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Accepted Abstracts - Submitted Abstracts - Thesis Abstracts
Jobs Adverts - Meetings Adverts - Special Announcements

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.

Melanie Gendre

Abstracts of recently accepted papers

X-ray Outflows in the Swift Burst Alert Detected Seyfert 1s

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Previous surveys of outflows in low-redshift active galactic nuclei (AGN) have relied on the analysis of sources selected primarily for their optical/X-ray brightness, and are therefore biased. Towards determining the outflow properties of local AGN, we detect warm absorption signatures of O VII and O VIII absorption edges in the available Suzaku/XMM-Newton CCD spectra of an unbiased sample of 44 Seyfert 1–1.5 sources selected in the very hard X-rays (14–195 keV) with the Swift Burst Alert Telescope. From our analysis, we find that O VII and O VIII absorption edges are present in 41% of the sample. This fraction is dependent on luminosity, with outflow detections in 60% of low luminosity and 30% of high luminosity sources. However, grating spectroscopy of the highest luminosity sources reveals that $\sim 80\%$ of these sources have ionized absorbers, but that the ionization states are higher/lower than produces the O VII and O VIII edges. This suggests that ionized absorption may be present in all local Seyfert 1s.

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preprint available at Preprints.html

Wide-field VLBA Observations of the Chandra Deep Field South

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Wide-field surveys are a commonly-used method for studying thousands of objects simultaneously, to investigate, e.g., the joint evolution of star-forming galaxies and active galactic nuclei. Very long baseline interferometry (VLBI) observations can yield valuable input to such studies because they are able to identify AGN unambiguously in the moderate to high-redshift Universe. However, VLBI observations of large swaths of the sky are impractical using standard methods, because the fields of view of VLBI observations are of the order of $10''$ or less, and have therefore so far played only a minor role in galaxy evolution studies. We have embarked on a project to carry out Very Long Baseline Array (VLBA) observations of all 96 known radio sources in one of the best-studied areas in the sky, the Chandra Deep Field South (CDFS). The challenge was to develop methods which could significantly reduce the amount of observing (and post-processing) time, making such a project feasible. We have developed an extension to the DiFX software correlator which allows one to efficiently correlate up to hundreds of positions within the primary beams of the interferometer antennas. This extension enabled us to target many sources simultaneously, at full resolution and high sensitivity, using only a small amount of observing time. The combination of wide fields-of-view and high sensitivity across the field in this survey is unprecedented. We have observed with the VLBA a single pointing containing the Chandra Deep Field South, in which 96 radio sources were known from previous observations with the Australia Telescope Compact Array (ATCA). From our input sample of 96 sources, 20 were detected with the VLBA, and one more source was tentatively detected. The majority of objects have flux densities in agreement with arcsec-scale observations, implying that their radio emission comes from very small regions. Two objects are visibly resolved. One VLBI-detected object had earlier been classified as a star-forming galaxy. Comparing the VLBI detections to sources found in sensitive, co-located X-ray observations we find that X-ray detections are not a good indicator for VLBI detections. We have successfully demonstrated a new extension to the DiFX software correlator, allowing one to observe hundreds of fields of view simultaneously. In a sensitive observation of the CDFS we detect 21 % of the sources and were able to re-classify 7 sources as AGN which had not been identified as such before. Wide-field VLBI survey science is now coming of age.

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Location of γ-ray Flare Emission in the Jet of the BL Lacertae Object OJ287 more than 14 pc from the Central Engine

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We combine time-dependent multi-waveband flux and linear polarization observations with sub-milliarcsecond-scale polarimetric images at $\lambda = 7$ mm of the BL Lacertae-type blazar OJ287 to locate the γ-ray emission in prominent flares in the jet of the source > 14 pc from the central engine. We demonstrate a highly significant correlation between the strongest γ-ray and millimeter-wave flares through Monte-Carlo simulations. The two reported γ-ray peaks occurred near the beginning of two major mm-wave outbursts, each of which is associated with a linear polarization maximum at millimeter wavelengths. Our Very Long Baseline Array observations indicate that the two mm-wave flares originated in the second of two features in the jet that are separated by > 14 pc. The simultaneity of the peak of the higher-amplitude γ-ray flare and the maximum in polarization of the second jet feature implies that the γ-ray and mm-wave flares are co-spatial and occur > 14 pc from the central engine. We also associate two optical flares, accompanied by sharp polarization peaks, with the two γ-ray events. The multi-waveband behavior is most easily explained if the γ-rays arise from synchrotron self-Compton scattering of optical photons from the flares. We propose that flares are triggered by interaction of moving plasma blobs with a standing shock. The γ-ray and optical emission is quenched by inverse Compton losses as synchrotron photons from the newly shocked plasma cross the emission region. The mm-wave polarization is high at the onset of a flare, but decreases as the electrons emitting at these wavelengths penetrate less polarized regions.

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The quasar PG 0844+349 in an X-ray weak state

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In March 2009 the well-studied quasar, PG 0844+349, was discovered with *Swift* to be in an X-ray weak state. A follow-up *XMM-Newton* observation several weeks later generated a good quality spectrum of the source, showing substantial curvature and spectral hardening. In combination with archival data at two previous epochs when the source was in a bright state, we examine the long-term spectral and timing properties of PG 0844+349 spanning nearly ten years and a factor of ten in brightness. Partial covering and blurred reflection models are compared to the data at each flux state while attempting to maintain consistency between the various epochs. In terms of the blurred reflection model, PG 0844+349 is in a reflection dominated state during the 2009 X-ray weak observations, which can be understood in terms of light bending. Moreover, the light bending scenario can also account for the short-term (i.e. 1000 s) spectral variability in the source. Other models cannot be decisively ruled out, but we note distinguishing features of the models that can be explored for in higher signal-to-noise data from current and future observatories.

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Gas Streaming Motions towards the Nucleus of M 81

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We present two-dimensional stellar and gaseous kinematics of the inner $120 \times 250\,\mathrm{pc}^2$ of the Liner/Seyfert 1 galaxy M 81, from optical spectra obtained with the GMOS integral field spectrograph on the Gemini North telescope at a spatial resolution of ≈ 10 pc. The stellar velocity field shows circular rotation and overall is very similar to the published large scale velocity field, but deviations are observed close to the minor axis which can be attributed to stellar motions possibly associated to a nuclear bar. The stellar velocity dispersion of the bulge is $162 \pm 15\,\mathrm{km\,s^{-1}}$, in good agreement with previous measurements and leading to a black hole mass of $\mathrm{M}_{BH} = 5.5^{+3.6}_{-2.0} \times 10^7\,\mathrm{M}_\odot$ based on the M_{BH}-σ relationship. The gas kinematics is dominated by non-circular motions and the subtraction of the stellar velocity field reveals blueshifts of $\approx -100\,\mathrm{km\,s^{-1}}$ on the far side of the galaxy and a few redshifts on the near side. These characteristics can be interpreted in terms of streaming towards the center if the gas is in the plane. On the basis of the observed velocities and geometry of the flow, we estimate a mass inflow rate in ionized gas of $\approx 4.0 \times 10^{-3}\,\mathrm{M}_\odot\,\mathrm{year}^{-1}$, which is of the order of the accretion rate necessary to power the LINER nucleus of M 81. We have also applied the technique of Principal Component Analysis (PCA) to our data, which reveals the presence of a rotating nuclear gas disk within ≈ 50 pc from the nucleus and a compact outflow, approximately perpendicular to the disk. The PCA combined with the observed gas velocity field shows that the nuclear disk is being fed by gas circulating in the galaxy plane. The presence of the outflow is supported by a compact jet seen in radio observations at a similar orientation, as well as by an enhancement of the [OI]/Hα line ratio, probably resulting from shock excitation of the circumnuclear gas by the radio jet. With these observations we are thus resolving both the feeding – via the nuclear disk and observed gas inflow, and the feedback – via the outflow, around the low-luminosity active nucleus of M 81.

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Redshifted H I nd OH absorption in radio galaxies and quasars

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From a survey for redshifted H I 21-cm and OH 18-cm absorption in the hosts of a sample of radio galaxies and quasars, we detect H I in three of the ten and OH in none of the fourteen sources for which useful data were obtained. As expected from our recent result, all of the 21-cm detections occur in sources with ultra-violet continuum luminosities of $L_{\rm UV} \leq 10^{23}$ W Hz^{-1}. At these "moderate" luminosities, we also obtain four non-detections, although, as confirmed by the equipartition of detections between the type-1 and type-2 objects, this near-50% detection rate cannot be attributed to unified schemes of active galactic nuclei (AGN). All of our detections are at redshifts of $z \lesssim 0.67$, which, in conjunction with our faint source selection, biases against UV luminous objects. The importance of ultra-violet luminosity (over AGN type) in the detection of 21-cm is further supported by the non-detections in the two high redshift ($z \sim 3.6 - 3.8$) radio galaxies, which are both type-2 objects, while having $L_{\rm UV} > 10^{23}$ W Hz^{-1}. Our 21-cm detections in combination with those previously published, give a total of eight (associated and intervening) H I absorbing sources searched and undetected in OH. Using the detected 21-cm line strengths to normalise the limits, we find that only two of these eight may have been searched sufficiently deeply in OH, although even these are marginal.

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Black-Hole Mass and Growth Rate at $z \simeq 4.8$: A Short Episode of Fast Growth Followed by Short Duty Cycle Activity

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We present new Gemini-North/NIRI and VLT/SINFONI H-band spectroscopy for a flux limited sample of 40 $z \simeq 4.8$ active galactic nuclei, selected from the Sloan Digital Sky Survey. The sample probably contains the most massive active black holes (BHs) at this redshift and spans a broad range in bolometric luminosity, $2.7 \times 10^{46} < L_{\rm bol} < 2.4 \times 10^{47} {\rm ergs\,s^{-1}}$. The high-quality observations and the accurate fitting of the Mg II $\lambda2798$ line, enable us to study, systematically, the distribution of BH mass ($M_{\rm BH}$) and normalized accretion rate ($L/L_{\rm Edd}$) at $z \simeq 4.8$. We find that $10^8 \leq M_{\rm BH} \leq 6.6 \times 10^9\, M_\odot$ with a median of $\sim 8.4 \times 10^8\, M_\odot$. We also find that $0.2 \leq L/L_{\rm Edd} \leq 3.9$ with a median of ~ 0.6. Most of these sources had enough time to grow to their observed mass at $z \simeq 4.8$ from $z = 20$, assuming a range of seed BH masses, with $\sim 40\%$ that are small enough to be stellar remnants. Compared to previously studied samples at $z \simeq 2.4$ and $\simeq 3.3$, the masses of the $z \simeq 4.8$ BHs are typically lower by ~ 0.5 dex and their $L/L_{\rm Edd}$ is higher by a similar factor. The new $z \simeq 4.8$ sample can be considered as the progenitor population of the most massive BHs at $z \simeq 2.4$ and $\simeq 3.3$. Such an evolutionary interpretation requires that the growth of the BHs from $z \simeq 4.8$ to $z \simeq 3.3$ and $z \simeq 2.4$ proceeds with short duty cycles, of about 10-20%, depending on the particular growth scenario.

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Thesis Abstracts

Studying the spectral shape and the X-ray/UV Variability of Active Galactic Nuclei with data from Swift and XMM archives

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Ph.D dissertation directed by: Prof. Fausto Vagnetti (U. Tor Vergata), Dr. Paolo Giommi (ASI)

Ph.D degree awarded: December 2010

Many efforts have been made in understanding the underlying origin of variability in Active Galactic Nuclei (AGN), but at present they could give still no conclusive answers. Since a deeper knowledge of variability will enable to understand better the accretion process onto supermassive black holes, I built the first *ensemble* struction functions (SFs) of the X-ray variability of samples of quasars with data from *Swift* and XMM-Newton archives in order to study the average properties of their variability. I show that the slope of the Structure Functions are consistent with the average of Power Density Spectrum (PDS) slopes for single sources; however, there is no evidence of a break in my *Ensemble* Structure Functions, at variance with what has been found for PDS and SFs of individual sources. This could be explained by the fact that the breaks and their dependence on the BH mass and AGN bolometric luminosity have been observed and analysed only for very low luminosity sources, and could not be extrapolated at the higher masses and luminosities of my sources.

Moreover, it is known that UV and X-ray luminosities of quasars are correlated and recent studies quantified this relation across 5 orders of magnitude. In this context, I present results on the X-ray/UV ratio from simultaneous observations in UV and X-ray bands of a sample of quasars with data from XMM-Newton archive. I confirm the anticorrelation and I do not find evidence for a dependence of α_{ox} on redshift, in agreement with previous authors. The dispersion of my simultaneous data ($\sigma \sim 0.12$) is not significantly smaller with respect to previous non-simultaneous studies, indicating that "artificial α_{ox} variability" introduced by non-simultaneity is not the main cause of dispersion: in fact, via a SF analysis I show that "intrinsic α_{ox} variability" , i.e. true variability of the X-ray to optical ratio, is important, and accounts for $\sim 30\%$ of the total variance, or more.

Lastly, my thesis presents a complete sample of *Swift*/SDSS faint blazars and other non-thermal dominated AGNs. I use this sample to calculate the general statistical properties of faint blazars and radio galaxies and in particular their Radio LogN-LogS with fluxes down to 10 mJy, in order to gain knowledge on the contribution to Cosmic Microwave Background (CMB) and gamma-ray background radiation from the faint tail of the radio population.

This thesis is available in pdf format upon request. I am pleased to acknowledge financial support through Grant ASI I/088/06/0.

Jobs Adverts

PhD research position

SRON, Netherlands Institute for Space Research,
Utrecht, The Netherlands

The High-Energy Astrophysics Division (HEA) of SRON, Netherlands Institute for Space Research (http://www.sron.nl), in collaboration with the Astronomy department of the Utrecht University, has a vacancy for a PhD student. Presently, SRON is PI Institute for two operational spectroscopic X-ray instruments, namely for the Reflection Grating Spectrometer (RGS) aboard XMM-Newton, and for the Low-Energy Transmission Grating (LETG) aboard Chandra. In addition, SRON is involved in the study and developement of future X-ray missions, such as ASTRO-H.

The PhD project is in the field of Active Galactic Nuclei and it is observational in nature. The successful candidate will mainly work on spectroscopic X-ray data collected by satellites Chandra, XMM-Newton and Suzaku, investigating the complex nature of the emission/absorption gas in the innermost regions of these objects and the impact of this gas beyond the active galactic nucleus boundaries - the so-called feedback. The PhD student will work under the supervision of dr. Elisa Costantini and dr. Jelle Kaastra and in close collaboration with the University of Utrecht.

Employment of this full-time position at SRON-Utrecht is by NWO (The Netherlands Organization for Scientific Research) and will be for a period of 4 years.

Applicants should send a full CV and the name(s) and address(es) of reference(s) (with a maximum of two, incl. phone and email), as well as a short outline of their knowledge and experience to SRON by email to pz@sron.nl or by regular mail to the Department of Personnel and Organization, Sorbonnelaan 2, 3584 CA Utrecht, the Netherlands. Please state the vacancy number (SRON 10-21) on letter and envelope. Applications will be accepted until January 31 2011.

Included Benefits: The salary will be in accordance with the PhD salary scales of NWO: EUR 2.037,00 gross per month on a full-time basis in the first year, increasing to EUR 2.610,00 in the fourth year. NWO has good secondary employment conditions.

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