo

Country: Japan

Abstract Title: A New Charaterization of the ULX Spectra via Comptonization

Abstract: Ultra Luminous X-ray sources (ULXs) are known to show shifts in spectral state between a two humped power-law shape ones (PL state) and a convex shape ones (disk-like state) with moths to year time scale (e.g. Pintore+2014). While the former state is frequently explained with a combination of multi-color disk (MCD) + thermal Comptonization (THC) model (Gladstone+2009), the later one is either with a MCD+THC or a Slim disk model (Watarai+2000). Since it exhibit more reasonable parameters (Miyawaki+2009), in present work, we adopt the former modeling to explain the disk-like state spectra.
In order to characterize the variability of the spectral continuum quantitatively with a unified way, we applied the MCD+THC modeling to several ULXs in nearby galaxies. Regardless of their spectral state, the model successfully reproduced the spectra. In spite of such significant changes in spectral shape, ULXs commonly exhibited cool inner-disk temperatures (Tin = 0.2 - 0.5 keV) and a cool thick (Te = 1.6 - 3 keV, tau ~ 10) coronae. To characterize the difference in spectral shape from the derived parameters, we introduced two new parameters. One is Q ≡ Te/Tin which represents a balance point of the Compton cooling and gravitational heating. The other is F≡ Fdirect/Ftotal which describes the fraction of un-Comptonized (directly-visible) MCD luminosity. In (Q, F) plane, spectra in the PL state are found in (Q, F) ~ (10, 0.6), while those in the disk-like state are (Q, F) ~ (3, 0.01). Thus, the spectral state can be clearly distinguished with these new parameter.

Registrant ID : 38

Dr. KOLEHMAINEN, Mari

Email: mari.kolehmainen@astro.unistra.fr

Institution: Observatoire Astronomique de Strasbourg

City: Strasbourg

Country: France

Registrant ID : 24

Dr. KUBOTA, Aya

Email: aya@shibaura-it.ac.jp

Institution: Shibaura Institute of Technology

City: Saitama-shi, Saitama 337-8570

Country: Japan

Abstract Title: Disk-corona model for highly accreting black holes and its application to ULX

Abstract: We developed a disk-corona model, diskEQ, for highly accreting black holes (Kubota & Done 2016 MNRAS in press). The model can treat thermal and non-thermal corona coupled with underlying disk which energetically consistent with an outer standard Novikov-Thorne disk. Moreover, the inner disk-corona can make a transition to a hot inner flow. We fit this to a Suzaku very high state spectrum from GX339-4. We showed that the VHS was fit with the model well with fully non thermal corona with optical depth of ~3 and ~0.5 for the inner flow and coupled corona, respectively. However, it could not be fit with the same Novikov-Thorne emissivity which can fi t the disk dominated high/soft state spectrum but instead requires that the inner flow is somewhat radiatively inefficient.
We also applied the model to a NuSTAR ULX IC342 X-1. The fit result showed that the ULX spectrum was more extreme case for the VHS of black hole binaries, i.e., the inner flow was found to be more efficient and much more optically thick. In the presentation, we would like to introduce our model and fit results on GX339-4 based on our paper (Kubota & Done 2016), and show the quick result on the model application on ULXs.

Registrant ID : 46

Prof. KÖRDING, Elmar

Email: elmar@koerding.eu

Institution: Radboud University Nijmegen

City: Nijmegen

Country: Netherlands

Abstract Title: Radio observations of ULXs

Registrant ID : 43

Prof. LIU, Jifeng

Email: jfliu@nao.cas.cn

Institution: National Astronomical Observatory of China

City: Chaoyang

Country: China

Abstract Title: Ultraluminous supersoft X-ray sources

Abstract: While ultraluminous supersoft X-ray sources (ULSs) bear features for intermediate mass black holes or very massive white dwarfs possibly close to Chandrasekhar mass limit, our recent discovery of processing relativistic baryonic jets from a prototype ULS in M81 demonstrate that they are not IMBHs or WDs, but black holes accreting at super-Eddington rates. This discovery strengthens the recent ideas that ULXs are stellar black holes with supercritical accretion, and provides a vivid manifestation of what happens when a black hole devours too much, that is, it will generate thick disk winds and fire out sub-relativistic baryonic jets along the funnel as predicted by recent numerical simulations.

Registrant ID : 6

Mrs. LOPEZ, Kristhell

Email: k.m.lopez@sron.nl

Institution: SRON Netherlands Institute for Space Research

City: Utrecht

Country: Netherlands

Abstract Title: NIR Counterparts of ULXs

Abstract: The X-ray luminosities of Ultraluminous X-ray sources (ULXs) are suggestive of intermediate mass (10^2--10^5 Msun) black holes (IMBHs) if they radiate isotropically at sub-Eddington levels. We have confirmed spectroscopically several M-type RSG donors (see Marianne Heida's abstract for more details). We observed 16 ULXs last April 2015, of which we found 8 candidate counterparts. We will provide an update of our most recent observing campaigns and discuss the impact of our findings.

Registrant ID : 12

Dr. MAPELLI, Michela

Email: michela.mapelli@oapd.inaf.it

Institution: INAF - OAPD

City: Padova

Country: Italy

Abstract Title: The impact of metallicity on the demographics of ULXs

Abstract: Do ULXs prefer low-metallicity environments? Several hints indicate that ULXs are more common in metal-poor late-type galaxies than in metal-rich ones, but definitive evidence is still missing. In this talk, I discuss why ULXs should be influenced by their environment (with particular attention to star formation and metallicity). In particular, I focus on the possibility that a class of ULXs is powered by massive stellar black holes (BHs, with mass >25 Msun), whose existence has recently been confirmed by the first direct detection of gravitational waves, GW150914. Finally, I show that N-body simulations combined with population synthesis recipes can help us to shed light on the demographics of ULXs.

Registrant ID : 42

Dr. MIDDLETON, Matthew

Email: mjm@ast.cam.ac.uk

Institution: Institute of Astronomy (University of Cambridge)

City: Cambridge

Country: United Kingdom

Abstract Title: Spectral-timing properties of ULXs

Abstract: ULXs show a plethora of spectral shapes which, taken on their own, can appear puzzling. I will discuss the progress made in understanding the spectra, recently improved through the discovery of absorption lines indicating the presence of powerful, radiatively driven winds, the availability of NuSTAR data to expand the observable bandpass and the development of models that derive from the latest radiative 3DMHD models. Crucially, the variability properties provide an additional, powerful lever-arm for understanding ULXs. When combined with spectral evolution, the spectral-timing properties can be well placed within the framework of super-critical accretion.

Registrant ID : 11

Prof. MINESHIGE, Shin

Email: shm@kusastro.kyoto-u.ac.jp

Institution: Kyoto University, Department of Astronomy

City: Kyoto 606-8501

Country: Japan

Abstract Title: From subcritical flow to supercritical flow

Abstract: We performed series of RHD simulations of accretion flow and outflow from the subcritical to supercritical regimes to see how observational features vary, depending on the mass accretion rates and viewing angles. We find that the relative importance of outflow and kinetic luminosity (compared with accretion flow and radiation luminosity) increases as the mass accretion rate increases.

Registrant ID : 3

Dr. MOTCH, Christian

Email: christian.motch@unistra.fr

Institution: Observatoire de Strasbourg

City: Strasbourg

Country: France

Abstract Title: A confirmed stellar-mass ULX with recurrent X-ray occultations from its precessing disk

Abstract: ULX P13 in NGC 7793 was shown to harbour a black hole with a mass of less the 15 solar masses implying that the source is in a supercritical accretion regime. In addition, P13 displays periodic bright and faint X-ray states that are likely due to occultation of the central X-ray source by a precessing accretion disk. New optical data allow us to refine the precession period. We will present X-ray spectra obtained in the low (occulted) state showing possible evidence of high velocity ejections and will discuss how the P13 low state spectrum relates to that exhibited by other high inclination systems.

Registrant ID : 30

Dr. OHSUGA, Ken

Email: ken.ohsuga@nao.ac.jp

Institution: NAOJ

City: Mitaka

Country: Japan

Abstract Title: Radiation-MHD simulations of super-Eddington accretion flows and outflows

Abstract: We introduce our results of Radiation-MHD simulations of super-Eddington accretion flows and outflows. Our simulations reveal that the powerful jets and clumpy disk winds are launched from the super-Eddington disks via the radiation pressure force. Our results are consistent with the observations of the ULXs (luminosity, spectra, time-variation, and ULX bubbles) and probably ULSs. We also show the simulation results of super-Eddington flows around NSs.

Registrant ID : 40

Dr. PAKULL, Manfred

Email: manfred.pakull@astro.unistra.fr

Institution: Observatoire Astronomique

City: Strasbourg

Country: France

Abstract Title: Mechanical vs X-ray luminosity

Abstract: A significant fraction of ULXs are surrounded by large ionized nebulae or bubbles. These can be powered either by the EUV- and X-ray photons or by supersonically expanding winds (or jets) emitted fom the central sources. The former mechanism allows to measure the total photon luminosity L_x irrespective of any possible beaming effects. The latter permits us to estimate the mechanical power L_mech involved. In a few cases (SS433, NGC 7793/S26) it appears that L_mech >> Lx, contradicting our current understanding of accretion onto compact objects. I will review the current observational situation and summarize what can be learned from ULX bubbles.

Registrant ID : 21

Dr. PINTO, Ciro

Email: cpinto@ast.cam.ac.uk

Institution: University of Cambridge, Institute of Astronomy

City: Cambridge

Country: United Kingdom

Abstract Title: XMM-Newton reveals extreme winds in ultraluminous X-ray sources

Abstract: Ultraluminous X-ray sources are extragalactic, off-nucleus, point sources with X-ray luminosities above 1039 erg/s, thought to be powered by accretion onto compact objects. Viable solutions include accretion onto neutron stars with strong magnetic fields, stellar-mass black holes at or in excess of the Eddington limit or intermediate-mass black holes. The lack of sufficient energy resolution in previous analyses has prevented an unambiguous identification of any emission or absorption lines in the X-ray band, thereby precluding a detailed analysis of the accretion flow. In this talk, I will show the discovery of rest-frame emission and blueshifted (~0.2c) absorption lines arising from highly ionized gas in the deep high-resolution XMM-Newton spectra of two ultraluminous X-ray sources. The blueshifted absorption lines occurs in a fast outflowing gas, whereas the emission lines originate in slow-moving gas around the source. The compact object is therefore surrounded by powerful winds with an outflow velocity of about 0.2c as predicted by models of highly-accreting black holes. Further, deep, XMM-Newton observations will reveal powerful winds in many other ultraluminous X-ray sources and provide important hints to estimate the energetics of the wind, the geometry of the system, and the black hole masses.

Registrant ID : 29

Dr. PINTORE, Fabio

Email: pintore@iasf-milano.inaf.it

Institution: INAF-IASF Milano

City: Milano

Country: Italy

Abstract Title: High quality broad-band X-ray spectra of ULXs: Testing and comparing phenomenological models of accreting compact objects

Abstract: Most ultraluminous X-ray sources (ULXs) are thought to be black holes of stellar origin accreting at super-Eddington rates. However, we know now that the ULX population may in fact hide accreting compact objects with significantly smaller or larger masses, as neutron star (NSs) or intermediate mass BHs (IMBHs). Low quality and band-limited X-ray spectra of these possible alternative ULX classes of objects may be difficult to distinguish from those of more 'canonical' ULXs. On the other hand, recent observations with XMM-Newton and NuSTAR at the same time allowed us to gather high-quality broad-band X-ray spectra of a few ULXs which, in principle, can help discriminating amongst different populations. Here we present a detailed investigation of some ULXs observed with both XMM-Newton and NuSTAR, testing and comparing phenomenological models usually adopted for the 'canonical' ultra-luminous state, for IMBHs accreting at sub-Eddington regimes, and for high-magnetic-field NSs, with the aim of checking for subtle peculiar behaviours.

Registrant ID : 37

Mr. PRIAJANA, I Gede Putu Mahadipa

Email: mahadipa@as.itb.ac.id

Institution: Institute Technology of Bandung

City: Bandung

Country: Indonesia

Abstract Title: Investigation of the Characteristics of Galaxies from SDSS Data by Using Samples from Combined Catalog of Ultraluminous X-ray Sources at <40 Mpc

Abstract: We constructed a combined catalog from two large catalogs of ultraluminous X-ray sources (ULXs) based on the archive data of two major X-ray missions, XMM-Newton and Chandra. The combined catalog provides an integrated larger sample of ULXs that will be useful for the study of their true nature and also their environment. For the current study, we applied some criteria in constructing the combined catalog as follows. The source must have a maximum luminosity (Lmax) higher than 2×1039 erg s-1 and its host galaxy must be less than 40 Mpc in distance. In addition, the source must be inside isophotal diameter (D25) of its host galaxy. Finally, we merged any duplicate identifications. From this selection, we obtained a total of 423 ULXs that are located in a total of 208 galaxies. We found duplicate identifications in only ~10% of total ULXs, which we labelled as overlap samples. We also found that the original catalog which was based on Chandra observations has ~26% more ULXs than that of XMM-Newton, which requires further investigation. For the current study, we divided the ULXs sample into those that overlap and those that do not overlap in the two original catalogs. We next used our combined ULXs catalog to find any correlation with their host galaxies. In this context, we also use data from SDSS and other sources to determine the galaxies characteristics.

Registrant ID : 8

Dr. ROBERTS, Tim

Email: t.p.roberts@durham.ac.uk

Institution: Centre for Extragalactic Astronomy, Durham University

City: Durham

Country: United Kingdom

Abstract Title: Workshop summary talk

Abstract: I will provide my perspective on the work presented at the workshop, that will hopefully bear some resemblance to what actually took place.

Registrant ID : 14

Dr. SHIDATSU, Megumi

Email: megumi.shidatsu@riken.jp

Institution: RIKEN

City: Wako

Country: Japan

Abstract Title: An Optically-thick Disk Wind in GRO J1655-40?

Abstract: We revisited the unusual wind in the galactic black hole X-ray binary GRO J1655–40 detected with Chandra in 2005 April, using long-term RXTE X-ray data and simultaneous optical/near-infrared photometric data. This wind is the most convincing case for magnetic driving in black hole binaries, as it has an inferred launch radius which is a factor of 10 smaller than the thermal wind prediction. However, the optical and near-infrared fluxes monotonically increase around the Chandra observation, whereas the X-ray flux monotonically decreases from 10 days beforehand. Yet the optical and near-infrared fluxes are from the irradiated outer disk, so for them to increase implies that the X-rays likewise increased. We applied a new irradiated disk model to the multi-wavelength spectral energy distributions. Fitting the optical and near-infrared fluxes, we estimated the intrinsic luminosity at the Chandra epoch was >=0.7 L_Edd, which is more than one order of magnitude larger than the observed X-ray luminosity. These results could be explained if a Compton-thick, almost completely ionized gas was present in the wind and strong scattering reduced the apparent X-ray luminosity. The effects of scattering in the wind should be taken into account for discussion of the wind-driving mechanism. Radiation pressure and Compton heating may also contribute to powering the wind at this high luminosity. The X-ray continuum spectrum at the Chandra epoch is unusually soft. It can be described with a standard disk and an optically-thick (tau~5) and low-temperature (~1 keV) Comptonization component, which is similar to those estimated from ULX spectra. The unusual GRO J1655-40 wind, formed at around the Eddington luminosity, may be smoothly connected to massive outflows driven from supercritical accretion flows.

Registrant ID : 5

Dr. SORIA, Roberto

Email: roberto.soria@curtin.edu.au

Institution: ICRAR-Curtin University

City: Perth

Country: Australia

Abstract Title: Overview of ULX species

Abstract: After almost two decades of X-ray and multiband investigations, we are starting to converge on the scenario that most ULXs are stellar-mass binary systems with super-critical accretors. However, new questions have arisen. For example: a) do the various phenomenological differences correspond mostly to differences in the accretion rates or in the viewing angle? b) what fraction of ULXs is powered by black holes and what fraction by neutron stars? c) what fraction of super-critical accreting black holes have a relativistic jet, in addition to dense outflows, and what is the relative power carried by radiation, jets/winds, advection? d) what fraction of ULXs are transient and what persistent? I will review what has been discovered over the last few years and what we should try to learn in this workshop and in the forthcoming years.

Registrant ID : 34

Dr. SUTTON, Andrew

Email: andrew.d.sutton@nasa.gov

Institution: MSFC

City: Huntsville, Al

Country: United States

Abstract Title: Crossing the Eddington limit: examining disk spectra at high accretion rates

Abstract: The faintest ULXs (<3e39 erg/s) typically have X-ray spectra which are disc-like, but subtly broader than expected for standard thin accretion discs. These so-called broadened discs (BDs) are thought to represent accretion at around the Eddington rate on to stellar remnant black holes. Here we report results from a comparison of XMM-Newton EPIC and Swift XRT data from black hole binaries (BHBs) in the thermal dominant state, at moderate Eddington ratios, with a sample of BD ULXs. We find that the BHB spectra are similar in shape to the BD ULXs, and the two samples differ mainly in luminosity, by a factor of ~10. Such spectral broadening at moderate Eddington ratios could imply a missing physical mechanism in our accretion disc models. We discuss the implications of our results on the BD ULXs.

Registrant ID : 19

Dr. SWARTZ, Douglas

Email: doug.swartz@nasa.gov

Institution: NASA/MSFC/USRA

City: Huntsville, AL

Country: United States

Abstract Title: ULXs in galaxies

Abstract: Ultraluminous X-ray sources were recognized as an important new population since first discovered in the earliest extragalactic X-ray observations. Since then, advances in angular resolution and sensitivity have led to the identification of hundreds of examples of these enigmatic objects. Though there is a wide range in intrinsic ULX properties, many insights can be made through ULX demographic studies. I review the history of these studies and examine some of the future directions needed to make further progress.

Registrant ID : 28

Dr. TAKAHASHI, Hiroyuki

Email: takahashi@cfca.jp

Institution: National Astronomical Observatory of Japan

City: Tokyo

Country: Japan

Abstract Title: Accretion and Outflow Observed in GRRMHD Simulation

Abstract: Black hole or neutron star accretion disks are known to be one of the most energetic system in high-energy astrophysical phenomena. Especially, the super critical accretion disk is of interest since the large amount of gravitational energy is liberated. In this system, as can be represented by the Ultra Luminous X-ray sources, the relativistic outflows and hard X-rays are observed.
We performed general relativistic radiation magnetohydrodynamic (GRRMHD) simulations. We found that the disk near the black hole is not in LTE and the gas is overheated up to 10^{10} K. The strong magnetic field near the black hole leads to the enhancement of the magnetic stress (viscosity). This mechanism forms the overheated region near the black hole. It is expected that the Compton upscatterd photons in the overheated region contribute to observed hard X-rays spectra.
Next we performed GRRMHD simulations of gas accretion onto the non-magnetized neutron star. We found that strong outflow is emanated from the neutron star, since the gas and energy are reflected at the surface of the neutron star. Due to this effect, the outflow is more energetic than that for the non-rotating black hole. When the central star is rotating, the outflow power from the black hole accretion disk becomes much more energetic due to the Blandford-Znajek effect.
We discuss details of the origin of overheating in this talk.

Registrant ID : 36

Mr. URQUHART, Ryan

Email: ryan.urquhart@postgrad.curtin.edu.au

Institution: Curtin University

City: Perth

Country: Australia

Abstract Title: Discovery of the first eclipsing ULXs

Abstract: We present the discovery, from archival Chandra and XMM-Newton data, of X-ray eclipses in two ultraluminous X-ray sources (ULXs), located in the same region of the galaxy M 51. Three eclipses were detected for ULX-1, two for ULX-2. The presence of eclipses puts strong constraints on the viewing angle, suggesting that both ULXs are seen almost edge-on and are certainly not beamed towards us. Despite the similar viewing angle and luminosity (approximately 2 x 1039 erg s-1 in the 0.3-8 keV band), their X-ray properties are different. ULX-1 has a soft spectrum, well fitted by Comptonization emission from a medium with electron temperature kTe ≈ 0.8 keV. ULX-2 is harder, well fitted by a slim disk with kTin ≈1.4-2.0 keV. ULX-1 has a significant contribution from multi-temperature thermal plasma emission; about 15% of this emission remains visible during the eclipses, proving that the emitting gas comes from a region slightly more extended than the size of the donor star. From the sequence and duration of the Chandra observations in and out of eclipse, we constrain the binary period of ULX-1 to be either approximately 6.3 days, or 12.5 to 13 days. If the donor star fills its Roche lobe (a plausible assumption for ULXs), both cases require an evolved donor; most likely a blue supergiant, given the young age of the stellar population in that galactic environment.

Registrant ID : 25

Dr. VINOKUROV, Alexandr

Email: vinokurov@sao.ru

Institution: Special Astrophysical Observatory

City: Nizhnij Arkhyz

Country: Russian Federation

Abstract Title: Spectral energy distribution of ULXs

Abstract: We model spectral energy distribution of ultraluminous X-ray sources from X-ray to optical range using Shakura-Sunyaev approach for supercritical disks. We consider a funnel in the disk and the wind arising in the funnel. The wind is illuminated by the funnel radiation reprocessing the radiation to UV and optical ranges. We take into account Comptonization in a hot corona which covers the inner parts of the supercritical disk. We apply the model for three ultraluminous X-ray source: Holmberg IX X-1, NGC 1313 X-1 and NGC 5408 X-1.

Registrant ID : 27

Prof. WEBB, Natalie

Email: Natalie.Webb@irap.omp.eu

Institution: IRAP

City: Toulouse

Country: France

Abstract Title: Searching for intermediate mass black holes

Abstract: Intermediate mass black holes (IMBHs) are thought to be the building blocks of supermassive black holes that are found in the centres of the more massive galaxies. However, until recently, the observational evidence for IMBHs has been weak, which poses problems for understanding the origin of supermassive black holes. Two promising environments to search for IMBHs include the centres of low mass galaxies and in the most luminous of the ultra lumimnous X-ray sources, the hyper-luminous X-ray sources (HLXs). In this talk I will present recent results on the environment around the best studied intermediate mass black hole candidate HLX-1, which has a mass of ~1e4 solar masses and I will present evidence for other candidate intermediate mass black holes detected in low mass galaxies through the black hole mass versus bulge luminosity relationship and tidal disruption events. I will also discuss other candidates associated recently discovered HLXs.

Registrant ID : 7

Mr. WIKTOROWICZ, Grzegorz

Email: gwiktoro@astrouw.edu.pl

Institution: University of Warsaw

City: Warsaw

Country: Poland

Abstract Title: Nature of the Extreme Ultraluminous X-ray Sources

Abstract: In this proof-of-concept study we demonstrate that in a binary system mass can be transferred toward an accreting compact object at extremely high rate. If the transferred mass is efficiently converted to X-ray luminosity (with disregard of the classical Eddington limit) or if the X-rays are focused into a narrow beam then binaries can form extreme ULX sources with the X-ray luminosity of L_x >= 10^42 erg/s. For example, Lasota & King argued that the brightest known ULX (HLX-1) is a regular binary system with a rather low-mass compact object (a stellar-origin black hole or a neutron star).

The predicted formation efficiencies and lifetimes of binaries with the very high mass transfer rates are large enough to explain all observed systems with extreme X-ray luminosities. These systems are not only limited to binaries with stellar-origin black hole accretors. Noteworthy, we have also identified such objects with neutron stars. Typically, a 10 Msun black hole is fed by a massive (~10 Msun) Hertzsprung gap donor with Roche lobe overflow rate of ~ 10^-3 Msun/yr (~ 2600 Mdot_Edd). For neutron star systems the typical donors are evolved low-mass (~2 Msun) helium stars with Roche lobe overflow rate of ~ 10^-2 Msun/yr.

Our study does not prove that any particular extreme ULX is a regular binary system, but it demonstrates that any ULX, including the most luminous ones, may potentially be a short-lived phase in the life of a binary star.

Registrant ID : 15

Dr. WOLTER, Anna

Email: anna.wolter@brera.inaf.it

Institution: INAF-Osservatorio Astronomico di Brera

City: Milano

Country: Italy

Abstract Title: Intermediate vs heavy stellar: what is the size of BHs in the ULXs?

Abstract: Ultraluminous X-ray sources pose still many interesting puzzles even after many years of active theoretical work and new discoveries. The largest consensus is that most of the ULXs in late type galaxies are powered by accretion in a binary system, while a fraction might be supernovae. Some contamination is always possible but much less than in early type galaxies. They are linked to SF episodes and possibly to low metallicity environs. One of the main issues is the dimension of the compact object powering the system. In the last years a trend from the IMBH (10^3-4 Msun) to the "heavy stellar mass" (around 100 Msun) has been evident in the literature as the favorite interpretation, with an apex at the discovery of the Neutron Star counterpart of a ULX in M82. However a few objects, dubbed HyperLuminous (HLX), are very difficult to explain with smaller objects. Are there really two population of binary ULXs? If so, we argue that ring galaxies (RiG) are the best place in which to search for them.

We collect all the observation of RiG with Chandra (the Cartwheel, Arp 284, Arp 147, NGC 922, AM 0644-741 and Arp 148) and derive the Xray Luminosity Function (XLF) of their point sources and compare it with models (like the X-ray Binaries XLF) and other surveys' results.

We also present the results from our "control sample" of RiG from the Arp & Madore sample at a spectroscopic redshift z <0.2 and discuss the comparison.

Registrant ID : 31

Dr. YOSHIDA, Tessei

Email: yoshida.tessei@astro.phys.sci.ehime-u.ac.jp

Institution: Ehime University

City: Matsuyama-shi, Ehime-ken

Country: Japan

Abstract Title: Two Types of Outbursts of the Ultraluminous X-Ray Source NGC1313 X-1: Two Years Continuous Observation with Swift/XRT

Abstract: Ultraluminous X-ray sources (ULXs) are known to vary X-ray luminosities with one order of magnitude. The observations with XMM-Newton, Suzaku, and so on have revealed detailed spectra of ULXs in the high and low luminosity states, but the behavior of the transitions between the two states (i.e., just rising and decaying phases during outbursts), is still unclear due mainly to the sparse data sampling.

In order to explore the characteristic behavior during the outbursts in ULXs, we analyzed two years (since 2013 June) continuous observations of NGC1313 X-1 obtained by a long-term monitoring with Swift/XRT. We found that X-1 has experienced the low luminosity state (about 7*10^39 erg/s, a quiescent stable phase) and two types of outbursts: One is month-scale outbursts with relatively modest brightening (to 9*10^39 erg/s) and spectral softening. Contrastingly, the other type shows day-scale, remarkable brightening (to 4*10^40 erg/s) with spectral hardening. We also found a distinctive behavior just before some outbursts.

Based on best-fit parameters of each phase and the hysteresis variation of NGC1313 X-1, we suggest a possibility of a "super-critical hetero-accretion flow" model, which composes of the moderately/highly massive super-critical inner/outer accretion disk. The luminosity and spectral variations of X-1 may be caused by moves of a joint surface of a hetero-accretion flow, which propagates inwards and outwards.

Registrant ID : 32

Dr. ZAMPIERI, Luca

Email: luca.zampieri@oapd.inaf.it

Institution: INAF-Astronomical Observatory of Padova

City: Padova

Country: Italy

Abstract Title: GTC/Swift variability campaign of Holmberg IX X-1

Abstract: L. Zampieri, M. Fiori, E. Bertone, E. Ripamonti, P. Esposito, F. Grise', F. Pintore, T.P. Roberts, R. Soria

Despite the significant observational progress made in the last years, dynamical measurements of the mass function of Ultraluminous X-ray sources (ULXs) are still limited to two cases. In particular, measurements of the orbital period are hampered by several factors, not least the small number of monitoring campaigns that have been awarded the required high-quality observing time and the amount of intrinsic stochastic variability of the sources. Understanding the multiwalength variability patterns of ULXs is of prime importance not only to determine possible periodicities but also to constrain the physical nature of these systems. Here we report the preliminary results of a ~1 year long photometric monitoring campaign of Holmberg IX X-1 carried out with the OSIRIS camera at the Gran Telescopio Canarias (21 epochs) and the Swift XRT telescope (more than 120 observations). Holmberg IX X-1 was already known to have optical variations of ~0.14 mag. Indeed, our preliminary results show that the source displays significant optical variability at times when the X-ray flux is highly variable. During this flaring phase, changes in the optical flux appear to be correlated with changes in the X-ray flux. However, the time lag of the optical emission is long in comparison with the light travel time and the X-ray reprocessing time in the system. No clear evidence of periodic modulations is found. We shortly address the implications of these observations for the origin of the variability of Holmberg IX X-1 and for the prospects of follow-up campaigns aimed at determining its orbital period.

Registrant ID : 18

Dr. ZOLOTUKHIN, Ivan

Email: ivan.zolotukhin@gmail.com

Institution: IRAP

City: Toulouse

Country: France

Abstract Title: A search for hyperluminous X-ray sources in the XMM-Newton source catalog

Abstract: We present a new method to identify luminous off-nuclear X-ray sources in the outskirts of galaxies from large public redshift surveys, distinguishing them from foreground and background interlopers. Using the 3XMM-DR5 catalog of X-ray sources and the SDSS DR12 spectroscopic sample of galaxies, with the help of this off-nuclear cross-matching technique, we selected 98 sources with inferred X-ray luminosities in the range 10^41 < L_X < 10^44 erg s^-1, compatible with hyperluminous X-ray objects (HLX). To validate the method, we verify that it allowed us to recover known HLX candidates such as ESO 243-49 HLX-1 and M82 X-1. From a statistical study, we conservatively estimate that up to 71 ± 11 of these sources may be foreground- or background sources, statistically leaving at least 16 that are likely to be HLXs, thus providing support for the existence of the HLX population. We identify two good HLX candidates and using other publicly available data sets, in particular the VLA FIRST in radio, UKIRT Infrared Deep Sky Survey in the near-infrared, GALEX in the ultraviolet and Canada-France-Hawaii Telescope Megacam archive in the optical, we present evidence that these objects are unlikely to be foreground or background X-ray objects of conventional types, e.g., active galactic nuclei, BL Lac objects, Galactic X-ray binaries, or nearby stars. However, additional dedicated X-ray and optical observations are needed to confirm their association with the assumed host galaxies and thus secure their HLX classification. We also present early results of our ongoing observational campaign to follow-up these HLX candidates.