Second International Spectrum-RG Conference

Science with eROSITA and ART-XC aboard Spectrum-RG

Kazan, 3-7 September, 2012

Kazan, Russia

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Spectrum-Roentgen-Gamma (Spectrum-RG) observatory is planned to be launched in 2013 into an L2 orbit. Over the first 4 years, its X-ray telescopes eROSITA and ART-XC will survey the whole sky with a record sensitivity in the 0.5-10 keV energy band. It is expected that the survey will discover practically all massive clusters of galaxies in the observable Universe and provide a uniquely rich database for studying the large scale structure of the Universe, testing cosmological models and constraining the nature of dark energy. The survey should also discover several millions of active galactic nuclei with which it will be possible to trace the history of growth of supermassive black holes in evolving galaxies. There also will be extensive observations of essentially all classes of Galactic X-ray sources, such as active stars, cataclysmic variables and X-ray binaries, as well as on hot diffuse interstellar and intergalactic media.

Abstracts

Monique Arnaud (CEA - Service d'Astrophysique, France)

XMM observations of clusters of galaxies and their identification

N/A

Solen Balman (Middle East Technical University)

X-ray Observations of Dwarf Novae

Diversity of the X-ray observations of dwarf nova are still not fully understood. I will summerize the X-ray spectral characteristics of dwarf novae during the quiescence and outburst. These different behaviour will be discussed in the light of DIM and the characteristics of the periodic and aperiodic variability in dwarf novae systems. I will also review nature of aperiodic time variability of brightness of dwarf novae. I show that light curves (chosen from XMM-Newton data) of dwarf novae systems in UV and X-ray energy bands demonstrate band limited noise. The frequency of the break indicates inner disk truncation with a range of radii $(3-10)\times10^{+9}$ cm. I show that the RXTE data od SS Cyg in outburst and quiescence reveal that the inner disk radius moves towards the white dwarf and receeds as the outburst declines to quiescence. Cross-correlations between the simultaneous UV and X-ray light curves find time lags in the X-rays of 96-181 sec consistent with travel time of matter from a truncated inner disc to the white dwarf surface.

Bradford Benson (University of Chicago, USA)

The South Pole Telescope: The Sunyaev-Zel'dovich Cluster Survey and Future Plans // The SPT collaboration

The 10-meter South Pole Telescope (SPT) is a millimeter wavelength telescope that recently completed a 2500 sq. deg. survey at 95, 150, and 220 GHz with unprecedented depth and angular resolution. SPT has already led to several major cosmological results, derived from measurements of the fine angular scale primary and

secondary CMB anisotropies, and the discovery of galaxy clusters via the Sunyaev-Zel'dovich (SZ) effect. I will give an overview of the latest cosmological results from the SPT, including constraints on dark energy, the mass of the neutrinos, the number of relativistic particle species, and the duration of the epoch of reionization. I will also give an overview of the status and plans to equip the SPT with even more sensitive polarization-sensitive instruments, including the currently operating SPTpol and the future SPT-3G experiments. SPTpol and SPT-3G will continue the current science goals of the SPT, and additionally measure the polarization of the CMB, which will be used to make high signal-to-noise measurements of the gravitational lensing of the CMB by large-scale structure, improve constraints on the mass of the neutrinos, and to search for signatures from Inflation and constrain its energy scale.

Ilfan Bikmaev (Kazan Federal University, Russia)

RTT-150 capabilities for optical follow-up eROSITA and ART-XC targets

// N.Sakhibullin(1), M.Pavlinsky (2), R.Sunyaev (2,3), R.Burenin (2), M.Revnivtsev(2), R. Gumerov
Kazan Federal University, Kazan, Russia, 2 - Space Research Institute, Russian Academy of Sciences, Moscow, Russia, 3 - Max-Planck Institute for Astrophysics, Garching, Germany

We will report the observational capabilities of the 1.5-meter Russian-Turkish telescope (RTT-150) on the optical follow-up of eROSITA and ART-XC targets based on our optical observations of X-Ray sources detected by INTEGRAL, RXTE, ROSAT, SWIFT.

Dmitry Bisikalo (Institute of Astronomy, RAS, Russia)

Accretion disks in close binary stars

We discuss physical processes occurring due the mass transfer between the components of close binary stars (CBS). To study the main properties of accretion disks and envelopes in different types of CBS we use results of three-dimensional HD and MHD numerical simulations. Special attention is paid to description of shock waves and density waves in the disks. In the frame of the self-consistent description of the MHD flows in CBS we have derived the conditions of the disk formation and found a criterion that splits two types of the flow corresponding to intermediate polars and polars. We have also investigated variations of the main characteristics of the disks depending on the value of the magnetic induction and analyzed the process of the magnetic field generations in the disks. In particular, it has been found that the quasi-periodic generation of the toroidal magnetic field in the disks leads to the alternation of the accretion and decretion regimes in the inner regions of the disk.

The main observational manifestations of the numerically found flow structure elements are also presented.

Hans Boehringer (Max Planck Institute for Extraterrestrial Physics, Germany)

Cosmological Studies with galaxy Clusters

// Gayoung Chon, Luigi Guzzo, Chris Collins

On the basis of the ongoing studies with the largest sample of X-ray luminous clusters which has been compiled from the ROSAT All-Sky Survey I illustrate various aspects of characterising the galaxy cluster population in the Universe, in assessing the large scale structure, and in constraining cosmological models. This work provides a comprehensive insight into the ingredients that go into cosmological modelling of an X-ray galaxy cluster survey. Several important ingredients will be discussed, e.g. the importance of well defined scaling relations of galaxy clusters. Based on this experience I give an outlook to the prospects of the eROSITA Survey.

Akos Bogdan (Smithsonian Astrophysical Observatory/CfA, USA)

The asynchronous evolution of bulges and supermassive black holes in NGC4342 and NGC4291

// William R. Forman, Irina Zhuravleva, J. Christopher Mihos, Ralph P. Kraft, Paul Harding, Qi Guo, Zhiyuan Li, Eugene Churazov, Alexey Vikhlinin, Paul E. J. Nulsen, Sabine Schindler, Christine Jones

According to the theoretical paradigm, supermassive black holes and galaxy bulges are believed to co-evolve, that is they grow in tandem and regulate each others growth. NGC4342 and NGC4291 are relatively nearby early-type galaxies, which host unusually massive black holes relative to their low bulge masses. The black hole-to-bulge mass ratios of NGC4342 and NGC4291 are $\sim$6.9% and $\sim$1.9%, which significantly exceed the typical observed ratio of $\sim$0.2%. Based on Chandra X-ray observations, we show the presence of extended dark matter halos around NGC4342 and NGC4291, thereby demonstrating that the observed low bulge masses are not due to tidal stripping, in which dominant fraction of the stellar population has been lost. We thus conclude that the supermassive black holes and the bulges did not co-evolve, as opposed to current theoretical models. The presence of massive dark matter halos around NGC4342 and NGC4291 implies that dark matter halos may play a fundamental role in regulating the black hole growth.

Marcella Brusa (Max Planck Institute for Extraterrestrial Physics, Germany)

The golden epoch of AGN-galaxy co-evolution: prospects for eROSITA

I will present recent results on AGN-galaxy co-evolution of low to moderate luminous X-ray selected AGN from the CDFS and COSMOS surveys. I will particularly focus on observed AGN (e.g. obscured AGN fraction, space density) and galaxy (e.g. masses, SFR) properties that have been used in the recent years to constrain models of AGN triggering and evolution. I will also discuss the expected contribution of the eROSITA survey towards a better understanding of the co-eval AGN-galaxy growth: for the first time eROSITA will provide a sizable sample (> 1000) of X-ray selected obscured AGN with $L_x > 45$, still lacking in current X-ray surveys, which represent the ideal laboratories to study the effect of AGN feedback (if any) on the host galaxy properties. Synergies with other multiwavelength surveys which will be available in the eROSITA time frame will also be discussed.

Rodion Burenin (Space Research Institute (IKI), Russia)

Optical identifications of galaxy clusters in SRG all sky survey

The strategies and methodology of optical identification of galaxy clusters in SRG all sky survey and their further redshift measurements will be considered. The potential of usage of publicly available optical surveys and the amount of additional optical observations will be discussed. The consideration will be based on the similar work made earlier in frames of 400 square degree ROSAT galaxy cluster survey and during the optical identifications of galaxy clusters detected by Plank observatory.

Vadim Burwitz (Max Planck Institute for Extraterrestrial Physics, Germany)

eROSITA testing and calibration activities at the MPE Panter X-ray test facility // W. Burkert, H. Bruninger, K. Dennerl, M. Freyberg, P. Friedrich, B. Menz, G. Hartner, MPE, Garching, Germany

A description of testing and calibration activities at the MPE Panter X-ray test facility of the eROSITA mirror modules, and the on board X-ray calibration source will be presented. Also activities concerning the testing of the CCD cooling system and preparation of the telescope structure parts will be described.

Gayoung Chon (Max Planck Institute for Extraterrestrial Physics, Germany)

Understanding the large scale structure with the REFLEX II catalogue // Hans Boehringer, Nina Nowak

The ROSAT-ESO Flux Limited X-ray Galaxy Cluster Survey (REFLEX) II catalogue has been completed with a flux-limit of 1.8×10^{-12} erg/s/cm^2 in the 0.1-2.4 keV ROSAT band. Larger than its predecessor by a factor of two comprising 918 galaxy clusters it is the largest homogeneous X-ray cluster catalogue existing today with a well-understood selection function. Among the series of the upcoming work to diagnose the large scale structure in the universe we present our effort to compile the first supercluster catalogue based on an X-ray flux-limited sample using a friends-of-friends algorithm. We study the statistics of the sample and investigate the effect of environment on the physical properties of the clusters. We discuss the prospects for the eROSITA.

Eugene Churazov (IKI, Russia; MPA, Germany)

Galaxy clusters in X-rays: plasma physics, AGN feedback and Cosmology

N/A

Nicolas Clerc (Max Planck Institute for Extraterrestrial Physics, Germany)

Cosmological interpretation of large X-ray cluster surveys with CR-HR diagrams

In this talk I will describe the CR-HR method jointly taking into account ICM properties and cosmological parameters with minimal assumptions and show how this method can be applied to the analysis of large cosmological X-ray surveys. I will then present the results we obtained from a large, serendipitous XMM-Newton cluster survey: X-CLASS, in particular concerning cluster X-ray scaling laws. I will show how this method can be applied to the eRosita extragalactic survey and discuss corresponding cosmological forecasts.

Miguel de Avillez (University of Evora, Portugal)

The Signature of Non-equilibrium Ionization and

time-dependent Cooling of the Interstellar Medium
// Dieter Breitschwerdt

The interstellar medium (ISM) is a dynamical system, in which the plasma is naturally driven out of ionization equilibrium due to atomic and dynamic processes, operating on different time scales. We review the effects of the history of the plasma on the cooling function and the associated non-equilibrium X-ray emission, derived from recent 3D high resolution simulations. Our most important results are: (1) in a dynamical ISM, the time-dependent ionization structure and, therefore, the cooling function, varies in space and time, depending on the initial conditions and its history, (2) the cooling paths can be quite different for gas with the same initial temperature, but having different evolution histories, and (3) due to delayed recombination in a dynamic plasma, X-ray emission can occur at low temperatures becoming, eventually, stronger than the corresponding emission from a plasma in collisional ionization equilibrium at $10^{6.2}$ K. This has far reaching consequences for the interpretation of EUV/X-ray spectra, which will be briefly discussed.

Konrad Dennerl (Max Planck Institute for Extraterrestrial Physics, Germany)

Comets, charge exchange, and a novel look at the X-ray Universe with eROSITA

The discovery of cometary X-ray emission in 1996 with Rosat has revealed the astrophysical importance of charge exchange (CX) for the generation of X-rays. CX is fundamentally different from other X-ray processes, because the X-rays are not produced by hot electrons, but by ions picking up electrons from neutral gas. Comets represent the best natural laboratory for investigating the physics of CX. With its high sensitivity to soft X-rays, its high spectral resolution, and its large field of view, eROSITA will be an ideal satellite for studying the CX interaction of the solar wind with comets and sampling the heavy ion flux at various heliographic latitudes and phases of the solar cycle. The potential of eROSITA for CX studies, however, is not restricted to comets. Also the heliosphere is a source of CX emission. The fact that eROSITA will scan the sky from the L2 region will provide an unprecedented opportunity to map the diffuse X-ray emission from the whole sky, unaffected by emission from the geocorona. By measuring the energy difference between the emission lines from H- and He-like ions, it may become possible to separate CX emission from thermal components of the diffuse soft X-ray emission. The fact that eROSITA will perform eight all-sky surveys will allow to distinguish between temporally variable and persistent features and thus provide an additional, unique opportunity for separating heliospheric emission from other components of the diffuse X-ray emission, in particular from the Local Hot Bubble.

Serguei Nikolaevitch Dodonov (Special Astrophysical Observatory RAS, Russia)

Power of medium band imaging

An observational technique which consists of repeated imaging of a field through a series of medium band (200 - 300 A FWHM) filters are described . Photometry of each image then provides low-resolution spectrophotometry of all detected objects. For faint objects this method comparable in efficiency to slitless spectroscopy, and cover a larger wavelength range. The principal advantages of the method are simplicity, accuracy in crowded fields, accurate sky subtraction, and ability to measure many objects simultaneously. The photometric measurements from medium band filters provide low resolution spectra for each object which are analysed by a statistical technique for classification and redshift estimation based on spectral template matching. On the base of existing medium band surveys and our observations on 6-m Telescope we discuss the possibility of using medium band observations in optical identification and classification of SRG-objects.

Alexis Finoguenov (MPE / University of Helsinki, Germany/ Finland)

CODEX: prototype for eROSITA cluster survey

// M.Mirkazemi, E.Rykoff, E.Rozzo, T.Plagge, J.P.Kneib, R.Dupke, J.Henry, L. van Waerbike, J. Carlstrom, P.Spinelli

We conduct the CODEX survey to obtain competitive Dark Energy constraints from X-ray clusters. For an unprecedented volume-limited sample of the 294 most massive X-ray selected clusters within the 10,000 sq.degs. BOSS area, we will secure the low-scatter X-ray mass proxies, comprehensive weak lensing calibration, and SZ observations. This survey will be complete to a redshift $z < 0.55$ for cluster masses above 4.2×10^{14}/h Msun. The cosmological promise of this unique sample is high, with a Dark Energy Task Force Figure of Merit (FoM) equal to 160, achieved in combination with BOSS BAO measurements. CODEX is the prototype for eROSITA cluster survey and allows us to prepare the multiwavelength follow-up data, which will be of primary importance for eROSITA cluster science on both parts of the sky. In the talk, the advances in weak lensing, Sunyaev-Zeldovich and spectroscopic studies will be presented.

Marat Gilfanov (IKI, Russia; MPA, Germany)

AGN and normal galaxies in the eROSITA all-sky survey

N/A

Stefan Gillessen (Max-Planck-Institute for Extraterrestrial Physics, Germany)

A gas cloud on its way towards the supermassive black hole at the Galactic Centre

Measurements of stellar orbits provide compelling evidence that the compact radio source Sagittarius A* at the Galactic Centre is a black hole four million times the mass of the Sun. With the exception of modest X-ray and infrared flares Sgr A* is surprisingly faint, suggesting that the accretion rate currently is very low. In 2011 we discovered a dense gas cloud approximately three times the mass of Earth that is falling into the accretion zone of Sgr A*. Our observations fully constrain the clouds orbit. It is highly eccentric with a pericenter distance of only 3100 times the Schwarzschild radius. The pericenter passage will happen in summer 2013 and already now we can see that the cloud has begun to tidally disrupt due to the black holes gravitational force. The cloud also is a probe for the properties of the accretion flow, and ultimately we might have a chance to see how a massive black hole is being fed.

Yuri Nickolaevich Gnedin (Central Astronomical Observatory at Pulkovo of RAS, Russia)

Magnetic fields of active galactic nuclei and quasars

// N.A. Silant'ev, S.D. Buliga, M.Yu. Piotrovich, T.M. Natsvlishvili

We present estimates of magnetic field in a number of AGNs from the Spectropolarimetric atlas of Smith, Young & Robinson (2002) from the observed degrees of linear polarization and the positional angles of spectral lines (H_α) (broad line regions of AGNs) and nearby continuum. The observed degree of polarization is lower than the Milne value in a nonmagnetized atmosphere. We hypothesize that the polarized radiation escapes from optically thick magnetized accretion discs and is weakened by the Faraday rotation effect. The Faraday rotation depolarization effect is able to explain both the value of the polarization and the position angle. We estimate the required magnetic field in the broad line region by using simple asymptotic analytical formulas for Milnes problem in magnetized atmosphere, which take into account the last scattering of radiation before escaping from the accretion disc. The polarization of a broad spectral line escaping from disc is described by the same mechanism. The characteristic features of polarization of a broad line is the minimum of the degree of polarization in the center of the line and continuous rotation of the position angle from one wing to another. These effects can be explained by existence of clouds in the left (keplerian velocity is directed to an observer) and the right (keplerian velocity is directed from an observer) parts of the orbit in a rotating keplerian magnetized accretion disc. Assuming a power-law dependence of the magnetic field inside the disc, we obtain the estimate of the magnetic field strength at first stable orbit near the central supermassive black

hole (SMBH) for a number of AGNs from the mentioned Spectropolarimetric atlas.

Sergei Grebenev (Space Research Institute (IKI), Russia)

Supergiant Fast X-ray Transients - status and prospects for study with Spectrum-RG

I review observational properties and theoretical models of Supergiant fast X-ray transients (SFXTs), a new population of X-ray binaries discovered with INTEGRAL, compare them with the other wind-fed accretors (persistent supergiant binaries and Be-systems) and other X-ray transient sources, discuss their location in the $P_{spin} - P_{orbit}$ diagram emphasizing the importance of measuring both these periods for all SFXTs, and finally consider opportunities for their study with Spectrum-RG. In particular, I discuss the importance of measuring their fluxes and spectra in the quiescent state and searching for previously unknown faint sources with similar properties in our and nearby galaxies to prepare a list of candidates in new SFXTs for their further study.

Mikhail Viktorovitch Gubarev (NASA/Marshall Space Flight Center, USA)

Development of Mirror Modules for the ART-XC Instrument

// B. Ramsey, S.L. ODell, R. Elsner, K. Kilaru, J. McCracken, M. Pavlinsky, A. Tkachenko, I. Lapshov

The Marshall Space Flight Center (MSFC) is developing x-ray mirror modules for the ART-XC instrument on board the Spectrum-Roentgen-Gamma Mission under a Reimbursable Agreement between NASA and the Russian Space Research Institute (IKI) ART-XC will consist of seven co-aligned x-ray mirror modules with seven corresponding CdTe focal plane detectors. Currently, four of the modules are being fabricated by the Marshall Space Flight Center (MSFC.) Each MSFC module provides an effective area of 65 cm2 at 8 keV, response out to 30 keV, and an angular resolution of 45 arcsec or better HPD. We will present a status of the ART x-ray module development at MSFC.

Tolga Guver (Sabanci University, Turkey)

Modeling the X-ray Spectra of Magnetars

// Ersin Gogus, Feryal Ozel

Observed X-ray spectra of strongly magnetized neutron stars reflect the effects of two distinct components at or near the surface of these sources. At the surface, the fully

ionized highly magnetic Hydrogen atmosphere determines the shape of the continuum spectrum. Furthermore, the interaction of photons with protons in the plasma gives rise to an absorption feature at the proton cyclotron energy that is somewhat weakened by the vacuum polarization resonance. In the magnetosphere these surface photons are further scattered by mildly relativistic charges, causing the observed spectral shape to be further affected. Resulting X-ray spectrum shows significant deviations from a Planck distribution and therefore often fit with a combination of two empirical models like the blackbody plus a power-law. We have developed self-consistent theoretical models that take into account all the relevant physical processes in the surface and in the magnetosphere of magnetars. In this talk I will summarize the properties of this model and present the results we have obtained so far from fitting the observed X-ray spectra of magnetars. I will also discuss expected implications of e-ROSITA and ART-XC observations of magnetars to our studies both during the survey phase and with pointed observations. These two detectors will provide a unique data set covering both the very soft and hard end of X-rays simultaneously.

Guenther Gustav Hasinger (Institute for Astronomy, University of Hawaii Manoa, USA)

Possibilities for eROSITA cooperation with Hawaii ground-based facilities

As one of the premier astronomy sites in the world, Hawai'i is well positioned to assume a leadership role in the development of the next generation of the world's most powerful ground-based telescopes: the Thirty Meter Telescope (TMT), the Advanced Technology Solar Telescope (ATST), and Pan-STARRS, all slated for the Hawaiian islands. The development of these new facilities represents great scientific potential for the astronomy research community. Pan-STARRS, an innovative wide-field imaging facility developed at IfA, has been operational via its first telescope, PS1, since 2010. With the largest digital camera ever built - 1.4 Gigapixels - and an unprecedented field of 7 deg^2, PS1 generates a time-lapse movie of the Northern sky in 5 pass-bands. PS1 has already discovered a number of potentially hazardous asteroids, comets, and a new class of very luminous supernova explosions. The second telescope, PS-2, is under construction on Haleakala. The TMT, ready for construction on Mauna Kea, will be among the world's most advanced ground-based observatories, operating in wavelengths ranging from the ultraviolet to mid-infrared, integrating the most modern innovations in precision control, segmented mirror design, and adaptive optics. It will address bold scientific questions like the search for habitable extrasolar planets, the First Light in the Universe, the earliest Black Holes and the nature of space itself. Combining the excellent sensitivity of the eROSITA survey with the powerful optical, NIR and sub-mm capabilities of the Hawaiian telescopes will allow for fruitful cooperations in many different areas of science.

Gert Huetsi (Max Planck Institute for Astrophysics, Germany)

Angular fluctuations in the CXB: Is Fe 6.4 keV line tomography of the large-scale structure feasible?

// Marat Gilfanov Rashid Sunyaev

AGN are known to account for a major fraction, if not all, of the Cosmic X-ray background radiation. The dominant sharp spectral feature in their spectra is the 6.4 keV fluorescent line of iron, which may contribute as much as $\sim 5-10\%$ to the CXB spectral intensity at $\sim 2-6$ keV. Due to cosmological redshift, the line photons detected at the energy E carry information about objects located at the redshift $z = 6.4/E - 1$. In particular, imprinted in their angular fluctuations is the information about the large-scale structure at redshift z. This opens a possibility to perform the Fe K_α line tomography of the cosmic large-scale structure. The tomographic signal is strongest for objects located at the redshift $z \sim 1$, and at the angular scales corresponding to $\ell \sim 100-300$, therefore an optimal detection can be achieved with an instrument having a rather modest angular resolution of $\sim 0.1-0.5^\circ$. For such an instrument, the CCD-type energy resolution of $\sim 100-200$ eV FWHM is entirely sufficient for the optimal separation of the signals originating at different redshifts. Among the currently planned and proposed missions, these requirements are best satisfied by LOFT, despite the fact that it was proposed for entirely different purpose. Among others, clear detection should be achieved by WFXT ($\sim 20-35\sigma$) and ATHENA ($\sim 10-20\sigma$). eROSITA, in the course of its 4 years all-sky survey, might also lead to a weak detection of the signal.

Dmitry Ivanov (Institute of Applied Astronomy RAS, Russia)

Radio Observations of the Cosmic Gamma-Ray Burst on "Quasar" Network Telescopes

// A.V. Ipatov, D.V. Ivanov, M.A. Kharinov. Institute of Applied Astronomy, Russian Academy of Sciences (St. Petersburg, Russia)

"Quasar" network of the Institute of Applied Astronomy consists of three 32-m fully steerable radio telescopes RT-32, located at the Svetloe, Zelenchukskaya and Badary observatories. Nowadays Quasar is fully operational and regularly participates in the observational programs of IVS, EVN, RadioAstron, etc. From the beginning of 2003 radio telescopes of the "Quasar" network have been used in a single-dish mode for observing radio emission afterglows of the cosmic gamma-ray bursts (GRB) at X-band. Minimum flux density that can be detected by RT-32 at X-band wavelength is about 6 mJy at 3σ level while the weather conditions are fine. As a result there were observed totally 67 GRBs, including associated supernovas (SN). Radio emission was detected from GRB030329, SGR1806-20, GRB080319B and GRB110328A using generally a method of drift scanning by elevation. To integrate the signal the scanning of each GRB source was repeated from one to four hours. Observations were carried out within the elevations range from 45° to 70°. Dependence of antenna

efficiency from elevation was defined observing reference sources 3C295, 3C48, 3C286 and 3147. The daily session was formed in such a manner that between hour-long observations of investigated sources the reference sources observations of ten minutes in duration were placed. Scheduling and processing of observations were made with a special program packages developed in IAA RAS: SchedMaker and ClassVisual.

Vladislav V. Izmodenov (Space Research Institute (IKI), Lomonosov Moscow State University, Russia)

Charge transfer reactions at interfaces between neutral gas and plasma: Dynamical effects and X-ray emission

// Elena A. Provornikova

Charge-transfer is the main process linking neutrals and charged particles in the interaction regions of neutral (or partly ionized) gas with a plasma. In this paper we illustrate the importance of charge-transfer with respect to the dynamics and the structure of neutral gas-plasma interfaces. We consider the following phenomena: (1) the heliospheric interface - region where the solar wind plasma interacts with the partly-ionized local interstellar medium (LISM) and (2) neutral interstellar clouds embedded in a hot, tenuous plasma such as the million degree gas that fills the so-called "Local Bubble". In (1), we discuss several effects in the outer heliosphere caused by charge exchange of interstellar neutral atoms and plasma protons. In (2) we describe the role of charge exchange in the formation of a transition region between the cloud and the surrounding plasma based on a two-component model of the cloud-plasma interaction. In the model the cloud consists of relatively cold and dense atomic hydrogen gas, surrounded by hot, low density, fully ionized plasma. We discuss the structure of the cloud-plasma interface and the effect of charge exchange on the lifetime of interstellar clouds. Charge transfer between neutral atoms and minor ions in the plasma produces X-ray emission. Assuming standard abundances of minor ions in the hot gas surrounding the cold interstellar cloud, we estimate the X-ray emissivity consecutive to the charge transfer reactions. Our model shows that the charge-transfer X-ray emission from the neutral cloud-plasma interface may be comparable to the diffuse thermal X-ray emission from the million degree gas cavity itself.

Ildar Khabibullin (Space Research Institute (IKI), Russia)

SRG/eROSITA prospects for detection of GRB afterglows

// S. Yu. Sazonov, R. A. Sunyaev

We discuss the potential of the eROSITA telescope on board the *Spectrum-X-Gamma* observatory to detect gamma-ray burst (GRB) X-ray afterglows during its 4-year all-sky survey. The expected rate of afterglows associated with long-duration GRBs

without any information on the bursts proper that can be identified by a characteristic power-law light curve in the eROSITA data is 4–8 events per year. An additional small number, $\lesssim 2$ per year, of afterglows may be associated with short GRBs, ultra hard (GeV) GRBs and X-ray flashes. eROSITA can thus provide the first unbiased (unaffected by GRB triggering) sample of $\lesssim 40$ X-ray afterglows, which can be used for statistical studies of GRB afterglows and for constraining the shape of the GRB $\log N$–$\log S$ distribution at its low-fluence end. The total number of afterglows detected by eROSITA may be yet higher due to orphan afterglows and failed GRBs. The actual detection rate could thus provide interesting constraints on the properties of relativistic jets associated with collapse of massive stars. Finally, eROSITA can provide accurate ($\lesssim 30''$) coordinates of newly discovered afterglows within a day after the event, early enough for scheduling further follow-up observations.

Viktor Khartov (Lavochkin Association, Russia)

SRG project status and overview

N/A

Dmitry Klochkov (IAAT, Uni. Tuebingen, Germany)

Luminosity-related spectral changes as a probe of the accretion regime in accreting pulsars

// A. Santangelo, R. Staubert, P.A. Becker, G. Schoenherr, C. Ferrigno

We discuss the dependences of the X-ray spectra of accreting binary pulsars on their luminosity. Our systematic study of the spectrum-luminosity dependences based on the new and archival X-ray data taken with INTEGRAL and RXTE on a sample of bright accreting pulsars indicates the presence of two distinct types of spectral variations with flux. Accreting pulsars with luminosities above $\sim 10^{37}$ erg/s show a softening of their spectral continuum and a decrease of the cyclotron line energy with flux. In the sources whose luminosity stays below or around $\sim 10^{37}$ erg/s an opposite behavior is observed. Our analysis shows that the spectrum-luminosity dependence of a particular pulsar is mostly the same on the long time scale (days to years) and on the time scale of individual pulsations (pulse-to-pulse variability). The two types of behavior most probably reflect two different regimes of accretion (i.e. two different configurations of the X-ray emitting accretion column/mound) which are realized in a source depending on whether its X-ray luminosity is above or below a critical value of about $\sim 10^{37}$ erg/s. The eROSITA instrument onboard SRG will be able to measure the hardness of the powerlaw-continuum in the known and newly discovered transient pulsars while ART-XC will provide an access to the variation of the cyclotron line.

Alexander Kolodzig (Max Planck Institute for Astrophysics, Germany)

AGN in the eRosita All-Sky survey: Statistics and correlation properties

// M.Gilfanov(1,2), R.Sunyaev(1,2), S.Sazonov(2), G.Huetsi(1) 1 - Max-Planck Institute for Astrophysics, Garching, Germany 2 -
Space Research Institute, Russian Academy of Sciences, Moscow, Russia

We study statistical properties of active galactic nuclei (AGN) to be detected in the all-sky survey by the eROSITA telescope aboard Spectrum-X Gamma observatory. Assuming that sensitivity of $\sim 10^{-14}$ erg/s/cm^2 (0.5-2 keV band) will be achieved in the course of a 4 years survey, we estimate that $\sim$3 million AGN will be detected. The redshift distribution of the detected AGN peaks at $z \sim 0.8$, with 10% of objects located at $z > 2$. A typical AGN detected in the survey will have the luminosity of $\sim 10^{44}$ erg/s. The $\sim$10% of brightest objects will be detected with more than $\sim$50 counts and their redshift distribution will peak at $z \sim 0.3$. We also discuss prospects for studying large scale structure with the survey data.

Roman Krivonos (IKI, Russia; MPA, Germany)

X-ray emission from IRAS galaxies

N/A

Andrei Lobanov (Max-Planck-Institut fuer Radioastronomie, Bonn, Germany)

Radio - X-ray Connections: Crossing the Turnovers

// J. Anton Zensus (MPIfR, Bonn)

The combination of high-sensitivity and high-resolution radio observations with measurements made at higher energies, from the X-ray to the VHE bands in particular, is a powerful tool to gain deep insight into the localisation, classification and physical properties of high-energy emitting objects in the Universe. Extended radio campaigns conducted in co-operation with the ROSAT and Fermi-LAT missions present the most striking examples of the success of such coordinated radio and high-energy observations. The 100-meter radio telescope in Effelsberg has been participating in a number of such coordinated programs, both as a stand alone instrument and as part of interferometric observations. This fruitful collaboration can now be extended into the next decade, with the anticipated launch of the Spectrum-RG mission carrying the eROSITA and the ART-XC instruments on board. The potential for such collaboration can be explored, building upon the past results

from ROSAT mission and the ongoing joint programs with the Fermi-LAT mission (Fermi-MOJAVE and FGAMMA programs). A co-ordinated observational program in the radio regime would bring strong benefits to a broad range of observations with eROSITA and ART-XC. The Effelsberg measurements, in particular, will deliver valuable complements to the deep field surveys and studies of high-redshift AGN. The LOFAR MSSS data will provide essential and timely radio counterparts to the all-sky survey (and observations of galaxy clusters in particular). Finally, high-resolution interferometry imaging will play a crucial role in localisation and characterisation of high-energy emission production sites and transitory phenomena (such as AGN and GRB flares and stellar disruption events near supermassive black holes).

Ilya Lomakin (Lavochkin Association)

SRG Project overview // Victor Khartov, Vladimir Babyshkin

The overview of the project. Status of the SC development, main goals and characteristics.

Alexander Anatolievich Lutovinov (Space Research Institute)

High-mass X-ray binaries in the Milky Way and LMC. Current view and prospects for SRG
// M.Revnivtsev, S.Tsygankov, R.Krivonos

The deep exposure spent by INTEGRAL for observations of different parts of the sky allowed us to obtain flux limited samples of high-mass X-ray binaries in our Galaxy and Large Magellanic Cloud. We have succeeded to obtain luminosity functions of these sources in both galaxies and to compare them in a wide luminosity range. These measurements allowed us to determine the most accurate up to date volume density distribution of sources in the Galaxy and connect it to the history of the star formation. Relations between different subclasses of HMXBs and relate them to different modes of the wind-fed accretion are discussed. The obtained dependence allowed us to predict a total number of HMXBs in the galaxies and to make predictions for observations of these sources with the eRosita and ART-XC telescopes onboard the SRG mission.

Natalya Lyskova (Max Planck Institute for Astrophysics, Germany; Space Research Institut (IKI), Russia)

A simple recipe for estimating masses of elliptical galaxies and clusters of galaxies // E. Churazov

We discuss a simple and robust procedure to evaluate the total mass/the circular velocity profile of massive elliptical galaxies and clusters of galaxies. The method only relies on information about the optical surface density and the projected velocity dispersion profiles of tracers and therefore can be applied even in case of poor or noisy observational data. Stars, globular clusters, planetary nebulae or galaxies can be used as mass tracers for ellipticals or galaxy clusters. The proposed procedure was tested on a sample of cosmological simulations of individual galaxies and galaxy clusters and then applied to real observational data. Independently the total mass profile was derived from the hydrostatic equilibrium equation for the gaseous atmosphere. Mismatch in mass profiles obtained from optic and X-ray data is used to estimate the non-thermal contribution to the gas pressure and/or to constrain the distribution of tracer's orbits.

Daniel Marrone (University of Arizona, USA)

SZ Followup of eROSITA Galaxy Clusters

Confirmation and redshift determination for the enormous catalog of galaxy clusters expected from eROSITA is a daunting challenge, particularly for the highest redshift clusters. Followup observations of these clusters at radio wavelengths via their Sunyaev-Zel'dovich effect signature is a promising tool for identifying clusters and narrowing the joint uncertainty in the mass-redshift plane. I will discuss the capabilities of current and planned SZ instruments to follow up eROSITA cluster candidates and the various comparisons within the SZ data and between SZ and X-ray that can be used to constrain cluster redshifts.

Dan McCammon (University of Wisconsin, USA)

Distribution of hot gas in the Galaxy // S. L. Snowden

Soft X-ray measurements starting in the late 1960s revealed the unexpected presence of large quantities of diffuse million-degree gas in the Galaxy, profoundly changing our understanding of the interstellar medium. The ROSAT all-sky survey in 1990 improved on available data by more than two orders of magnitude in both angular resolution and statistical precision, resulting in a revolution of understanding in many areas and an equal number of new questions. Except for a handful of painfully obtained "postage stamp" observations of the X-ray background with the improved resolution of CCD detectors on modern observatories, the ROSAT survey has remained the high-water mark of diffuse background data for over 20 years. The eROSITA survey now promises another order of magnitude improvement in statistics and angular resolution, but the most exciting possibilities are opened by the spectral resolution of the CCD detectors–up to ten times better than the proportional counter resolution of all existing wide area surveys, the promise of the first continuous spectral coverage through the 300-500 eV range, and the great reduction of systematic uncertainties due to the orbit and survey plan.

Marat Mingaliev (Special Astrophysical Observatory, Russia)

AGNs observations at the RATAN-600 radio telescope

// A. Gorshkov, V. Konnikova

As a result of more than 40 years of studies of variability of extragalactic radio sources, it has become clear that the overwhelming majority of them with flat spectra are variable on timescales from tens of years to tens of minutes. There is virtually no doubt that long-term variability is a consequence of nonstationary processes in AGN. The most adequate explanation of the observed character of the variability is given by shock models. It is most likely that flux variability on daily and intraday timescales has an external cause, and is due scintillation on the turbulent interstellar medium. The main criterion enabling us to choose between intrinsic and external origins of IDV, particularly at centimeter wavelengths, is the form of the spectrum. If the spectrum is rising, the cause of the IDV is intrinsic; otherwise, other criteria are required to distinguish between the alternatives. In this report we will present results of a study of the variability of AGNs at the RATAN-600 radio telescope on timescales from several days up to 10 years. Observations were done at six frequencies 0.97, 2.3, 3.9, 7.7, 11.1, and 21.7 GHz. The variability timescales and spectra determined from the analysis of light curves, structure functions, and autocorrelation functions are presented. In most cases, the derived variability parameters are sufficient to distinguish intrinsic and external variability. The main argument for a particular type of variability is provided by the form of the spectrum and the frequencies at which this spectrum is formed.

Alexei Moiseev (Special Astrophysical Observatory RAS, Russia)

The 6-m telescope BTA: current state and perspectives for SRG survey.

Russian 6-m telescope BTA (Big Telescope Alt-azimuth) operated by Special Astrophysical Observatory OF RUS is the largest optical telescope in Eurasia. We present a short review of the instrumental equipment the telescope, the opportunities for the optical support of Spectrum-RG surveys are also discussed.

Sandor Molnar (Leung Center for Cosmology and Particle Astrophysics, Taiwan)

Hard Thermal X-ray Emission from Merging Clusters of Galaxies

// Mark Birkinshaw

The next generation of hard X-ray telescopes (Spectr-RG, NuSTAR) will be sensitive to hard X-rays up to 30–80 keV. This hard energy X-ray band is ideal to study merging

galaxy clusters because during merging the intra-cluster gas heats up to high temperatures, typically above 20 keV. At these mildly relativistic temperatures the relativistic corrections become important. Therefore we use relativistic thermal bremsstrahlung taking into account electron–ion and electron–electron bremsstrahlung to calculate the spectra and images of merging clusters in the hard X-ray bands. We use merging galaxy clusters from our self consistent FLASH simulations which take dark matter and gas dynamics into account. We estimate the hard band X-ray fluxes for our merging clusters to study the feasibility of their detection with the next generation had X-ray missions.

Tony Mroczkowski (California Institute of Technology/Jet Propulsion Lab, Pasadena, USA)

High-Resolution SZE Confirmation of EASS Clusters with MUSTANG-2

// B. Mason, C. Romero, M. Devlin, A. Young, S. Dicker, J. McMahon, E. D. Reese, J. Brevik, J. Sievers, J. Aguirre, M. Rosenman

The eROSITA All-Sky Survey (EASS) is expected to locate over 10^5 groups and clusters. However, these detections will be limited to $\sim 0.5'$ resolution and a few tens of photon counts, making spectroscopy and separation of contamination by AGN difficult. MUSTANG-2, the next-generation 9" resolution bolometric instrument for imaging the thermal Sunyaev-Zel'dovich effect (tSZE) from the Green Bank Telescope (GBT), will provide valuable confirmation of EASS candidate clusters, particularly for high redshift objects which powerfully leverage cosmological determinations and where X-ray surface brightness is greatly diminished.

Located at a latitude of 38° North, the GBT+MUSTANG-2 will be able to observe clusters as low as declination -20°. With up to 349 feed horn-coupled detectors, MUSTANG-2 will be able to measure the integrated tSZE flux densities (i.e. Y_{sz}) of clusters down to 7×10^{13} $M_\odot$ in only a few minutes each, regardless of redshift. These constraints will inform mass estimates of the clusters. Additionally, by combining the eROSITA surface brightness data with deeper MUSTANG-2 observations for a subset of EASS cluster, we can provide a complementary probe of ICM temperature.

Daisuke Nagai (Yale University, USA)

Outstanding Challenges in the Era of Precision Cluster Cosmology

Recent years have witnessed the emergence of galaxy clusters as powerful laboratories for cosmology and astrophysics. The current generation of cluster surveys have provided independent confirmation of the cosmic acceleration and significantly tighten

constraints on the nature of mysterious dark energy and dark matter as well as providing new insights into the growth of massive galaxies and black holes. A number of new surveys (including eROSITA) are underway to advance our understanding of the structure formation and fundamental physics of the cosmos in the coming decade. However, the use of clusters as sensitive cosmological probe requires solid understanding of cluster physics. In this talk, I will discuss several outstanding challenges in our understanding the cluster formation and future prospects for studying the missing cluster physics through the combination of simulation and observational approaches.

Ada Nebot (Observatoire Astronomique de Strasbourg, France)

XMM-Newton Survey Science Center Galactic Plane Survey // C. Motch. On behalf of the XMM-SSC

We report on the results from a Galactic survey conducted by the XMM-Newton Survey Science Center. Using optical and infrared follow-up observations supplemented by crosscorrelation with a large range of multiwavelength archival catalogues we identified about one third of the ∼1000 serendipitously detected X-ray sources at $|b| < 20$ deg and spread over a wide range of Galactic longitudes. In the soft band, most of the sources are identified with stars, while the hard band is dominated by the extragalactic background population. We show that the surface density of soft sources increases towards the galactic plane, due to a combined effect of X-ray luminosity-age and scale-height-age relations. We have evidence of a Galactic population detected in the hard band. These sources have X-ray and infrared colours consistent with main sequence or evolved binary stars, and their surface density increases towards the Galactic Center (GC). We also identified a few exotic objects, such as gamma-Cas-like stars, T-Tauri stars, HeAe stars, and cataclysmic variables. This Galactic survey combined with similar campaigns covering different Galactic directions (Barcons et al 2002, Della Ceca et al 2004, Motch et al 2010) will help us to classify X-ray sources in an statistical manner. The results of this XMM-Newton Galactic survey provides a useful glance on the huge scientific potential of the eROSITA Galactic survey, in which we expect to observe about 0.3 to 0.5 million stars.

Naomi Ota (Nara Women's University)

The ASTRO-H mission

The ASTRO-H mission is the sixth in a series of Japanese X-ray missions, planned to be launched in 2014. ASTRO-H is equipped with a suite of sensitive instruments with a high spectral resolution ($\leq$ 7 eV) and a very wide energy range from 0.3 to 600 keV. The instruments include the Soft X-ray Spectrometer consisting of the Soft X-ray Telescope and the X-ray micro-calorimeter array (0.3–12 keV); the Hard

X-ray Imager located in the focal plane of focusing hard X-ray mirrors (5–80 keV); the Soft X-ray Imager as a wide-field X-ray CCD camera for the soft X-ray mirror (0.4–12 keV); a non-imaging Soft Gamma-ray Detector (40–600 keV). The mission aims to understand the dynamics of the evolving Universe and the concentration of energy including non-thermal high-energy phenomena. I plan to present about the mission overview, status, and science themes that will be explored with ASTRO-H's unprecedented spectroscopic capability and wide bandpass.

Mikhail Pavlinsky (Space Research Institute (IKI), Russia)

SRG/ART-XC

N/A

Thomas Jeffrey Plagge (University of Chicago/KICP, USA)

Measuring the Hubble Constant with Sunyaev-Zel'dovich and X-ray Cluster Data

// Massimiliano Bonamente, John Carlstrom, Marshall Joy, Erik Leitch, Adam Mantz, Daniel Marrone, Stephen Muchovej

Follow-up measurements of the Sunyaev-Zel'dovich (SZ) effect can be a useful complement to X-ray galaxy cluster surveys. For example, Bonamente et al and others have used the combination of X-ray and SZ data to measure the Hubble constant, finding results consistent with other estimates. The large sample of high-redshift clusters to be discovered by eROSITA offers the chance to dramatically increase the precision of this technique, provided SZ follow-up data can be obtained. I will discuss previous H_0 results as well as ongoing work using a sample of $\sim$ 100 RASS-selected clusters observed by the Combined Array for Research in Millimeter-wave Astronomy (CARMA). I will also give a preview of the improvements we expect when combining data from eROSITA and an upgraded CARMA array.

Etienne Pointecouteau (IRAP (CNRS/University of Toulouse), France)

The pressure profile of galaxy clusters as seen by Planck

// on behalf of the Planck Consortium

The pressure support in halos underlies their gravitational potential well. Constraining its distribution is thereby a powerful probe of their matter content (dark and baryonic), and of the physical processes at play within. From the observation of a sample of massive clusters of galaxies in the Planck survey, we have statistically detected their Sunyaev-Zeldovich (SZ) effect out to $3 \times R_{500}$, i.e., a density contrast

$\delta \sim 50 - 100$. Combining the Planck data with XMM-Newton archive data for our whole sample, we have independently reconstructed the underlying thermal pressure profile from the X-ray and SZ observations. Both are consistent in the region of overlap (i.e., $[0.1-1] \times R_{500}$). This unique constraint is in fairly good agreement with theoretical predictions, and allowed us to provide a precise analytical description making using a GNFW model over the whole radial range (i.e., $[0.1 - 3] \times R_{500}$). We further derived constraints on the gas mass fraction out to the outskirts of clusters showing an overall compatibility with the expected gas fraction from CMB observations.

Sergei Borisovich Popov (Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia)

Isolated compact objects for Spectrum-RG

// J. Pons (Univ. Alicante, Spain), P. Boldin (IKI, Moscow), J. Miralles (Univ. Alicante, Spain), B. Posselt (Harvard-Smithsonian CfA, USA), V.F. Suleimanov (Univ. Tubingen, Germany and Kazan University), S.I. Blinnikov (ITEP and SAI, Moscow)

We discuss several populations of isolated compact objects, which can be potentially observed by Spectrum-RG. The most promising class of objects is formed by close-by isolated cooling neutron stars. We apply new cooling curves and discuss properties of these sources on the P-Pdot diagram. We demonstrate that eROSITA can increase the number of known sources of this kind by a factor of 3. New discoveries will be very important to clarify the field decay scenario, and to advance the program for "Grand unification" of neutron stars. Then we discuss isolated cooling young white dwarfs. These objects are also promising targets for eROSITA. Many of them have been observed by ROSAT, and eROSITA will increase the number. Finally, we briefly discuss the possibility to observe magnetars using ART-XC and comment on the long-discussed possibility to detect isolated accreting neutron stars.

Konstantin Aleksandrovich Postnov (Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia)

On the dependence of the cyclotron line energy on the luminosity in accreting X-ray pulsars

// N.I. Shakura

The dependence of the cyclotron line energy E_c on the luminosity in accreting X-ray pulsars is revisited and comparison with current X-ray observations is made. It is shown that at luminosities below the local Eddington value L^*_{Edd} the accretion flow is stopped via Coulomb braking, and a positive correlation of the cyclotron line energy with X-ray flux $E_c \sim L_x$ is expected. Such a correlation is indeed observed in some X-ray pulsars (Her X-1, GX 304, possibly in A0536+26). At X-ray luminosities $L^*_{Edd} < L_x < L^*$, where L^* corresponds to the formation of the optically

thick accretion column, no dependence is expected ($E_c \approx const$). At higher X-ray luminosities $L > L^*$ the negative correlation should be observed $E_c \sim 1/L_x$, as observed in some bright accreting transient X-ray pulsars (4U 0115+63, V 0332+53).

Peter Predehl (Max Planck Institute for Extraterrestrial Physics, Germany)

eROSITA - An Overview of Science and Instrument

eROSITA (extended ROentgen Survey with an Imaging Telescope Array) is the core instrument on the Russian Spektrum-Roentgen-Gamma (SRG) mission which is current scheduled for launch in 2014. eROSITA will perform a deep survey of the entire X-ray sky. In the soft band ($0.5 - 2$ keV), it will be about 30 times more sensitive than ROSAT, while in the hard band ($2 - 8$ keV) it will provide the first ever true imaging survey of the sky. The design driving science is the detection of large samples of galaxy clusters to redshifts $z > 1$ in order to study the large scale structure in the Universe and test cosmological models including Dark Energy. In addition, eROSITA is expected to yield a sample of a few million AGN, including obscured objects, revolutionizing our view of the evolution of supermassive black holes. The survey will also provide new insights into a wide range of astrophysical phenomena, including X-ray binaries, active stars and diffuse emission within the Galaxy.

Roman Rafikov (Princeton University, USA)

New Ideas on Mechanisms of Angular Momentum Transport and Variability in Boundary Layers of Accretion Disks // Mikhail Belyaev, James Stone

Disk accretion onto a weakly magnetized central object, e.g. a white dwarf or a neutron star, is inevitably accompanied by the formation of a boundary layer near the surface, in which matter slows down from the highly supersonic orbital velocity of the disk to the rotational velocity of the star. Here I will describe a novel, robust mechanism of the angular momentum transport inside the astrophysical boundary layers. We perform high resolution 2D hydrodynamical simulations in the equatorial plane of a boundary layer and generically find that the supersonic shear in the boundary layer excites non-axisymmetric quasi-stationary acoustic modes that are trapped between the surface of the star and a Lindblad resonance in the disk. These modes rotate in a prograde fashion, are stable for hundreds of orbital periods, and have a pattern speed that is less than and of order the rotational velocity at the inner edge of the disk. Dissipation of acoustic modes in weak shocks provides a universal mechanism for angular momentum and mass transport even in purely hydrodynamic (i.e. non-magnetized) boundary layers. Periodicity of these trapped modes may be relevant for explaining the variability seen in accreting compact objects.

Thomas H Reiprich (Bonn University, Germany)

Cluster Cosmology with eROSITA

eROSITA will discover about 100,000 galaxy clusters, among them ALL massive clusters in the observable Universe. This good statistics together with the tight correlation between X-ray luminosity and gravitational mass makes eROSITA the likely first "Stage IV" dark energy probe. We report on our preparations to using the eROSITA clusters for cosmological constraints. This includes forecasts using the Fisher Matrix and Markov Chain Monte Carlo approaches as well as predictions for which clusters redshifts and mass proxies better than X-ray luminosity can be obtained directly from the eROSITA survey data. These simulations are tailored specifically to eROSITA, taking into account source photons registered at the detectors plus a detailed X-ray and particle background model. The employed cosmological tests include the evolution of the cluster mass function and angular clustering. We show that eROSITA will yield competitive constraints on several cosmological parameters.

Mikhail G. Revnivtsev (Space Research Institute (IKI), Russia)

Populations of Galactic X-ray sources visible to SRG

In this talk I would like to review the population of Galactic X-ray sources, visible to SRG survey telescopes. Statistics of populations of different sources will provide tools to probe different physical mechanisms, operational in stellar binaries. Soft and Hard X-ray energy bands, planned to be available on SRG, will be extremely effective for selection of accreting and coronally active sources. It will be extremely important to develop methods to combine X-ray and optical/IR data to identify the nature of huge number of sources in the SRG survey. Among other topics of my talks I will try to outline some methods to search for populations of stellar binaries with accreting neutron stars and white dwarfs.

Jan Robrade (Hamburger Sternwarte, Germany)

Stars in the eROSITA all-sky survey

The largest fraction of the galactic X-ray sources that will be detected with eROSITA are stars. The stellar content of the eROSITA all-sky survey will however be extremely diverse, with objects ranging from nearby magnetically active low-mass stars over young stellar populations to distant massive stars that generate bright X-ray emission from powerful wind shocks.

I will highlight scientific opportunities that will become possible with the eROSITA data of an unprecedented sample of X-ray data from various stellar populations at different ages. eROSITA allows a virtually complete census of the X-ray properties of all stars in the solar neighborhood out to 25 pc, numerous young T Tauri

and HAeBe stars as well as massive OB stars will be detected in star forming regions at all evolutionary stages and the all-sky coverage enables the study of spatially extended regions like stellar association, moving groups and open clusters. The large number of X-ray detections of rare objects like peculiar and evolved stars or substellar objects complements the complete stellar samples, allowing to study fundamental X-ray properties of various types of stellar sources. Others astrophysical questions include (pseudo-)diffuse emission, effects of high-energy radiation on disk chemistry and evolution, local star formation history and star formation modes or the structure of the nearby galactic environment.

Mara Salvato (Max Planck Institute for Extraterrestrial Physics, Germany)

Redshifts and added values for AGN eROSITA sources

eROSITA will provide a new Xray map of the distribution of AGN in the sky. In order to exploit its potential for AGN evolution , we need to gather redshifts and know properties of the hosts such as masses and SFR. Not all this information will be provided by spectroscopy, eventually available for at least the brightest sources. I will present what we have learned on photoz and added values for AGN using COSMOS, CDFS and EGS surveys and how it apply to the eROSITA AGN survey.

Sergey Sazonov (Space Research Institute (IKI), Russia)

A full AGN census by X-ray and infrared all-sky surveys (SRG vs. WISE)

N/A

Juergen H.M.M. Schmitt (Hamburger Sternwarte, Germany)

The high-energy environment of exoplanet host stars

More than 700 hundred stars are now known to be orbited by their own planets. Almost all of these exoplanet host stars are of late type and show the typical signatures of magnetic activity. While the magnetic activity of the Sun is quite low in comparison to its stellar siblings, other planet host stars show a considerable amount of activity and hence crate a high-energy environment very different from the solar system. I will present a systematic discussion of the X-ray properties of exoplanet hosts, single out the most extreme cases and explore the consequences of X-ray and EUV irradiation of planets by their hosts. Furthermore I will address the issue of possible star-planet interactions and discuss the observational evidence for this phenomenon.

Nikolai Ivanovich Shakura (Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia)

Microlensing evidence for super-Eddington disk accretion in quasars // P. Abolmasov

Microlensing by the stellar population of lensing galaxies provides an important opportunity to spatially resolve the accretion disks in strongly lensed quasars. Disk sizes estimated this way are generally larger than the standard Shakura-Sunyaev accretion disk model predicts. Analysing the observational data on microlensing variability allows to suggest that some fraction of lensed quasars (primarilly, smaller-mass objects) are accreting in super-Eddington regime. Super-Eddington accretion manifests itself in formation of an optically-thick envelope scattering the radiation formed in the disk. This makes the apparent disk size larger and practically independent on wavelength. In the framework of our model, it is possible to make self-consistent estimates of mass accretion rates and black hole masses for the cases when both de-amplified fluxes and radii are available.

Boris Mihaylovich Shustov (INASAN, Russia)

Spectrum-UV and its synergy with Spectrum-RG

Key science problems of the coming years require further development of multi-wavelength approach. Among these hot astrophysical issues are search for missing baryons, revealing the nature of astronomical engines etc. X-ray and UV telescopes are especially powerful instruments to study the problems. In the Federal Space Program of Russia the Spectrum series of space missions (Spectrum-R, Spectrum-RG and Spectrum-UV) is aimed to ensure a multi-wavelength access to space. A brief review of the Spectrum-UV (World Space Observatory-Ultraviolet) mission is given. The observatory is to be put into orbit in coming decade. Major instrument is a 1.7 m UV-telescope equipped with high resolution spectrographs and UV-imager(s). The observatory is to be put into orbit in coming decade. Some observational programs will be carried on in cooperation by Spectrum-RG and Spectrum-UV teams.

Jonathan LeRoy Sievers (Princeton, USA)

The ACTPol Experiment // The ACTPol Collaboration

ACTPol is a polarization-sensitive upgrade to the Atacama Cosmology Telescope (ACT) that will begin observations during 2012. ACTPol's main focus is on observations of the CMB, but it will aslo be an extremely powerful SZ survey instrument. We present an update on the status of ACTPol and some of the scientific results we hope to achieve.

Alexei A. Starobinsky (Landau Institute for Theoretical Physics RAS)

Growth of matter density perturbations as a test of dark energy properties

For many models of present dark energy, the growth of matter perturbations in the gravitationally clustered component of the Universe (baryons + cold dark matter) is the most sensitive test of possible difference of dark energy from an exact cosmological constant. I review recent results in this area including the cases of both quintessence and f(R) models of dark energy.

Meng Su (Harvard University/MIT, USA)

Fermi Bubbles Seen by eROSITA

Based on data from the Fermi Gamma-ray Space Telescope, we have discovered two gigantic gamma-ray emitting bubble structures in our Milky Way (known as the Fermi bubbles), extending ~ 50 degrees above and below the Galactic center with a width of ~ 40 degrees in longitude. The gamma-ray emission associated with these bubbles has a significantly harder spectrum ($dN/dE \sim E^2$) than the inverse Compton emission from known cosmic ray electrons in the Galactic disk, or the gamma-rays produced by decay of pions from proton-ISM collisions. There is no significant difference in the spectrum or gamma-ray luminosity between the north and south bubbles. The bubbles are spatially correlated with the hard-spectrum microwave excess known as the WMAP haze; we also found features in the ROSAT soft X-ray maps at $1.5 - 2$ keV which line up with the edges of the bubbles. The Fermi bubbles are most likely created by some large episode of energy injection in the Galactic center, such as past accretion events onto the central massive black hole, or a nuclear starburst in the last ~ 10 Myr. Study of the origin and evolution of the bubbles also has the potential to improve our understanding of recent energetic events in the inner Galaxy and the Galactic cosmic ray acceleration. Furthermore, we have recently identified a gamma-ray cocoon feature within the southern bubble, with a jet-like feature along the cocoons axis of symmetry, and another directly opposite the Galactic center in the north. If confirmed, these jets are the first resolved gamma-ray jets ever seen. I will discuss the forecast of the Bubbles been seen by eROSITA and the science we can learn by studying the bubbles using eROSITA.

Valery F. Suleimanov (Institute for Astronomy and Astrophysics, Tuebingen University, Germany)

Application of neutron star atmosphere models to

determination of neutron star parameters
// J. Poutanen, M. Revnivtsev, K. Werner

Extended set of hot neutron star model atmospheres with Compton scattering taken into account are computed for 6 chemical compositions, 3 values of $\log g$, and a wide range of luminosities L. Two different methods for the description of Compton scattering are considered: Kompaneets equation and the integral method which uses fully relativistic redistribution function. The model spectra are close to a diluted blackbody with color temperatures $T_{\rm c}$, which are higher than the effective temperatures $T_{\rm eff}$. Dependences of the color correction coefficient $f_{\rm c} = T_{\rm c}/T_{\rm eff}$ on the luminosity are also calculated.

We then apply these calculations to the cooling tails of the X-ray bursts. We demonstrate that the dependence of normalization K of the blackbody fit on bolometric flux F ($K^{-1/4} - F$) for a passively cooling neutron star must corresponds to the $f_{\rm c} - L$ dependence. Some thermonuclear bursts show the expected cooling behavior and they can be fitted by the theoretical curves $f_{\rm c} - L$. The neutron star mass and radius can be then found from the fits. This cooling tail method was applied to the long burst of 4U1724-307 and a relatively large neutron star radius (> 14 km) was found. We argue that the direct fitting of the spectra observed in the PCA energy band by the model spectra is almost useless. However, useful constraints on the neutron star parameters can be found if the soft energy band is also used. The influence of the neutron star fast rotating on the basic parameters determination is also discussed.

Rashid A. Sunyaev (IKI, Russia; MPA, Germany)

Observational appearance of clusters of galaxies in X-Rays and in microwave spectral band; why we need the sample of eRosita clusters

N/A

Joachim Ernst Truemper (Max Planck Institut for Extraterrestrial Physics, Germany)

Lessons learned from the ROSAT all sky survey

N/A

Yuying Zhang (Bonn University, Germany)

Status on mass calibration using a representative cluster sample at z 0.2 and on optical follow-up using mock surveys

We have constructed a volume-limited, representative sample of more than 50 clusters in the redshift range of 0.15-0.3 selected from the ROSAT All-Sky Survey, which will be completed by 30/04/2013 with a total of 1.44 Msec observing time in four successful XMM-Newton PI proposals. We will report the status on the data collections and analyses, and present some preliminary results on mass calibrations for precision cosmology from our pilot study focusing mainly in the X-ray and optical bands. Apart from the observational sample, we will report our status on investigations on optical follow-up of galaxy clusters in upcoming surveys using mock samples constructed from three simulated surveys with 1000 square degree each consisting of different galaxy-formation model.

Irina Zhuravleva (Max Planck Institute for Astrophysics, Germany)

ICM inhomogeneities

// E. Churazov, A. Kravtsov, E.T. Lau, D. Nagai, R. Sunyaev

The intracluster medium (ICM) is not perfectly homogeneous as confirmed by both X-ray observations and simulations. We propose a novel description of the ICM in simulated galaxy clusters that allows us to divide gas into a nearly hydrostatic "bulk" component and non-hydrostatic high density inhomogeneities and investigate their properties individually. We show that the density distributions of the bulk component within radial shells can be well described by a log-normal distribution. The FWHM of the density distributions shows small scatter between individual clusters and is in agreement with the amplitude of density perturbations found in the Coma cluster core. Comparison of the basic properties in both gas components shows that (i) the RMS velocities in the bulk gas are small and steadily increase with radius in contrast to large and strongly varying velocities in gas inhomogeneities; (ii) clumping factor for bulk gas determines the lower limit on the boosts of the X-ray emissivity and is less than 15-25 per cent within r_{500}.

Werner Becker (Max Planck Institute for Extraterrestrial Physics, Germany)

Supernova Remnants and Compact Objects in the eROSITA All-Sky Survey

// T. Prinz,

Supernovae are rare events, believed to occur approximately every 50 years in the Galaxy. However, in the past 2000 years only 7 historical Galactic SNe have been observed. Most Galactic SNe go unobserved owing to visible band extinction by interstellar dust. Similar the observed number of supernova remnants (SNRs) in our Galaxy, which is approximately only 30% of the number expected from gamma-ray

measurements of 26Al. Most searches for SNRs were performed in the radio band, though there are strong selection effects which can cause remnants to be undetected. The ROSAT All-Sky survey (RASS) has demonstrated the potential power for finding new SNRs. Inspecting RASS data for unknown supernova remnants brought up a list of $\sim$ 200 candidates, of which 7% could be confirmed to be SNRs in multi-wavelength campaigns meanwhile. As for the SNRs, there are similar selection effects that hamper radio searches for young pulsars. The approximative lifetime of a SNR is 100 kyrs. Up to now about 120 pulsars are detected in the Galaxy with a spindown age of less than that. Assuming a birthrate of 2 SNe per century this is only 7% of the total number expected, indicating that radio detection of young pulsars in SNRs is even more prone to selections effects than that of SNRs. The eROSITA survey provides a sensitivity which is about an order of magnitude higher than in the ROSAT all-sky survey. It is therefore possible to continue the previous SNR identification campaign and the search for new supernova remnants and pulsars with a much higher sensitivity than possible so far. We will report on our feasibility study for finding new supernova remnants and detecting pulsars in the eRASS.

Bradford Benson (University of Chicago, USA)

The South Pole Telescope: The Sunyaev-Zeldovich Cluster Survey, and Measurements of Structure Formation using the CMB // SPT collaboration

N/A

Maria Bergemann (Max-Planck Institute for Astrophysics, Germany)

Improving the accuracy of spectroscopic parameters in large-scale stellar surveys

Chemical composition of late-type stars is one of the major observational constraints to the evolution of our Galaxy. Still, calculation of element abundances from observed stellar spectra is a challenging task due to the difficulties of incorporating various physical aspects of radiative transfer theory, such as non-local thermodynamic equilibrium (NLTE), into spectrum analysis codes. The codes used for automated analysis of large sets of high- and low-resolution spectra obtained in various Galactic star surveys, such as SDSS/SEGUE, Gaia-ESO, and LAMOST, rely on a simplifying LTE assumption. Application of existing NLTE-capable codes to such surveys is computationally prohibitive; NLTE studies are often limited to a handful of stars.

I will describe our project at MPA aimed at large-scale NLTE abundance calculations for various chemical elements. I will focus on transition metals with $22 < Z < 28$ and show some results for a grid of stellar parameters including very metal-poor dwarfs and giants. Particular attention will be

given to iron, which is a proxy of stellar metallicity. I will present a new method to account for NLTE in any spectroscopic study enabling accurate derivation of metallicity, effective temperature, and surface gravity of FGK stars.

Hermann Brunner (Max Planck Institute for Extraterrestrial Physics, Germany)

eROSITA data analysis: pipeline processing, archiving, and interactive analysis

// H. Brunner (1), T. Boller (1), C. Grossberger (2), F. Guglielmetti (1), G. Lamer (3), F. Pacaud (4), I. Kreykenbohm (2) , M. Ramos-Ceja (4) , M. Wille (2) – 1: MPE, 2: RSB, 3: AIP, 4: AIfA

The eROSITA Science Analysis Software System (SASS), currently under development at MPE, AIP, RSB, and AIfA, is a standard compliant (OGIP FITS, CALDB) software package with an FTOOLS-like parameter interface, in part based on ROSAT and XMM-Newton heritage. It is designed with both pipeline processing and interactive analysis in mind. The eROSITA data processing pipeline consists of four task chains for event calibration, image and exposure map creation, source characterization, and extraction of source specific products, respectively. The input data are prepared for pipeline processing by means of a preprocessor. The data analysis pipeline will be set up to process pointed and survey-mode observations in a unified way. Archiving occurs on several different levels, in the form of the original data frames, FITS-formatted raw data, and calibrated data products. The all-sky survey data will be organized into 4700 overlapping fields of size 3.6 x 3.6 degrees, on which several different source characterization algorithms will be performed. The main data products will be calibrated event lists, images, exposure and background maps, as well as spectra and light curves for all objects exceeding a minimum number of counts. A cumulative source catalogue will be maintained. Data access will be provided via a Web interface. The users will be able to rerun the standard pipeline processing by means of the provided SASS data analysis package and perform their own in depth analysis using publicly available software packages like FTOOLS or XSPEC.

Marcella Brusa (Max Planck Institute for Extraterrestrial Physics, Germany)

The search for high z (z> 3) X-ray selected AGN: present status and eROSITA perspectives

// A. Comastri, F. Civano, R. Gilli

In the recent years, a new interest as emerged in the study of the high-redshift (z> 3) AGN population, mainly motivated by the multiwavelength identication campaigns from medium deep and deep X-ray surveys which, for the first time, were able to

provide sizable samples of quasars with luminosities above $\log L_x = 44$. We discuss the status of the present knowledge of the space density and evolution of the z> 3 X-ray selected AGN population, as derived from COSMOS and CDFS surveys. In particular, we will compare the results with predictions from XRB synthesis models and semianalythic models of galaxy formation, and we will discuss the perspectives for the soon to be launched German-Russian eROSITA mission.

Vadim Burwitz (Max Planck Institute for Extraterrestrial Physics, Germany)

eROSITA testing and calibration activities at the MPE Panter X-ray test facility

// W. Burkert, H. Bruninger, K. Dennerl, M. Freyberg, P. Friedrich, B. Menz, G. Hartner, MPE, Garching, Germany

A description of testing and calibration activities at the MPE Panter X-ray test facility of the eROSITA mirror modules, and the on board X-ray calibration source will be presented. Also activities concerning the testing of the CCD cooling system and preparation of the telescope structure parts will be described.

Konrad Dennerl (Max Planck Institute for Extraterrestrial Physics, Germany)

Determination of the eROSITA mirror HEW with subpixel resolution

// Wolfgang Burkert, Vadim Burwitz, Michael Freyberg, Peter Friedrich, Gisela Hartner

The Point Spread Function (PSF) of the eROSITA mirror modules is specified to have an on-axis Half Energy Width (HEW) of 15 arcsec. This is only slightly larger than the eROSITA pixel size of 75 microns, which corresponds to 9.6 arcsec at the PANTER test facility, where the PSF is being measured with a prototype of the eROSITA CCD. We have developed a fast algorithm which provides a substantially higher spatial resolution by utilizing the information contained in the charge ratios of split events. By applying this algorithm to measurements where the CCD is systematically shifted in subpixel increments (typically in a 12 x 12 pattern), we are able to achieve an effective resolution of 2 arcsec for specific pixel patterns. This algorithm can also be used to compute the two dimensional probability distribution for detecting a photon from an incident point-like beam, for each combination of photon energy, low energy (split) threshold, selected pixel patterns, and subpixel scan properties. These maps allow us to deconvolve the measured PSF and thus to minimize the influence of the spatial detector resolution on the determination of the eROSITA mirror HEW. After launch, the algorithm for improving the spatial resolution by reconstructing the subpixel position will be applied to the science data.

Rozaliya Doroshenko (IAAT Tuebingen, Germany)

Transient bursting pulsar GRO J1744-28.
// V. Doroshenko, V. Suleymanov, A. Santangelo, S. Piraino

We report on the analysis of BeppoSAX observations of a unique transient bursting X-ray pulsar GRO J1744-28 carried out in March and April 1997. We determine and refine the pulse-period of the source and confirm the lag of the pulsed burst flux with respect to persistent emission reported earlier based on the RXTE data. We exploit the broadband spectral capabilities of the BeppoSAX to constrain the spectrum of the source in persistent and burst states, and find that an additional blackbody-like soft component might contribute to the burst spectrum. We argue that intermittent thermonuclear burning in vicinity of the polar caps of the pulsar might be responsible for this component and might trigger the onset of instabilities triggering the type II bursts observed in this source, although the onset of the bursts itself might also trigger the thermonuclear flashes.

Victor Doroshenko (IAAT, Tuebingen, Germany)

The mates and the Supergiant Fast X-ray transients
// A. Santangelo, L. Ducci

Supergiant Fast X-ray transients (SFXT) have recently emerged as a subclass of High mass X-ray binaries which exhibit little persistent emission and mainly manifest themselves in short X-ray outbursts. The emission is pulsed at least in some cases, and is likely powered by accretion from wind of the companion. This implies that the compact object is a neutron star. So what makes these objects so different from normal persistent wind-accreting pulsars? We attempt to answer this question which is crucial for understanding of the SFXT physics. We review properties of several wind accreting HMXBs and point out that the so-called "off-states" observed in some of them might be the missing link between the two classes. We conclude that if this is the case, the interaction of neutron stars magnetosphere with accreting plasma must be responsible for distinct observational appearance of the two classes. Observations with the upcoming eRosita and Loft missions will help to constrain the properties of these sources both in quiescent and bursting states and better understand their nature.

Michael Freyberg (Max Planck Institute for Extraterrestrial Physics, Germany)

On the eROSITA in-orbit calibration strategy and plan
// Konrad Dennerl

eROSITA aboard SRG consists of 7 identical mirror modules with 7 identical CCD cameras as focal plane instrumentation. It will observe the X-ray sky in the 0.3-10 keV range. ART-XC as the other instrument on SRG will extend the spectral range to higher energies.

In this presentation we describe how the on-ground calibration is planned, with respect to maximum scientific exploitation, in combination with an in-orbit calibration and performance verification following the commissioning of the instrument.

This will be performed within one module and between the 7 eROSITA modules,. If XMM-Newton (or other X-ray missions) will still be operational, a dedicated cross-calibration campaign is envisaged. Emphasis will be on the selection of the celestial targets depending on the various calibration subjects (e.g., PSF, vignetting, boresight, response, background) and on the procedure of the measurements with the internal Fe-55 calibration source.

Michael Freyberg (Max Planck Institute for Extraterrestrial Physics, Germany)

eROSITA as an explorer of the Local Interstellar Medium and the Soft X-ray Background

eROSITA will extend the ROSAT all-sky survey in many ways, e.g. because its improved spatial resolution will ease to distinguish point-like sources from extended sources like clusters of galaxies; its significantly enhanced effective area above 0.3 keV and a broader spectral coverage upto 10 keV will provide enough statistics to disentangle various emission components; its better spectral resolution especially at low energies reduces ambiguities in spectral modeling; the multiple sky coverage will enable us to determine time variable processes on times-scales of months to few years; an orbit at L2 (outside Earth's residual atmosphere) will reduce local contamination by solar and geospheric X-ray emission lines and will thus provide a cleaner background close to low-energy thermal lines. Therefore eROSITA will be an excellent observatory to study large-scale and low-surface brightness objects, especially the Local Interstellar Medium (LISM) with the Local Hot Bubble being only one object, where ROSAT, Chandra, XMM-Newton, Suzaku, were all limited in one or the other way. It will be able provide a global overview with unprecedented sensitivity.

Peter Friedrich (Max Planck Institute for Extraterrestrial Physics, Germany)

The eROSITA X-Ray Telescope

The eROSITA X-ray telescope consists of a compact bundle of 7 co-aligned mirror modules with a focal length of 1600 mm and 54 nested mirror shells each.

The 61 arcmin field-of-view will yield a high grasp of about 1000 cm^2deg^2 around 1 keV and 10 cm^2deg^2 at 10 keV. An angular resolution of 15 arcsec HEW on-axis (resulting in an average angular resolution of ∼26 arcsec HEW over the field-of-view and 30 arcsec including all optical and spacecraft error contributions) will allow to distinguish between point sources and extended emission of clusters from galaxies which are relevant for cosmological studies. Stray-light is suppressed by X-ray baffles consisting of concentric cylinders mounted on top of each mirror module. The integration of flight mirror modules is running since early 2011.

Christoph Grossberger (Dr. Karl Remeis-Observatory Bamberg & ECAP, Germany)

Recognition of hot pixels on CCDs in the eROSITA Near Real Time Analysis

// M. Wille, C. Schmid, H. Brunner, J.Wilms, I. Kreykenbohm, J. Hoelzl

With the eROSITA Near Real Time Analysis (NRTA) we present a versatile software framework which easily permits sanity checks, first quick-look analysis and automated archiving of mission data. We give a short overview of the general working principle of the NRTA and show examples of a conceivable tool chain which can be used for data processing with special emphasis on the software responsible for the detection of defective pixels on charge-coupled devices (CCDs). We demonstrate the capabilities of the detection software (such as differentiation between bright pixels and bright lines as well as recognition of flickering pixels) and discuss the algorithm which is based on statistical analysis of raw event data. Afterwards we show the results of hot pixel search tests with data taken by XMM-Newton. The performance of the detection software suggests that it is capable of securely detecting hot pixels with a mean signal of 2:5 above background level.

Fabrizia Guglielmetti (Max Planck Institute for Extraterrestrial Physics, Germany)

Faint source detection with Bayesian mixture models

// H. Boehringer, H. Brunner, N. Clerc, F. Pace, M. Roncarelli, P. Rosati, C. Schmid

With the aim to address current astrophysical problems, for instance in the fields of stellar evolution, evolution of galaxies and the large–scale structure of the universe, X-ray imaging data are exploited. The background-source separation technique has been developed employing Bayesian probability theory (BPT) combined with a two component mixture model technique (Guglielmetti et al, 2009, MNRAS, 396, 165). The probabilistic mixture model is incorporated into the Bayesian technique to jointly estimate the background and detect the sources, providing consistent

uncertainties of background and sources. The resulting background model is sensitive to cosmic, instrumental and exposure time variations. Faint, both pointlike and extended, sources are revealed in a multiresolution analysis. The multiresolution analysis facilitates the detection of faint objects close to the background signal and the detection of complex morphologies of extended sources. Point-like sources on top of diffuse emissions are automatically separated. The background-source separation algorithm gives the benefit of an additional technique intrinsic to BPT: the multiband analysis. The multiband analysis provides a statistical combination of multiple data at different energy bands improving the detection of faint sources and sources in crowded regions. The technique has been successfully applied to data observed in the X-ray part of the electromagnetic spectrum (ROSAT, Chandra X-ray Observatory). The application of the technique on simulated eROSITA datasets is shown.

Nail Inogamov (Landau Institute for Theoretical Physics, RAS)

Bondi accretion of slowly rotating gas onto a supermassive black hole // R.A. Sunyaev

We consider accretion of gas slowly rotating at a Bondi radius. Descent of gas under Bondi radius leads to creation of toroidal centrifugal barrier. Combined action of saturated electron heat conduction and bremsstrahlung radiation loses decrease temperature and ensure significant volume compression. In those conditions viscosity becomes important and there are two disks growing from the toroidal barrier. One of them is an accretion disk covering interval of radiuses inside the barrier, while another is an inverse outflowing disk which transports outside angular momentum of an inner disk. We analyse how the outside disk passes through surrounding atmosphere above a radius of a toroidal barrier. Dynamical and heat balances in presence of ionizing radiation and saturated electron heat conduction from atmosphere define structure of an outside disk.

Dmitry Ivanov (Institute of Applied Astronomy RAS, Russia)

"Quasar" radiotelescopes - current state and possibilities for SRG follow-up. // Ipatov A., Smolentsev S., Mardyshkin V., Fedotov L., Ivanov D., Kaidanovsky M., Kharinov M., Mikhailov A., Rahimov A., Dyakov A. Institute of Applied Astronomy, Russian Academy of Sciences (St. Petersburg, Russia)

will be later

Georgii Khorunzhev (Space Research Institute (IKI), Russia)

Predictions for the eROSITA all-sky survey based on the XBootes survey data // Sergey Sazonov

Using the Chandra Xbootes survey, we examine the possibility of using existing IR, optical and UV photometric all-sky surveys for identification of SRG/eROSITA sources. The majority of AGNs detected by eROSITA are expected to have mid-infrared counterparts in the WISE survey, and a significant fraction will also have optical and UV counterparts in the SDSS, PanSTARRS and GALEX surveys. Such multi-band data can significantly constrain the nature and redshifts of eROSITA sources.

Ingo Kreykenbohm (Dr. Karl Remeis Observatory & ECAP, Germany)

The eRosita pre-processing and NRTA software
// J. Wilms, C. Grossberger, C. Schmid, M. Wille, C. Graefe, G. Lamer, H. Brunner

We present an overview of the eROSITA pre-processing (preproc) and Near Real Time Analysis (NRTA) software. As a first step, the incoming binary telemetry files are decoded and the event and housekeeping (HK) information is written to separate FITS files. In a second step, the resulting corresponding FITS files are then merged and chronologically sorted. Finally the FITS files are split into eroDays and stored in the archive. Health checks like whether all HK counters are within normal limits or badpixel detection are then performed to identify possible problems of the instrument as early as possible and to ensure the scientific quality of the data. The resulting detector maps and HK graphs are displayed for visual inspection using a Web Interface. The third step is to run the eROSITA standard pipeline to obtain sky images, source catalogs, and spectra. Simulated telemetry streams (see also poster by C. Schmid) can be used as input data to test the eROSITA NRTA software.

Omar Mirian Kurtanidze (Abastumani Observatory, Georgia)

Optical study of extragalactic VHE sources // Maria Nikolashvili

To study optical variability of extragalactic sources the long-term campaign was conducted in Abastumani Observatory since 1997, which allowed to collect 250 000 CCD frames during 2 600 nights. This extensive campaign of about 70 blazars was carried out during five years in BVRI bands and later on mainly in R band using 70-cm meniscus (f/3, SBIG ST6 and Apogee Ap6E) and 125-cm Ritchey-Chretien (f/13, Apogee Ap6E) telescopes. The list of target objects also includes 15 sources selected from the Einstein Slew Survey Sample to study optical variability of X-ray selected BL Lacertae objects. At the starting date of the project only two TeV sources were

known Mrk 421 and Mrk 501. Later on, eleven sources included in our list of X-ray selected BL Lacertae, have been detected as sources of TeV emission by VERITAS, HESS and MAGIC. Most frequently monitored source is 1ES 1959+650 (740 nights) which shows maximum amplitude of variation in 1.22 magn. in R band. Highest amplitude of variation was detected in the case of 1ES 0647+250 1.5 magn. Lowest observed amplitudes of optical variation are detected for 1ES 0229+200 and 1ES 2344+514, which are equal to 0.15 magnitudes. Here we present the preliminary light curves of eleven sources already detected at TeV. Besides, we present the results of very frequent observations of two sources detected by FERMI (1FGL J2311.0+3425, 67 nights) and MAGIC (1FGL J2001.1+4351) in the 2nd half of 2010. These sources show prominent variations with maximum amplitude in R band equal to 0.7 magn. The very dense optical coverage in our survey allow to study the time variability properties of the sample down to IDV scales, that was detected for many of them.

Georg Lamer (Leibniz Institute for Astrophysics Potsdam, Germany)

eROSITA survey simulations and source detection

// H. Brunner, F. Guglielmetti, Roncarelli, M., Pace, F.

We present simulations of the eROSITA all-sky survey fields. The simulated images are based on hydrodynamical simulations to model the diffuse X-ray emission from groups and clusters of galaxies, point-like sources are added to represent the emission from AGN.

We apply source detection algorithms developed for the eROSITA data reduction pipeline and discuss the quality of the resulting source lists in the light of the eROSITA survey science.

Pavel Minaev (Space Research Institute (IKI), Russia)

Gamma-ray bursts: the dependence of the spectral lag on the energy

// A.S. Pozanenko, S.A. Grebenev, S.V. Molkov

We investigated dependence of a spectral lag against energy band based on 28 bright GRBs registered by SPI and IBIS/ISGRI of INTEGRAL observatory. It is found that for simple structure bursts or separate pulses of multi-peaked bursts the energy-dependent lag can be approximated by the relation of $\tau \sim A \log E$, where A is a positive parameter, which correlates with pulse duration. We also have not found any negative lag in simple structure bursts or in well separated pulses. While investigating the time profile of the whole burst negative lag may appear due to different spectral parameters of the pulses.

Dmitrij Isidorovich Nagirner (Saint Petersburg State University, Russia)

Compton scattering of radiation of star in spherical relativistic outflow from it

The problem of transformation of spectrum of radiation of a star as a result of electron scattering in spherical symmetric stellar shell is considered. The stationary equations of radiative transfer and relativistic hydrodynamical movement of shell matter are formulated. It is shown that only direct radiation of the star acts on the dynamic of the shell. The expressions for the intensity of radiation along the rays and for spectrum of the flux of scattered radiation are obtained. The equation of radiative transfer is solved in one-scattering approximation. The results can be applied for the interpretation of observations of gamma-ray bursts.

Mikhail Yur'evich Piotrovich (Central Astronomical Observatory at Pulkovo, Russia)

Topology of magnetic field and polarization in accretion discs of AGN

// Yu.N. Gnedin, S.D. Buliga, N.A. Silant'ev, T.M. Natsvlishvili

In this work we demonstrate that the wavelength dependence of polarization degree and position angle allows us to derive the distribution of magnetic field in accretion disc. The polarized radiation arises due to scattering of emission light by electrons in a magnetized optically thick accretion disc. Faraday rotation of polarization plane is taken into consideration. Through wavelength dependence of polarization it is possible to derive the value of the magnetic Prandtl number in the accretion disc plasma. The power law index of the polarization wavelength dependence is related with the radial distribution of magnetic field in an accretion disc. This allows us to test the various models of an accretion disc around the central black hole.

Adriana Mancini Pires (Leibniz Institute for Astrophysics Potsdam, Germany)

eROSITA expectations for thermally emitting isolated neutron stars // Christian Motch, Axel Schwope

While fewer in number than the dominant rotation-powered radio pulsar population, peculiar classes of isolated neutron stars (INSs), which include magnetars, the ROSAT-discovered "Magnificent Seven" (M7), rotating radio transients (RRATs), and central compact objects in supernova remnants (CCOs), represent a key element

in understanding the neutron star phenomenology. In particular, and in spite of many searches, no other thermally emitting INS presenting exactly the same characteristics as the M7 has been identified outside the solar vicinity to date. It is therefore very important for population studies to understand why there are so many thermally emitting sources with similar periods (and presumably ages and magnetic fields) in such a small volume. Is this an anomaly caused by the Sun's current location close to regions of active stellar formation of the Gould Belt or does it really mean that radio surveys do miss a large population of INSs, at least as large as that of normal radio pulsars? To answer these questions, investigations at fainter fluxes as well as population modelling in the Galactic scale are needed. In this contribution, we present expectations for the number of new thermally emitting INSs potentially to be discovered by the eROSITA mission during its first years of all-sky survey.

Alexei Pozanenko (Space Research Institute (IKI), Russia)

Observations of GRB-like transients // M. Barkov

We investigate properties and probability of afterglow detection with Spectrum-RG instruments of classical gamma ray-bursts, bursts based on supermassive star of Population III, and the events like Swift 1644+57 which has been interpreted as a manifestation of tidal disruption of a star by the central black hole of AGN.

Arne Rau (Max Planck Institute for Extraterrestrial Physics, Germany)

The X-ray transient Sky - Experience from previous missions and lessons + predictions for eROSITA

N/A

Manami Sasaki (Institute for Astronomy and Astrophysics, University of Tuebingen, Germany)

The hot ISM in our Galaxy and the Magellanic Clouds

Supernova remnants (SNRs), interstellar bubbles, and superbubbles are the main engines for the cycle of matter in the interstellar medium (ISM), releasing huge amounts of energy and matter in shock waves. Owing to their high temperature, SNRs and super-/bubbles can best be studied in soft X-rays. I would like to present some recent results on the studies of SNRs and the hot ISM in our Galaxy and the Magellanic Clouds and discuss the prospects of ISM research with the eROSITA telescope on board the SRG satellite.

Christian Schmid (Dr. Remeis-Observatory & ECAP, Germany)

eROSITA Event Simulator // T. Brand, H. Brunner, N. Clerk, F. Guglielmetti, I. Kreykenbohm, M. Khnel, M. Wille, J. Wilms

We present an instrument simulation toolkit for eROSITA. It comprises the most relevant telescope and detector characteristics by applying specific calibration data, such as the PSF and RMF. The simulation software processes a set of predefined X-ray sources stored in the SIMPUT format and produces an event file for the particular observation setup. Thereby the it takes into account the motion of the telescope during the all-sky survey. Simulated data can be used to study the performance of the instrument and to develop and verify data analysis software. We present examples demonstrating the capabilities of the simulation software. For fast and easy access to simulations we provide a web interface.

Marco Selig (Max Planck Institute for Astrophysics, Germany)

Information Theory Based High Energy Photon Imaging // Torsten A. Enlin

The proper analysis of data is an inevitable necessity in all fields of physics. In high energy astronomy, where observations in the X-ray domain are performed, the data consist of information about the detected photons; i.e., their detection time, incidence angle, and frequency or energy. The numerous sources emitting X-ray photons can be classified into two phenomenological classes, diffuse sources and point sources. Separating these source components, given spatially resolved photon counts, is a nontrivial task due to their superposition and the shot noise in the data. Our main goal is the reconstruction of the photon flux and its separation into a diffuse and a point-like component.

Alexander Vol'kovich Serber (Institute of Applied Physcs of the Russian Academy of Sciences)

Cyclotron Absorption Feature in Spectra of Hot Magnetized Isolated Neutron Stars

Based on analysis of cyclotron radiation pressure on an isolated hot magnetized neutron star, we determine a region on the $\lg B - \lg T_*$ plane for which an extended plasma envelope covering the entire star can be formed and supported by the cyclotron radiation pressure. The cyclotron optical depth of this envelope is large, so that cyclotron scattering in the nonuniform magnetic field premeating it results in the formation of a pronounced broad absorption feature in the observed spectrum of the object.

Ilias N Sibgatullin (Moscow State University, Russia)

Nonlinear convection in fluids with anomalous properties

Transition to chaotic motions in a plain layer of a fluid with fixed temperatures on the boundaries is considered in the case of the temperature interval comprising the temperature of density maximum (penetrative convection). Stable and unstable layers may form within the layer, depending on the position of the point of density maximum in the conductive state. Transition to doubly-periodic motion through subritical Neimark-Sacker bifurcation and intermittent motions were described.

D. Kuznetsova, I. Sibgatullin Fluid Dyn. Res. 44 (2012) 031410.

Douglas A. Swartz (USRA/Marshall Space Flight Center, USA)

Prospects for AGN Science Using ART/SRG

// Mikhail V. Gubarev, Stephen L. O'Dell, Brian D. Ramsey, Massimilliano Bonamente

The enhanced hard X-ray sensitivity provided by the Astronomical Rontgen Telescope to the Spectrum Rontgen Gamma mission facilitates the detection of heavily obscured and other hard-spectrum cosmic X-ray sources. The SRG all-sky survey will obtain large, statistically-well-defined samples of active galactic nuclei (AGN) and clusters of galaxies including a significant population of local heavily-obscured AGN. In anticipation of the SRG all-sky survey, we investigate the prospects for refining the bright end of the AGN luminosity function and determination of the local black hole mass function, comparing the spatial distribution of AGN with large-scale structure defined by galaxy clusters and groups, and probing the galaxy cluster mass function. Particular emphasis is placed on studies of the deep survey Ecliptic Pole regions.

Yury Aleksandrovich Uvarov (Ioffe Institute, St. Petersburg, Russia)

A torus structure of Vela pulsar wind nebula. Determination of the leptonic distribution function anisotropy. // Bykov A.M.

We discuss a geometrical model of the torus structure of Vela pulsar wind nebula (PWN) and suggest a method of determination of the leptonic distribution function anisotropy based on a comparison of the model predicted images and the high angular resolution Chandra images of Vela PWN. We determine an angular dependence of distribution function in a broad angular range.

List of talks

- **Monique Arnaud** *XMM observations of clusters of galaxies and their identification*
- **Solen Balman** *X-ray Observations of Dwarf Novae*
- **Bradford Benson** *The South Pole Telescope: The Sunyaev-Zel'dovich Cluster Survey and Future Plans*
- **Ilfan Bikmaev** *RTT-150 capabilities for optical follow-up eROSITA and ART-XC targets*
- **Dmitry Bisikalo** *Accretion disks in close binary stars*
- **Hans Boehringer** *Cosmological Studies with galaxy Clusters*
- **Akos Bogdan** *The asynchronous evolution of bulges and supermassive black holes in NGC4342 and NGC4291*
- **Marcella Brusa** *The golden epoch of AGN-galaxy co-evolution: prospects for eROSITA*
- **Rodion Burenin** *Optical identifications of galaxy clusters in SRG all sky survey*
- **Vadim Burwitz** *eROSITA testing and calibration activities at the MPE Panter X-ray test facility*
- **Gayoung Chon** *Understanding the large scale structure with the REFLEX II catalogue*
- **Eugene Churazov** *Galaxy clusters in X-rays: plasma physics, AGN feedback and Cosmology*
- **Nicolas Clerc** *Cosmological interpretation of large X-ray cluster surveys with CR-HR diagrams*
- **Miguel de Avillez** *The Signature of Non-equilibrium Ionization and time-dependent Cooling of the Interstellar Medium*
- **Konrad Dennerl** *Comets, charge exchange, and a novel look at the X-ray Universe with eROSITA*
- **Serguei Nikolaevitch Dodonov** *Power of medium band imaging*
- **Alexis Finoguenov** *CODEX: prototype for eROSITA cluster survey*
- **Marat Gilfanov** *AGN and normal galaxies in the eROSITA all-sky survey*
- **Stefan Gillessen** *A gas cloud on its way towards the supermassive black hole at the Galactic Centre*

- **Yuri Nickolaevich Gnedin** *Magnetic fields of active galactic nuclei and quasars*
- **Sergei Grebenev** *Supergiant Fast X-ray Transients - status and prospects for study with Spectrum-RG*
- **Mikhail Viktorovitch Gubarev** *Development of Mirror Modules for the ART-XC Instrument*
- **Tolga Guver** *Modeling the X-ray Spectra of Magnetars*
- **Guenther Gustav Hasinger** *Possibilities for eROSITA cooperation with Hawaii ground-based facilities*
- **Gert Huetsi** *Angular fluctuations in the CXB: Is Fe 6.4 keV line tomography of the large-scale structure feasible?*
- **Dmitry Ivanov** *Radio Observations of the Cosmic Gamma-Ray Burst on "Quasar" Network Telescopes*
- **Vladislav V. Izmodenov** *Charge transfer reactions at interfaces between neutral gas and plasma: Dynamical effects and X-ray emission*
- **Ildar Khabibullin** *SRG/eROSITA prospects for detection of GRB afterglows*
- **Viktor Khartov** *SRG project status and overview*
- **Dmitry Klochkov** *Luminosity-related spectral changes as a probe of the accretion regime in accreting pulsars*
- **Alexander Kolodzig** *AGN in the eRosita All-Sky survey: Statistics and correlation properties*
- **Roman Krivonos** *X-ray emission from IRAS galaxies*
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List of participants

1. Dr Arefiev, Vadim, *Space Research Institute (IKI), Russia*
   arefiev@iki.rssi.ru
2. Dr Arnaud, Monique, *CEA - Service d'Astrophysique, France*
   Monique.Arnaud@cea.fr
3. Prof. Balman, Solen, *Middle East Technical University*
   solen@astroa.physics.metu.edu.tr
4. Prof. Dr. Becker, Werner, *Max Planck Institute for Extraterrestrial Physics, Germany*
   web@mpe.mpg.de
5. Dr. Benson, Bradford, *University of Chicago, USA*
   bbenson@kicp.uchicago.edu
6. Dr. Bergemann, Maria, *Max-Planck Institute for Astrophysics, Germany*
   mbergema@mpa-garching.mpg.de
7. Dr. Bikmaev, Ilfan, *Kazan Federal University, Russia*
   ibikmaev@yandex.ru
8. Prof. Bisikalo, Dmitry, *Institute of Astronomy, RAS, Russia*
   bisikalo@inasan.ru
9. Prof. Dr. Boehringer, Hans, *Max Planck Institute for Extraterrestrial Physics, Germany*
   hxb@mpe.mpg.de
10. Dr Bogdan, Akos, *Smithsonian Astrophysical Observatory/CfA, USA*
    akbogdan@gmail.com
11. Mr Boldin, Pavel A, *Space Research Institute (IKI), Russia*
    boldin.pavel@gmail.com
12. Dr. Brunner, Hermann, *Max Planck Institute for Extraterrestrial Physics, Germany*
    hbrunner@mpe.mpg.de
13. Dr. Brusa, Marcella, *Max Planck Institute for Extraterrestrial Physics, Germany*
    marcella@mpe.mpg.de
14. Buliga, Stanislava Dmitrievna, *Central Astronomical Observatory of the Russian Academy of Sciences at Pulkovo, Russia*
    aynim@mail.ru
15. Dr. Burenin, Rodion, *Space Research Institute (IKI), Russia*
    rodion@iki.rssi.ru

16. Dr. Burwitz, Vadim, *Max Planck Institute for Extraterrestrial Physics, Germany*
burwitz@mpe.mpg.de

17. Prof. Cherepashchuk, Anatoly Mikhailovich, *Sternberg Astronomical Institute of Moscow State Uiversity (SAI MSU), Russia*
cherepashchuk@gmail.com

18. Dr Chernyshov, Dmitry Olegovich, *Lebedev's Institue of Physics, Moscow, Russia*
chernyshov@dgap.mipt.ru

19. Dr. Chesalin, Lev, *Space Research Institute (IKI), Russia*
lchesali@iki.rssi.ru

20. Dr. Chon, Gayoung, *Max Planck Institute for Extraterrestrial Physics, Germany*
gchon@mpe.mpg.de

21. Dr. Churazov, Eugene, *IKI, Russia; MPA, Germany*
churazov@iki.rssi.ru

22. Dr Clerc, Nicolas, *Max Planck Institute for Extraterrestrial Physics, Germany*
nclerc@mpe.mpg.de

23. Prof. de Avillez, Miguel, *University of Evora, Portugal*
mavillez@galaxy.lca.uevora.pt

24. Dr. Dennerl, Konrad, *Max Planck Institute for Extraterrestrial Physics, Germany*
kod@mpe.mpg.de

25. Dr. Dodonov, Serguei Nikolaevitch, *Special Astrophysical Observatory RAS, Russia*
dodo@sao.ru

26. Dr Doroshenko, Victor, *IAAT, Tuebingen, Germany*
doroshv@astro.uni-tuebingen.de

27. Doroshenko, Rozaliya, *IAAT Tuebingen, Germany*
doroshr@astro.uni-tuebingen.de

28. Dr. Dubrovich, Victor Konstantinovich, *SAO, St-Petersburg, Russia*
dvk47@mail.ru

29. Prof. Finoguenov, Alexis, *MPE / University of Helsinki, Germany/ Finland*
alexis@mpe.mpg.de

30. Dr. Freyberg, Michael, *Max Planck Institute for Extraterrestrial Physics, Germany*
mjf@mpe.mpg.de

31. Dr. Friedrich, Peter, *Max Planck Institute for Extraterrestrial Physics, Germany*
pfriedrich@mpe.mpg.de

32. Master Fujii, Hirokazu, *University of Tokyo, Japan*
hirokazufujii@gmail.com

33. Galeev, Almaz, *Kazan Federal University, Russia*
almazgaleev2@yandex.ru

34. Prof. Gilfanov, Marat, *IKI, Russia; MPA, Germany*
gilfanov@iki.rssi.ru

35. Dr. Gillessen, Stefan, *Max-Planck-Institute for Extraterrestrial Physics, Germany*
ste@mpe.mpg.de

36. Prof. Gnedin, Yuri Nickolaevich, *Central Astronomical Observatory at Pulkovo of RAS, Russia*
gnedin@gao.spb.ru

37. Dr. Grebenev, Sergei, *Space Research Institute (IKI), Russia*
sergei@hea.iki.rssi.ru

38. Grossberger, Christoph, *Dr. Karl Remeis-Observatory Bamberg & ECAP, Germany*
christoph.grossberger@sternwarte.uni-erlangen.de

39. Dr. Gubarev, Mikhail Viktorovitch, *NASA/Marshall Space Flight Center, USA*
Mikhail.V.Gubarev@nasa.gov

40. Dr. Guglielmetti, Fabrizia, *Max Planck Institute for Extraterrestrial Physics, Germany*
fabrizia@mpe.mpg.de

41. Dr Guver, Tolga, *Sabanci University, Turkey*
tolgaguver@sabanciuniv.edu

42. Prof. Hasinger, Guenther Gustav, *Institute for Astronomy, University of Hawaii Manoa, USA*
hasinger@ifa.hawaii.edu

43. Huetsi, Gert, *Max Planck Institute for Astrophysics, Germany*
gert@mpa-garching.mpg.de

44. Dr. Ibrahimov, Mansur, *Institute of Astronomy RAS, Russia*
mansur@inasan.ru

45. Dr. Inogamov, Nail, *Landau Institute for Theoretical Physics, RAS*
nailinogamov@googlemail.com

46. Irtuganov, Eldar, *Kazan Federal University, Russia*
rus.flyer@mail.ru

47. Ph.D. Ivanov, Dmitry, *Institute of Applied Astronomy RAS, Russia*
dvi@ipa.nw.ru

48. Prof. Izmodenov, Vladislav V., *Space Research Institute (IKI), Lomonosov Moscow State University, Russia*
vlad.izmodenov@gmail.com

49. Dr. Karasev, Dmitri, *Space Research Institute (IKI), Russia*
dkarasev@iki.rssi.ru

50. Mr. Khabibullin, Ildar, *Space Research Institute (IKI), Russia*
khabibullin@iki.rssi.ru

51. Dr. Khamitov, Irek Munavirovich, *TUBITAK National Observatory, Turkey*
irek_khamitov@hotmail.com

52. Khartov, Viktor, *Lavochkin Association, Russia*
khartov@laspace.ru

53. Dr. Khatri, Rishi, *Max Planck Institute for Astrophysics, Germany*
khatri@mpa-garching.mpg.de

54. Khorunzhev, Georgii, *Space Research Institute (IKI), Russia*
horge@iki.rssi.ru

55. Dr. Klochkov, Dmitry, *IAAT, Uni. Tuebingen, Germany*
klochkov@astro.uni-tuebingen.de

56. Kolodzig, Alexander, *Max Planck Institute for Astrophysics, Germany*
alex@mpa-garching.mpg.de

57. Dr. Kreykenbohm, Ingo, *Dr. Karl Remeis Observatory & ECAP, Germany*
ingo.kreykenbohm@sternwarte.uni-erlangen.de

58. Dr. Krivonos, Roman, *IKI, Russia; MPA, Germany*
krivonos@iki.rssi.ru

59. Dr Kurtanidze, Omar Mirian, *Abastumani Observatory, Georgia*
blazar_aao@yahoo.com

60. Dr. Lamer, Georg, *Leibniz Institute for Astrophysics Potsdam, Germany*
glamer@aip.de

61. Dr. Lapshov, Igor, *Space Research Institute (IKI), Russia*
lapchoff@iki.rssi.ru

62. Dr. Lobanov, Andrei, *Max-Planck-Institut fuer Radioastronomie, Bonn, Germany*
alobanov@mpifr-bonn.mpg.de

63. Lomakin, Ilya, *Lavochkin Association*
ilya_lomakin@laspace.ru

64. Dr Lutovinov, Alexander Anatolievich, *Space Research Institute*
aal@iki.rssi.ru

65. Lyskova, Natalya, *Max Planck Institute for Astrophysics, Germany; Space Research Institut (IKI), Russia*
lyskova@mpa-garching.mpg.de

66. Marrone, Daniel, *University of Arizona, USA*
dmarrone@email.arizona.edu

67. McCammon, Dan, *University of Wisconsin, USA*
mccammon@physics.wisc.edu

68. dr. Merloni, Andrea, *Max Planck Institute for Extraterrestrial Physics, Germany*
am@mpe.mpg.de

69. Minaev, Pavel, *Space Research Institute (IKI), Russia*
minaevp@mail.ru

70. Dr Mingaliev, Marat, *Special Astrophysical Observatory, Russia*
marat@sao.ru

71. Dr Moiseev, Alexei, *Special Astrophysical Observatory RAS, Russia*
moisav@gmail.com

72. Dr. Molkov, Sergey, *Space Research Institute (IKI), Russia*
molkov@iki.rssi.ru

73. Dr Molnar, Sandor, *Leung Center for Cosmology and Particle Astrophysics, Taiwan*
sandor@asiaa.sinica.edu.tw

74. Dr. Mroczkowski, Tony, *California Institute of Technology/Jet Propulsion Lab, Pasadena, USA*
tonym@astro.caltech.edu

75. Prof Nagai, Daisuke, *Yale University, USA*
daisuke.nagai@yale.edu

76. Prof. Nagirner, Dmitrij Isidorovich, *Saint Petersburg State University, Russia*
dinagirner@gmail.com

77. Prof. Nandra, Kirpal, *Max Planck Institute for Extraterrestrial Physics, Germany*
knandra@mpe.mpg.de

78. Natsvlishvili, Tinatin Mikhailovna, *Central Astronomical Observatory of the Russian Academy of Sciences at Pulkovo, Russia*
tinatin@gao.spb.ru

79. Dr. Nazarov, Vladimir, *Space Research Institute (IKI), Russia*
vnazarov@romance.iki.rssi.ru

80. Dr. Nebot, Ada, *Observatoire Astronomique de Strasbourg, France*
ada.nebot@astro.unistra.fr

81. Nikolaeva, Evgeny, *Kazan Federal University, Russia*
evgeny.nikolaeva@gmail.com

82. Nikolaevitch, Perkhnyak Alexander, *Nizhny Novgorod Planetarium*
perkhnyak@gmail.com

83. Prof. Ota, Naomi, *Nara Women's University*
naomi@cc.nara-wu.ac.jp

84. Dr. Pal'shin, Valentin, *Ioffe Physical-Technical Institute*
val@mail.ioffe.ru

85. Dr. Pavlinsky, Mikhail, *Space Research Institute (IKI), Russia*
pavlinsky@iki.rssi.ru

86. Piotrovich, Mikhail Yur'evich, *Central Astronomical Observatory at Pulkovo, Russia*
mike@gao.spb.ru

87. Dr Pires, Adriana Mancini, *Leibniz Institute for Astrophysics Potsdam, Germany*
apires@aip.de

88. Dr. Plagge, Thomas Jeffrey, *University of Chicago/KICP, USA*
tplagge@kicp.uchicago.edu

89. Dr. Podorvanyuk, Nikolay Yurievich, *Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia*
Nikolay.Podorvanyuk@gmail.com

90. Dr. Pointecouteau, Etienne, *IRAP (CNRS/University of Toulouse), France*
etienne.pointecouteau@irap.omp.eu

91. Dr. Popov, Sergei Borisovich, *Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia*
sergepolar@gmail.com

92. Prof. Postnov, Konstantin Aleksandrovich, *Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia*
kpostnov@gmail.com

93. Dr, Pozanenko, Alexei, *Space Research Institute (IKI), Russia*
grb123@mail.ru

94. Dr. Predehl, Peter, *Max Planck Institute for Extraterrestrial Physics, Germany*
predehl@mpe.mpg.de

95. Prof Rafikov, Roman, *Princeton University, USA*
rrr@astro.princeton.edu

96. Dr Ramsey, Brian Donald, *NASA/Marshall Space Flight Center, USA*
Brian.Ramsey@nasa.gov

97. Dr Rau, Arne, *Max Planck Institute for Extraterrestrial Physics, Germany*
arau@mpe.mpg.de

98. Prof. Reiprich, Thomas H, *Bonn University, Germany*
reiprich@astro.uni-bonn.de

99. Dr. Revnivtsev, Mikhail G., *Space Research Institute (IKI), Russia*
revnivtsev@hea.iki.rssi.ru

100. Dr. Robrade, Jan, *Hamburger Sternwarte, Germany*
jrobrade@hs.uni-hamburg.de

101. Sakhibullin, Nail, *Kazan Federal University, Russia*
Nail.Sakhibullin@ksu.ru

102. Dr., Salvato, Mara, *Max Planck Institute for Extraterrestrial Physics, Germany*
mara@mpe.mpg.de

103. Prof. Santangelo, Andrea , *IAAT-Kepler Center Tbingen, Germany*
andrea.santangelo@uni-tuebingen.de

104. Dr Sasaki, Manami, *Institute for Astronomy and Astrophysics, University of Tuebingen, Germany*
sasaki@astro.uni-tuebingen.de

105. Dr. Sazonov, Sergey, *Space Research Institute (IKI), Russia*
sazonov@iki.rssi.ru

106. Schmid, Christian, *Dr. Remeis-Observatory & ECAP, Germany*
christian.schmid@sternwarte.uni-erlangen.de

107. Prof. Schmitt, Juergen H.M.M., *Hamburger Sternwarte, Germany*
jschmitt@hs.uni-hamburg.de

108. Dr. Schwope, Axel Dietrich, *Leibniz Institute for Astrophysics Potsdam, Germany*
aschwope@aip.de

109. Selig, Marco, *Max Planck Institute for Astrophysics, Germany*
mselig@mpa-garching.mpg.de

110. Dr. Serber, Alexander Vol'kovich, *Institute of Applied Physcs of the Russian Academy of Sciences*
serber@appl.sci-nnov.ru

111. Prof. Shakura, Nikolai Ivanovich, *Moscow MV Lomonosov State University, Sternberg Astronomical Institute, Russia*
nikolai.shakura@gmail.com

112. Dr. Shustov, Boris Mihaylovich, *INASAN, Russia*
bshustov@inasan.ru

113. Dr. Sibgatullin, Ilias N, *Moscow State University, Russia*
sibgat@imec.msu.ru

114. Dr. Sievers, Jonathan LeRoy, *Princeton, USA*
jsievers@princeton.edu

115. Prof. Starobinsky, Alexei A., *Landau Institute for Theoretical Physics RAS*
alstar@landau.ac.ru

116. Dr. Su, Meng, *Harvard University/MIT, USA*
mengsu.astro@gmail.com

117. Dr. Suleimanov, Valery F., *Institute for Astronomy and Astrophysics, Tuebingen University, Germany*
suleimanov@astro.uni-tuebingen.de

118. Prof. Sunyaev, Rashid A., *IKI, Russia; MPA, Germany*
sunyaev@iki.rssi.ru

119. Dr. Swartz, Douglas A., *USRA/Marshall Space Flight Center, USA*
doug.swartz@nasa.gov

120. Dr. Tkachenko, Alexey, *Space Research Institute (IKI), Russia*
ayut@iki.rssi.ru

121. Professor Truemper, Joachim Ernst, *Max Planck Institut for Extraterrestrial Physics, Germany*
jtrumper@mpe.mpg.de

122. Dr Uvarov, Yury Aleksandrovich, *Ioffe Institute, St. Petersburg, Russia*
uv@astro.ioffe.ru

123. Prof. Wilms, Joern, *Remeis-Observatory & ECAP, Germany*
joern.wilms@sternwarte.uni-erlangen.de

124. Dr. Zhang, Yuying, *Bonn University, Germany*
yyzhang@astro.uni-bonn.de

125. Dr Zhuchkov, Roman, *Kazan Federal University, Russia*
gilgalen@yandex.ru

126. Dr Zhuravleva, Irina, *Max Planck Institute for Astrophysics, Germany*
izhur@mpa-garching.mpg.de