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From the Editor

The Active Galaxies Newsletter is produced monthly. The deadline for contributions is the last friday of the month. The Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter and are also available on the web page.

As always as editor of the newsletter I am very interested to hear any suggestions or feedback regarding the newsletter. So do not hesitate in emailing me your suggestions.

Many thanks for your continued subscription.

Janine van Eymeren

Spitzer-IRS high resolution spectroscopic survey of the 12μm Seyfert galaxies: II. Results for the Complete Dataset

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We present our *Spitzer* IRS spectroscopic survey from $10\mu m$ to $37\mu m$ of the Seyfert galaxies of the $12\mu m$ Galaxy Sample, collected in high resolution mode (R$\sim$ 600). The new spectra of 61 galaxies, together with the data we already published, gives us a total of 91 $12\mu m$ Seyfert galaxies observed, out of 112. We discuss the mid-IR emission lines and features of the Seyfert galaxies, using an improved AGN classification scheme: instead of adopting the usual classes of Seyfert 1's and Seyfert 2's, we use the spectropolarimetric data from the literature to divide the objects into categories "AGN 1" and "AGN 2", where AGN 1's include all broad-line objects, including the Seyfert 2's showing hidden broad lines in polarized light. The remaining category, AGN 2's contains only Seyferts with no detectable broad lines in either direct or polarized spectroscopy. We present various mid-IR observables, such as ionization-sensitive and density-sensitive line ratios, the PAH 11.25μm feature and the H_2 S(1) rotational line equivalent widths, the ($60\mu m$ - $25\mu m$) spectral index and the source extendedness at $19\mu m$, to characterize similarities and differences in the AGN populations, in terms of AGN dominance versus star formation dominance.

We find that the mid-IR emission properties characterize all the AGN 1's objects as a single family, with strongly AGN-dominated spectra. In contrast, the AGN 2's can be divided in two groups, the first one with properties similar to the AGN 1's except without detected broad lines, and the second with properties similar to the non-Seyfert galaxies, such as LINERs or starburst galaxies.

We computed a semianalytical model to estimate the AGN and the starburst contributions to the mid-IR galaxy emission at $19\mu m$. For 59 galaxies with appropriate data, we can separate the $19\mu m$ emission into AGN and starburst components using the measured mid-IR spectral features. We use these to quantify the brightness thresholds that an AGN must meet to satisfy our classifications: AGN 1 have an AGN contribution ≥ 73 % and AGN 2 ≥ 45 % of their total emission at $19\mu m$.

The detection of [NeV] lines turns out to be an almost perfect signature of energy production by an AGN. Only 4 ($\sim 7.5\%$ percent) of 55 AGN 1 and 2 (10% percent) out of 20 AGN 2 do not have [NeV] 14.3μm down to a flux limit of $\sim 4 \times 10^{-15} ergs^{-1}cm^{-2}$. We present mean spectra of the various AGN categories. Passing from AGN-dominated to starburst-dominated objects, the continuum steepens, especially at wavelengths shorter than $20\mu m$, while the PAH feature increases in its equivalent width and the high ionization lines decrease.

We estimate H_2 mass and excitation temperature through the measurement of the S(1) rotational line of this molecule. Finally we derive the first local luminosity functions for the brighest mid-infrared lines and the PAH feature at $11.25\mu m$. No statistical difference is apparent in the space densities for Seyfert 1's and 2's of a given line luminosity, nor for the new classes of AGN 1's and 2's. We use the correlation between [Ne V] line and nonstellar infrared continuum luminosity to derive the global output of accretion-powered galactic nuclei in the local universe.

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preprint available at astro-ph/0911.3348

Radial Velocity Offsets Due to Mass Outflows and Extinction in Active Galactic Nuclei

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We present a study of the radial velocity offsets between narrow emission lines and host galaxy lines (stellar absorption and H I 21-cm emission) in Seyfert galaxies with observed redshifts less than 0.043. We find that 35% of the Seyferts in the sample show [O III] emission lines with blueshifts with respect to their host galaxies exceeding 50 km s^{-1}, whereas only 6% show redshifts this large, in qualitative agreement with most previous studies. We also find that a greater percentage of Seyfert 1 galaxies show blueshifts than Seyfert 2 galaxies. Using *HST*/STIS spatially-resolved spectra of the Seyfert 2 galaxy NGC 1068 and the Seyfert 1 galaxy NGC 4151, we generate geometric models of their narrow-line regions (NLRs) and inner galactic disks, and show how these models can explain the blueshifted [O III] emission lines in collapsed STIS spectra of these two Seyferts. We conclude that the combination of mass outflow of ionized gas in the NLR and extinction by dust in the inner disk (primarily in the form of dust spirals) is primarily responsible for the velocity offsets in Seyfert galaxies. More exotic explanations are not needed. We discuss the implications of this result for the velocity offsets found in higher redshift AGN.

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preprint available at http://arxiv.org/abs/0911.0675

Kinematics of the parsec-scale radio jet in 3C 48

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We present results on the compact steep-spectrum quasar 3C 48 from observations with the Very Long Baseline Array (VLBA), the Multi-Element Radio Linked Interferometer Network (MERLIN) and the European VLBI Network (EVN) at multiple radio frequencies. In the 1.5-GHz VLBI images, the radio jet is characterized by a series of bright knots. The active nucleus is embedded in the southernmost VLBI component A, which is further resolved into two sub-components A1 and A2 at 4.8 and 8.3 GHz. A1 shows a flat spectrum and A2 shows a steep spectrum. The most strongly polarized VLBI components are located at component C $\sim$0.25 arcsec north of the core, where the jet starts to bend to the northeast. The polarization angles at C show gradual changes across the jet width at all observed frequencies, indicative of a gradient in the emission-weighted intrinsic polarization angle across the jet and possibly a systematic gradient in the rotation measure; moreover, the percentage of polarization increases near the curvature at C, likely consistent with the presence of a local jet-ISM interaction and/or changing magnetic-field directions. The hot spot B shows a higher rotation measure, and has no detected proper motion. These facts provide some evidence for a stationary shock in the vicinity of B. Comparison of the present VLBI observations with those made 8.43 years ago suggests a significant northward motion for A2 with an apparent transverse velocity $\beta_{app} = 3.7 \pm 0.4\,c$.

The apparent superluminal motion suggests that the relativistic jet plasma moves at a velocity of $\gtrsim 0.96\,c$ if the jet is viewed at an inclination angle less than 20°. A simple precessing jet model and a hydrodynamical isothermal jet model with helical-mode Kelvin-Helmholtz instabilities are used to fit the oscillatory jet trajectory of 3C 48 defined by the bright knots.

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On the detectability of H I 21-cm in Mg II absorption systems

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We investigate the effect of two important, but oft neglected, factors which can affect the detectability of H I 21-cm absorption in Mg II absorption systems: The effect of line-of-sight geometry on the coverage of the background radio flux and any possible correlation between the 21-cm line strength and the rest frame equivalent width of the Mg II 2796 Å line, as is seen in the case of damped Lyman-α absorption systems (DLAs). Regarding the former, while the observed detection rate at small angular diameter distance ratios ($DA_{\rm abs}/DA_{\rm QSO} > 0.8$) is a near certainty ($P > 0.9$), for an unbiased sample, where either a detection or a non-detection are equally likely, at $DA_{\rm abs}/DA_{\rm QSO} \geq 0.8$ the observed detection rate has only a probability of $P \lesssim 10^{-15}$ of occuring by chance. This
$gtrsim8\sigma$ significance suggests that the mix of $DA_{\rm abs}/DA_{\rm QSO}$ values at $z_{\rm abs}$
$lapp1$ is correlated with the mix of detections and non-detections at low redshift, while the exclusively high values of the ratio ($DA_{\rm abs}/DA_{\rm QSO} \sim 1$) at $z_{\rm abs}$
$gapp1$ contribute to the low detection rates at high redshift.

In DLAs, the correlation between the 21-cm line strength ($\int\tau\,dv/N_{\rm HI}$) and the Mg II equivalent width ($\mathrm{W}_{\rm r}^{\lambda2796}$) is dominated by the velocity spread of the 21-cm line. This has recently been shown not to hold for Mg II systems in general. However, we do find the significance of the correlation to increase when the Mg II absorbers with Mg I 2852 Å equivalent widths of $\mathrm{W}_{\rm r}^{\lambda2852} > 0.5$ Å are added to the DLA sample. This turns out to be a sub-set of the parameter space where Mg II absorbers and DLAs overlap and the fraction of Mg II absorbers known to be DLAs rises to 50%. We therefore suggest that the width of the 21-cm line is correlated with $\mathrm{W}_{\rm r}^{\lambda2796}$ for all systems likely to be DLAs and note a correlation between $\mathrm{W}_{\rm r}^{\lambda2852}$ (Mg I) and $N_{\rm HI}$, which is not apparent for the singly ionised lines. Furthermore, the 21-cm detection rate at $DA_{\rm abs}/DA_{\rm QSO} < 0.8$ rises to
$gtrsim\%$ for absorbers with $\mathrm{W}_{\rm r}^{\lambda2852} > 0.5$ Å and large values of $DA_{\rm abs}/DA_{\rm QSO}$ may explain why the absorbers which have similar values of $\mathrm{W}_{\rm r}^{\lambda2796}$ to the detections remain undetected. We do, however, also find the neutral hydrogen column densities of the non-detections to be significantly lower than those of the detections, which could also contribute to their weak absorption. Applying the $\int\tau\,dv/N_{\rm HI}$–$\mathrm{W}_{\rm r}^{\lambda2796}$ correlation to yield column densities for the Mg II absorbers in which this is unmeasured, we find no evidence of a cosmological evolution in the neutral hydrogen column density in the absorbers searched for in 21-cm.

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preprint available at http://arxiv.org/abs/0910.3998

Simultaneous Multiwavelength and Optical Microvariability Observations of CTA 102 (PKS J2232+1143)

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We present analysis of both the short-term optical and long-term multiwavelength variability of CTA 102. In 2004, this object was observed in an intense optical flaring state. Extensive R-band microvariability observations were carried out during this high state. In 2005, we obtained several weeks of contemporaneous radio, optical, and X-ray observations of CTA 102. These observations recorded distinct flaring activity in all three wavebands. Subsequent analysis revealed that this object may appear

redder when in a brighter optical state, and that the X-ray, optical, and radio activity do not appear to be correlated. The shape of the observed spectral energy distributions suggests that both synchrotron-related and external inverse Compton processes may contribute to the X-ray emission. Our results are also compared to other results on this object and archival microvariability observations. It appears that more rapid, dramatic microvariability events occur when CTA 102 is in an elevated optical flux state.

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Fitting LINER nuclei within the AGN family: A matter of obscuration?

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In this paper we study the nuclear obscuration of galaxies hosting *Low Ionization Narrow Emission Regions* (LINERs) based on their X-ray and optical emission. They show column densities at soft energies (0.5-2 keV) mostly related to the diffuse emission around the AGN, showing a correlation with the optical extinction. Column densities at hard energies (2-10 keV) seem to be much higher than what would be expected from the optical extinction. They might be associated to the inner regions of the AGN, buried at optical wavelengths. The main result of this paper is that around 50% of our LINER sample shows signatures of *Compton-thickness* according to the most common tracers: the X-ray spectral index, $\mathsf{F_X(2-10\ keV)/F([OIII])}$ ratio and $\mathsf{FeK}\alpha$ equivalent width (EW). However, the EWs of *Compton-thick* LINERs are significantly lower than in *Compton-thick* Seyferts ($\simeq$200 eV against $\geq$ 500 eV), suggesting that the 2–10 keV emission is dominated by electron scattering of the otherwise invisible AGN, or by emission from shocked gas associated to star formation rather than by reflection from the inner wall of the torus. However, no clear relation seems to exist between galaxies with optical dust lanes and X-ray classified *Compton-thick* objects. This may suggest that *Compton-thick* sources should be related to absorbing material located at the very inner regions of the AGN, maybe in the putative dusty torus. Larger black hole masses and lower Eddington ratios than Seyfert galaxies have been found. This effect can be better attributed to LINER nuclei being hosted by earlier morphological types than Seyfert nuclei. However, it has to be noted that, once a proper correction to the X-ray luminosity is applied, LINERs show Eddington ratios overlapping those of type 2 Seyferts. We speculate with a possible scenario for LINER nuclei: an inner obscuring matter similar to that of type 2 Seyfert, and an external obscuring matter responsible for the optical extinction. *Compton-thick* sources appear to be more common among LINERs than Seyferts.

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paper available at 2009ApJ...704.1570G

The X-ray luminous cluster underlying the bright radio-quiet quasar H1821+643

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We present a *Chandra* observation of the only low redshift, $z = 0.299$, galaxy cluster to contain a highly luminous radio-quiet quasar, H1821+643. By simulating the quasar PSF, we subtract the quasar contribution from the cluster core and determine the physical properties of the cluster gas down to 3 arcsec (15 kpc) from the point source. The temperature of the cluster gas decreases from 9.0$\pm$0.5 keV down to 1.3$\pm$0.2 keV in the centre, with a short central radiative cooling time of 1.0$\pm$0.1 Gyr, typical of a strong cool-core cluster. The X-ray morphology in the central 100 kpc shows extended spurs of emission from the core, a small radio cavity and a weak shock or cold front forming a semi-circular edge at $\sim$ 15 arcsec radius. The quasar bolometric luminosity was estimated to be $\sim 2\times10^{47}\,\mathrm{erg\,s^{-1}}$, requiring a mass accretion rate of $\sim 40\,\mathrm{M_\odot\,yr^{-1}}$, which corresponds to half the Eddington accretion rate. We explore possible accretion mechanisms for this object and determine that Bondi accretion, when boosted by Compton cooling of the accretion material, could provide a significant source of the fuel for this outburst. We consider H1821+643 in the context of a unified AGN accretion model and, by comparing H1821+643 with a sample of galaxy clusters, we show that the quasar has not significantly affected the large-scale cluster gas properties.

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preprint available at http://arxiv.org/abs/0911.2339

Close supermassive binary black holes

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It has been proposed that when the peaks of the broad emission lines in active galactic nuclei (AGNs) are significantly blueshifted or redshifted from the systemic velocity of the host galaxy, this could be a consequence of orbital motion of a supermassive blackhole binary (SMB) (Gaskell 1983). The AGN J1536+0441 (=SDSS J153636.22+044127.0) has recently been proposed as an example of this phenomenon (Boroson & Lauer 2009). It is proposed here instead that 1536+044 is an example of line emission from a disc. If this is correct, the lack of clear optical spectral evidence for close SMBs is significant and argues either that the merging of close SMBs is much faster than has generally been hitherto thought, or if the approach is slow, that when the separation of the binary is comparable to the size of the torus and broad-line region, the feeding of the black holes is disrupted.

Nature in press.

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preprint available at http://adsabs.harvard.edu/abs/2009arXiv0903.4447G

Inflow of the Broad-Line Region and the Fundamental Limitations of Reverberation Mapping

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The evidence from velocity-resolved reverberation mapping showing a net infall of the broad-line region (BLR) of AGNs is reviewed. Different lines in many objects at different epochs give a consistent picture of BLR motions. The motions are dominated by virialized motion (rotation plus turbulence) with significant net inflow. The BLR mass influx is sufficient to power the AGN. The increasing blueshifting of lines with increasing ionization potential is a consequence of scattering off infalling material. The high blueshiftings of the UV lines in Narrow-Line Seyfert 1s are due to enhanced BLR inflow rates rather than strong winds. Seemingly conflicting cases of apparent outflow reverberation mapping signatures are a result of the breakdown of the axial-symmetry assumption in reverberation mapping. There are several plausible causes of this breakdown: high-energy variability tends to be intrinsically anisotropic, regions of variability are necessarily located off-axis, and X-ray observations reveal major changes in line-of-sight column densities close to the black hole. Results from reverberation mapping campaigns dominated by a single event need to be treated with caution.

To appear in: *Accretion and Ejection in AGNs: a Global View*, eds. L. Maraschi, G. Ghisellini, R. Della Ceca & F. Tavecchio, *Astron. Soc. Pacific Conf. Series.*

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preprint available at http://adsabs.harvard.edu/abs/2009arXiv0910.3945G

Thesis Abstracts

Nuclear activity and interstellar medium in a sample of isolated galaxies

J. Sabater

Thesis work conducted at: Instituto de Astrofísica de Andalucía - Consejo Superior de Investigaciones Científicas & Universidad de Granada, Spain

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Ph.D degree awarded: June 2009

Galaxy evolution depends strongly on the environment. In particular, galaxy-galaxy interactions can induce nuclear activity by removing angular momentum from the gas and, in this way, feed the central black hole. Hence, a higher rate of nuclear activity would be expected in interacting galaxies. However, different studies of this topic lead to contradictory results. They might be due to the design of the surveys, sometimes focused on galaxies with emission lines, or due to different selection criteria of the samples. The goal of the AMIGA project (Analysis of the interstellar Medium of Isolated GAlaxies; http://amiga.iaa.es/) is to provide a statistically significant sample of the most isolated galaxies in the Local Universe and to quantify the properties of the interstellar medium in these galaxies and its relationship to the star formation and nuclear activity. The aim of the here summarized PhD thesis was to study the effects of the environment on nuclear activity within this frame.

The PhD work was focused on the study of nuclear activity in isolated galaxies. We chose three methods to select active galactic nuclei (AGN) candidates. The first method was based on the study of the nuclear activity traced by the deviations on the radio to far-infrared (FIR) correlation using reprocessed data from IRAS as well as NVSS and FIRST. In order to check the presence of a genuine radio AGN we got VLA images for 40 of the AGN candidates with radio-excess to check whether the radio emission was actually produced by a background radio source. The second method was the use of FIR colours in order to find obscured AGN candidates. The last method was the use of optical spectra from the Sloan Digital Sky Survey (SDSS) for ~ 350 isolated galaxies, obtaining the stellar populations, nebular emission and nuclear activity classification. We also used the existing information on nuclear activity in the Véron-Cetty catalogue and in the NASA Extragalactic Database. Finally, we compared the results obtained between the different methods and with samples in denser environments, taking into account the possible effects of the morphology and the luminosity.

The main results of the PhD work are the following. We did not find isolated galaxies with more than a factor 5 of radio excess above the radio-FIR correlation. Using a threshold of a factor 3 of radio excess we found a rate of 2%, the lowest rate found in comparison with other samples. When comparing with samples of galaxies in denser environments, the rate of radio excess galaxies grows with the number of galaxies in interaction or the proximity to the cluster center. To discard the possible effect of the density-morphology or the density-luminosity relations we compared the rate of radio-excess for galaxies with the same luminosities and morphologies in different samples obtaining always an increment of the rate of radio-excess towards denser or more interacting environments. We found 58 AGN-candidates using the FIR colour criterion. We also quantified the accuracy of FIR colour method to select AGN candidates obtaining a success rate for this method of 72.2%. Finally, we obtained a fraction of about 22% of AGN using the optical spectra, a significant fraction for a sample of isolated galaxies. We produced a final catalogue of AGN-candidate galaxies which will provide a baseline for the study of the nuclear activity depending on the environment.

We conclude that the environment plays a crucial and direct role in triggering radio nuclear activity and not only via the density-morphology or the density-luminosity relations. Our studies confirm the very low rate of AGN in the AMIGA sample, making of it the most quiescent sample studied so far in the literature.

Meetings

The X-ray Astronomy Revolution: The Ongoing Impact of XMM-Newton and Chandra

Royal Astronomical Society, The Geological Society Lecture Theatre, Burlington House, Piccadilly, London, UK
2010 January 8th

Webpage: `http://www.star.le.ac.uk/ras_xmm_chandra/`

Observations in the X-ray band provide an unique view of high energy processes and key constraints on a variety of phenomena which cannot be probed through other techniques. In 10 years of operation, the XMM-Newton and Chandra observatories have revolutionised our knowledge of the Universe at X-ray wavelengths, challenging previous paradigms and providing major advances in our understanding of the physics and evolution of X-ray sources. Using these facilities astronomers have, for example, traced the growth of black holes out to z 5, measured fundamental cosmological parameters using distant cluster samples, investigated the incidence and impact of energetic outflows in AGN, studied the high-energy properties of active stars and star formation activity in our own Galaxy, and explored the diversity of neutron-star and black-hole accretion modes. This RAS discussion meeting will highlight some of the major contributions made by XMM-Newton and Chandra to key questions in astrophysics and cosmology.

Organisers: Mike Watson (Leicester), Dave Alexander (Durham), Mat Page (MSSL)

What Drives the Growth of Black Holes?

Durham, England
19-22 April 2010

Webpage: `http://astro.dur.ac.uk/growthofblackholes/`

This workshop will explore the processes that drive accretion onto supermassive black holes, from the most luminous distant quasars to more quiescent local systems. Currently there are conflicting discussions in the literature over which processes are most important, with different observations or theoretical studies often providing apparently contradictory results, as well as theorists often disagreeing with the observers.

One cause of these disagreements may be that we are exploring systems with a very wide range in black hole mass, Eddington ratio, redshift, and environment. The workshop aims to clarify the ranges of parameter space that are probed by different studies, and help understand how the key physical processes may vary with these parameters.

The workshop will feature an exciting program of observational and theoretical talks and posters, as well as active discussion.

The main questions to be addressed will be:

1. How does gas accrete onto black holes, from kpc scales to ¡1 pc scales?
2. What are the links between black-hole growth and their host galaxies and large-scale environments?
3. What fuels the rapid growth of the most massive (and also the first) black holes?
4. What is the detailed nature of AGN feedback and its effects on black hole fueling and star formation?

The workshop will be held at the new Calman Learning Centre at Durham University from 19 to 22 April 2010, and will be limited to roughly 80 attendees.

Because of the limited space, workshop participants will be selected through a pre-registration process. If you are interested in attending, please submit your pre-registration with a talk/poster title and (optional) abstract, here.

All those wishing to attend the workshop should pre-register with the title of their presentation. Those selected for presentations will be notified by 15 January 2010, when full registration will begin. Please submit your title/abstract early!

Scientific organising committee: D Alexander, R Hickox, P Best, R Davies, T di Matteo, A Fabian, J Greene, M Volonteri

Local organising committee: L Borrero, K Coppin, A Danielson, J Geach, A Goulding, J Mullaney

Jobs

Postdoctoral Research Position, University of Kentucky

Prof. Moshe Elitzur
Physics & Astronomy Department, University of Kentucky
Lexington, KY 40506-0055, USA

Applications are invited for a postdoctoral research position in theoretical astrophysics to work with Prof. Moshe Elitzur at the University of Kentucky, Lexington, KY, USA. The start date is around September 2010, although an earlier start is possible. Interest in radiative processes, AGN and starburt galaxies is advantageous. The successful applicant will be able to join the science team of CanariCam, the mid-IR imager on the 10.4m GTC telescope. Applicants should send curriculum vita, bibliography and a statement of research interests by e-mail to moshe@pa.uky.edu and arrange for three letters of recommendation to be sent the same way. The initial appointment is for one year, with an expected extension for another year. The review of applications will start at the end of December, and will continue until the position is filled

E-mail contact: moshe@pa.uky.edu

Postdoctoral Research Position, Landessternwarte, University of Heidelberg

Prof. Stefan Wagner
Landessternwarte, Königstuhl 12
69117 Heidelberg, Germany

The Landessternwarte Heidelberg (LSW) offers one postdoctoral position on AGN in its High-Energy Astrophysics group. We are looking for a postdoctoral researcher interested in AGN research, preferably involving studies at gamma-ray energies. Our team is involved in the Very High Energy Gamma-ray Experiment H.E.S.S., and AGN observing programs with Fermi, INTEGRAL, SUZAKU, XMM, Chandra, as well as ground-based optical and radio telescopes.
Candidates are invited to participate in multifrequency projects involving access to dedicated telescopes (eg LBT, HESS), and are encouraged to contribute to the multifrequency programme with own research projects.
Heidelberg is one of the main astrophysics centres in Germany with five institutes involved in most fields of astrophysics and particle-astrophysics.

The current postdoctoral opening is for an initial period of 18 months with the possibility of an extension of up to four years.

More information about these positions can be obtained from Stefan Wagner, swagner@lsw.uni-heidelberg.de.
The review of applications will begin on December 15, 2009 and will continue until the position is filled. Applications (including a CV, list of publication, description of accomplishments and research interests, as well as contact information for 3 references) should be sent to Prof. S. Wagner, Landessternwarte Heidelberg.

E-mail contact: swagner@lsw.uni-heidelberg.de

Postdoctoral Research Position, Technion

Dr. Shai Kaspi, Prof. Ehud Behar, Prof. Ari Laor
Physics Department, Astronomy & Astrophysics group,
Technion, Haifa 32000, Israel

Applications are invited for a postdoctoral research position. The successful applicant will work with Dr. Shai Kaspi, Prof. Ehud Behar, Prof. Ari Laor, and collaborators on studies of AGN X-ray and Radio emission, variability, monitoring, spectroscopy and reverberation mapping. The successful applicant will be encouraged to also conduct independent research. A PhD is required. The position is for one year initially with the possible extension of one or two more year. The starting date could be as soon as possible, but flexible. Information about the Department can be found at http://physics.technion.ac.il. Applications including CV, publications list, one-page statement of research interests, and two professional reference letters should be sent to Dr. Shai Kaspi by e-mail. Screening will begin on Dec. 15, 2009 and continue until the position is filled.

E-mail contact: shai@physics.technion.ac.il