Active Galaxies Newsletter	*An electronic publication dedicated to the observation and theory of active galaxies*
No. 198 — April 2014	Editor: Megan Argo (agnews@manchester.ac.uk)

Accepted Abstracts - Submitted Abstracts - Thesis Abstracts
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From the Editor

Welcome to all the new subscribers, and thanks to everyone who contributed to this issue of the Active Galaxies Newsletter.

This newsletter is intended to disseminate paper abstracts, meeting announcements, job adverts and other information which may be of interest to the active galaxies community. It is produced monthly and, whilst the deadline for contributions is the last day of the month, contributions may be submitted at any time. 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, any suggestions or feedback regarding the newsletter are welcome.

Many thanks for your continued subscription.

Megan Argo

Abstracts of recently accepted papers

High Spatial Resolution of the Mid-Infrared Emission of Compton-Thick Seyfert 2 Galaxy Mrk 3

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Mid-infrared (MIR) spectra observed with Gemini/Michelle were used to study the nuclear region of the Compton-thick Seyfert 2 (Sy 2) galaxy Mrk 3 at a spatial resolution of ∼200 pc. No polycyclic aromatic hydrocarbons (PAHs) emission bands were detected in the N-band spectrum of Mrk 3. However, intense [Ar III] 8.99 μm, [S IV] 10.5 μm and [Ne II] 12.8 μm ionic emission-lines, as well as silicate absorption feature at 9.7μm have been found in the nuclear extraction (∼200 pc). We also present subarcsecond-resolution Michelle N-band image of Mrk 3 which resolves its circumnuclear region. This diffuse MIR emission shows up as a wings towards East-West direction closely aligned with the S-shaped of the Narrow Line Region (NLR) observed at optical [O III] λ5007Å image with *Hubble/FOC.* The nuclear continuum spectrum can be well represented by a theoretical torus spectral energy distribution (SED), suggesting that the nucleus of Mrk 3 may host a dusty toroidal structure predicted by the unified model of active galactic nucleus (AGN). In addition, the hydrogen column density ($N_H = 4.8^{+3.3}_{-3.1} \times 10^{23}\,\mathrm{cm}^{-2}$) estimated with a torus model for Mrk 3 is consistent with the value derived from X-ray spectroscopy. The torus model geometry of Mrk 3 is similar to that of NGC 3281, both Compton-thick galaxies, confirmed through fitting the 9.7μm silicate band profile. This results might provide further evidence that the silicate-rich dust can be associated with the AGN torus and may also be responsible for the absorption observed at X-ray wavelengths in those galaxies.

Accepted by MNRAS 2014

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DRAFT is available at http://arxiv.org/abs/1403.2266

Kiloparsec-scale outflows are prevalent among luminous AGN: outflows and feedback in the context of the overall AGN population

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We present integral field unit (IFU) observations covering the [O III]$\lambda\lambda4959, 5007$ and Hβ emission lines of sixteen $z < 0.2$ type 2 active galactic nuclei (AGN). Our targets are selected from a well-constrained parent sample of $\approx 24,000$ AGN so that we can place our observations into the context of the overall AGN population. Our targets are radio-quiet with star formation rates ($\sim<$[10–100] $M_\odot\,\mathrm{yr}^{-1}$) that are consistent with normal star-forming galaxies. We decouple the kinematics of galaxy dynamics and mergers from outflows. We find high-velocity ionised gas (velocity widths $\approx$ 600–1500 $\mathrm{km\,s^{-1}}$; maximum velocities $\leq 1700\,\mathrm{km\,s^{-1}}$) with observed spatial extents of $>\sim$ (6–16) kpc in all targets and observe signatures of spherical outflows and bi-polar superbubbles. We show that our targets are representative of $z < 0.2$, luminous (i.e., $L_{[\mathrm{O\ III}]} > 10^{41.7}\,\mathrm{erg\,s^{-1}}$) type 2 AGN and that ionised outflows are not only common but also in $\geq$70% (3σ confidence) of cases, they are extended over kiloparsec scales. Our study demonstrates that galaxy-wide energetic outflows are not confined to the most extreme star-forming galaxies or radio-luminous AGN; however, there may be a higher incidence of the most extreme outflow velocities in quasars hosted in ultra-luminous infrared galaxies. Both star formation and AGN activity appear to be energetically viable to drive the outflows and we find no definitive evidence that favours one process over the other. Although highly uncertain, we derive mass outflow rates (typically $\approx$10$\times$ the SFRs), kinetic energies ($\approx$ 0.5–10% of L_{AGN}) and momentum rates (typically $>\sim$ 10–20 $\times\, L_{\mathrm{AGN}}/c$) consistent with theoretical models that predict AGN-driven outflows play a significant role in shaping the evolution of galaxies.

Accepted by MNRAS

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A NEW METHOD FOR MEASURING EXTRAGALACTIC DISTANCES

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We have pioneered a new method for the measurement of extragalactic distances. This method uses the time-lag between variations in the short wavelength and long wavelength light from an active galactic nucleus (AGN), based on a quantitative physical model of dust reverberation that relates the time-lag to the absolute luminosity of the AGN. We use the large homogeneous data set from intensive monitoring observations in optical and near-infrared wavelength bands with the dedicated 2-m MAGNUM telescope to obtain the distances to 17 AGNs in the redshift range $z = 0.0024$ to $z = 0.0353$. These distance measurements are compared with distances measured using Cepheid variable stars, and are used to infer that $H_0 = 73 \pm 3$ (random) km s^{-1} Mpc^{-1}. The systematic error in H_0 is examined, and the uncertainty in the size distribution of dust grains is the largest source of the systematic error, which is much reduced for a sample of AGNs for which their parameter values in the model of dust reverberation are individually measured. This AGN time-lag method can be used beyond 30 Mpc, the farthest distance reached by extragalactic Cepheids, and can be extended to high-redshift quasi-stellar objects.

Published by the Astrophysical Journal Letters, 784, L11, 5 pp. (2014)

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The triggering mechanism and properties of ionized outflows in the nearest obscured quasars

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We have identified ionized outflows in the narrow line region of all but one SDSS type 2 quasars (QSO2) at $z \leq 0.1$ (20/21, detection rate 95%), implying that this is a ubiquitous phenomenon in this object class also at the lowest z. The outflowing gas has high densities ($n_e \geq 1000$ cm^{-3}) and covers a region the size of a few kpc. This implies ionized outflow masses $M_{outf} \sim$(0.3-2.4)$\times 10^6$ M$_\odot$ and mass outflow rates $\dot{M}$ <few M$_\odot$ yr^{-1}. The triggering mechanism of the outflows is related to the nuclear activity. The QSO2 can be classified in two groups according to the behavior and properties of the outflowing gas. QSO2 in Group 1 (5/20 objects) show the most extreme turbulence, they have on average higher radio luminosities and higher excess of radio emission. QSO2 in Group 2 (15/20 objects) show less extreme turbulence, they have lower radio luminosities and, on average, lower or no radio excess. We propose that two competing outflow mechanisms are at work: radio jets and accretion disk winds. Radio jet induced outflows are dominant in Group 1, while disk winds dominate in Group 2. We find that the radio jet mode is capable of producing more extreme outflows. To test this interpretation we predict that: 1) high resolution VLBA imaging will reveal the presence of jets in Group 1 QSO2; 2) the morphology of their extended ionized nebulae must be more highly collimated and kinematically perturbed.

Accepted by MNRAS
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Preprint available at http://arxiv.org/abs/1403.1175

Fueling the central engine of radio galaxies III. Molecular gas and star formation efficiency of 3C 293

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CONTEXT: Powerful radio galaxies show evidence of ongoing active galactic nuclei (AGN) feedback, mainly in the form of fast, massive outflows. But it is not clear how these outflows affect the star formation of their hosts.
AIMS: We investigate the different manifestations of AGN feedback in the evolved, powerful radio source 3C 293 and their impact on the molecular gas of its host galaxy, which harbors young star-forming regions and fast outflows of HI and ionized gas.
METHODS: We study the distribution and kinematics of the molecular gas of 3C 293 using high spatial resolution observations of the ^{12}CO(1-0) and ^{12}CO(2-1) lines, and the 3 mm and 1 continuum taken with the IRAM Plateau de Bure interferometer. We mapped the molecular gas of 3C 293 and compared it with the dust and star-formation images of the host. We searched for signatures of outflow motions in the CO kinematics, and re-examined the evidence of outflowing gas in the HI spectra. We also derived the star formation rate (SFR) and star formation efficiency (SFE) of the host with all available SFR tracers from the literature, and compared them with the SFE of young and evolved radio galaxies and normal star-forming galaxies.
RESULTS: The ^{12}CO(1-0) emission line shows that the molecular gas in 3C 293 is distributed along a massive ($M(\mathrm{H_2}) \sim 2.2 \times 10^{10}$ M$_\odot$) $\sim 24''$(21 kpc-) diameter warped disk, that rotates around the AGN. Our data show that the dust and the star formation are clearly associated with the CO disk. The ^{12}CO(2-1) emission is located in the inner 7 kpc (diameter) region around the AGN, coincident with the inner part of the ^{12}CO(1-0) disk. Both the ^{12}CO(1-0) and ^{12}CO(2-1) spectra reveal the presence of an absorber against the central regions of 3C 293 that is associated with the disk. We do not detect any fast ($\geq$500 km s^{-1}) outflow motions in the cold molecular gas. The host of 3C 293 shows an SFE consistent with the Kennicutt-Schmidt law of normal galaxies and young radio galaxies, and it is 10-50 times higher than the SFE estimated with the 7.7 μm PAH emission of evolved radio galaxies. Our results suggest that the apparently low SFE of evolved radio galaxies may be caused by an underestimation of the SFR and/or an overestimation of the molecular gas densities in these sources.
CONCLUSIONS: The molecular gas of 3C 293, while not incompatible with a mild AGN-triggered flow, does not reach the high velocities ($\geq$500 km s^{-1}) observed in the HI spectrum. We find no signatures of AGN feedback in the molecular gas of 3C 293.

Accepted by A&A
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Preprint available at http://arxiv.org/abs/1402.7208

The co-evolution of galaxies and supermassive black holes in the near Universe

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A fundamental role is attributed to supermassive black holes (SMBH), and the feedback they generate, in the evolution of galaxies. But theoretical models trying to reproduce the relation between the SMBH mass and stellar velocity dispersion of the galaxy bulge make broad assumptions about the physical processes involved. These assumptions are needed due to the scarcity of observational constraints on the relevant physical processes which occur when the SMBH is being fed via mass accretion in Active Galactic Nuclei (AGN). In search for these constraints, our group – AGN Integral Field Spectroscopy (AGNIFS) – has been mapping the gas kinematics as well as the stellar population properties of the inner few hundred parsecs of a sample of nearby AGN hosts. In this contribution, I report results obtained so far which show gas inflows along nuclear spirals and compact disks in the inner tens to hundreds of pc in nearby AGN hosts which seem to be the sources of fuel to the AGN. As the inflow rates are much larger than the AGN accretion rate, the excess gas must be depleted via formation of new stars in the bulge. Indeed, in many cases, we find ~ 100 pc circumnuclear rings of recent star formation (ages $\sim 10 - 500$ Myr) that can be interpreted as a signature of co-evolution of the host galaxy and its AGN.

Published in the Brazilian Journal of Physics, vol 43, issue 5 (Proceedings of the 2013 Texas Symposium on Relativistic Astrophysics).

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Preprint available at arXiv:1403.5816

Feeding and Feedback in nearby AGN – Comparison with the Milky Way center

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I discuss feeding and feedback processes observed in the inner few hundred parsecs of nearby active galaxies using integral field spectroscopy at spatial resolutions of a few to tens of parsecs. Signatures of feedback include outflows from the nucleus with velocities ranging from 200 to 1000 km/s, with mass outflow rates between 0.5 and a few $M_{\odot}yr^{-1}$. Signatures of feeding include the observation of gas inflows along nuclear spirals and filaments, with velocities ranging from 50 to 100km/s and mass flow rates from 0.1 to 1 $M_{\odot}yr^{-1}$. These rates are 2–3 orders of magnitude larger than the mass accretion rate to the supermassive black hole (SMBH). These inflows can thus lead, during less than one activity cycle, to the accumulation of enough gas in the inner few hundred parsecs, to trigger the formation of new stars, leading to the growth of the galaxy bulge. Young to intermediate age stars have indeed been found in circumnuclear rings around a number of Active Galactic Nuclei (AGN). One of these rings, with ~ 100 pc radius is observed in the Seyfert 2 galaxy NGC 1068, and is associated to an off-centered molecular ring, very similar to that observed in the Milky Way (MW). On the basis of an evolutionary scenario, we speculate that, in the MW, molecular gas has already accumulated within the inner ~ 100 pc and is already triggering the formation of new stars. A possible increase in the star-formation rate in the region will then be followed, tens of millions of years into the future, by the triggering of nuclear activity in Sgr A*.

To be published in the Proceedings of the IAU Symp. 303, 2014.

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Meetings

PhD course: Introduction to sub-mm interferometry and science with ALMA

Place: Dark Cosmology Centre (DARK), Niels Bohr Institute, University of Copenhagen
Dates: 13-21 August, 2014

Webpage: `http://dark.nbi.ku.dk/calendar/calendar2014/interferometry_science_course/`
Email: `mcl@dark-cosmology.dk`

DARK Associate Professors, Marianne Vestergaard and Lise Christensen, along with Wouter Vlemmings from the Nordic ALMA regional centre, Chalmers University of Technology) and Sébastien Müller, ALMA Regional Centre (ARC), will provide a 10-day course on research and observations with the Atacama Large Millimeter Array (ALMA).

The interferometry experts Wouter Vlemmings and Sébastian Müller will provide background reading and lectures on interferometry. Exercises will include hands-on tutorials and exercises, including introduction to and use of the data manipulation and analysis software CASA, feasibility calculations and technical computations relevant for proposal preparations, hints on proposal writing, and possibly small science projects.

Several talks on possible science with ALMA covering many subfields of astronomy will be held by Kirsten Kraiberg Knudsen (Chalmers Technical University, Onsala), and DARK Fellow Julie Wardlow, among others.

The course will provide 2.5 ETCS points for student not participating in the exercises and the exam and 5 ETCS points for students participating in the exercises/project work. There is no fee for attending the course, but students coming from outside of Copenhagen will have to cover their own transport and housing costs. There is a limited space available; the list of participants will be confirmed later this spring.

Special Announcements

e-MERLIN/VLBI National Facility CALL FOR e-MERLIN PROPOSALS - Cycle-2

Deadline for Receipt of Proposals - 23:59:59 UT on 15th April 2014

e-MERLIN requests proposals from the international astronomical community for observations to be made during cycle-2. Proposals will be peer-reviewed by the e-MERLIN Time allocation Committee, following the procedures of the STFC Panel for Allocation of Telescope Time. Allocation will be made on the basis of scientific merit and technical feasibility alone. During this period approximately 50% of observing time is allocated to 12 large legacy projects and most of the remaining time will be allocated via PATT to standard proposals solicited prior to each observing semester.

e-MERLIN provides high resolution (40-150mas) and high sensitivity ($\sim$7-14 Jy in this Cycle-1) imaging at cm wavelengths, as well as polarimetry, spectroscopy and astrometry.

Please see http://www.e-merlin.ac.uk/observe/call_cycle2.html for full information.

E-mail contact: emerlin@jb.man.ac.uk