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

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. Please note that the editor may reject submissions which do not use the template. As always, any suggestions or feedback regarding the newsletter are welcome.

Thanks for your continued subscription.

Megan Argo

Abstracts of recently accepted papers

A Reverberation-Based Black Hole Mass for MCG-06-30-15

Misty C. Bentz[1], Edward M. Cackett[2] , D. Michael Crenshaw[1], Keith Horne[3], Rachel Street[4] and Benjamin Ou-Yang[1]

[1] Department of Physics and Astronomy, Georgia State University, Atlanta, GA 30303, USA
[2] Department of Physics and Astronomy, Wayne State University, 666 W. Hancock St., Detroit, MI 48201, USA
[3] SUPA Physics and Astronomy, University of St. Andrews, Fife, KY16 9SS Scotland, UK
[4] Las Cumbres Observatory Global Telescope Network, 6740B Cortona Drive, Goleta, CA 93117, USA

We present the results of a reverberation campaign targeting MGC-06-30-15. Spectrophotometric monitoring and broad-band photometric monitoring over the course of 4 months in the spring of 2012 allowed a determination of a time delay in the broad Hβ emission line of $\tau = 5.3 \pm 1.8$ days in the rest frame of the AGN. Combined with the width of the variable portion of the emission line, we determine a black hole mass of $M_{\rm BH} = (1.6 \pm 0.4) \times 10^6\,{\rm M}_\odot$. Both the H$\beta$ time delay and the black hole mass are in good agreement with expectations from the $R_{\rm BLR}$–L and $M_{\rm BH} - \sigma_\star$ relationships for other reverberation-mapped AGNs. The Hβ time delay is also in good agreement with the relationship between Hβ and broad-band near-IR delays, in which the effective BLR size is $\sim 4-5$ times smaller than the inner edge of the dust torus. Additionally, the reverberation-based mass is in good agreement with estimates from the X-ray power spectral density break scaling relationship, and with constraints based on stellar kinematics derived from integral field spectroscopy of the inner ~ 0.5 kpc of the galaxy.

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E-mail contact: bentz@astro.gsu.edu
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A Low-Mass Black Hole in the Nearby Seyfert Galaxy UGC 06728

Misty C. Bentz[1], Merida Batiste[1], James Seals[1], Karen Garcia[1], Rachel Kuzio de Naray[1], Wesley Peters[1], Matthew D. Anderson[1], Jeremy Jones[1], Kathryn Lester[1], Camilo Machuca[1], J. Robert Parks[1], Crystal L. Pope[1], Mitchell Revalski[1], Caroline A. Roberts[1], Dicy Saylor[1], R. Andrew Sevrinsky[1], and Clay Turner[1]

[1] Department of Physics and Astronomy, Georgia State University, Atlanta, GA 30303, USA

We present the results of a recent reverberation mapping campaign for UGC 06728, a nearby low-luminosity Seyfert 1 in a late-type galaxy. Nightly monitoring in the spring of 2015 allowed us to determine an Hβ time delay of $\tau = 1.4 \pm 0.8$ days. Combined with the width of the variable Hβ line profile, we determine a black hole mass of $M_{\rm BH} = (7.1 \pm 4.0) \times 10^5\,{\rm M}_\odot$. We also constrain the bulge stellar velocity dispersion from higher-resolution long slit spectroscopy along the galaxy minor axis and find $\sigma_\star = 51.6 \pm 4.9\,{\rm km\,s^{-1}}$. The measurements presented here are in good agreement with both the $R_{\rm BLR}$–L relationship and the $M_{\rm BH} - \sigma_\star$ relationship for AGNs. Combined with a previously published spin measurement, our mass determination for UGC 06728 makes it the lowest-mass black hole that has been fully characterized, and thus an important object to help anchor the low-mass end of black hole evolutionary models.

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The near-to-mid infrared spectrum of quasars

Antonio Hernán-Caballero[1], Evanthia Hatziminaoglou[2], Almudena Alonso-Herrero[3] and Silvia Mateos[4]

[1] Departamento de Astrofísica y CC. de la Atmósfera, Facultad de CC. Físicas, Universidad Complutense de Madrid, E-28040 Madrid, Spain
[2] European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching bei München, Germany
[3] Centro de Astrobiología, (CAB, CSIC-INTA), ESAC Campus, E-28692 Villanueva de la Cañada, Madrid, Spain
[4] Instituto de Física de Cantabria, CSIC-UC, Avenida de los Castros s/n, 39005, Santander, Spain

We analyse a sample of 85 luminous ($\log(\nu L_\nu(3\mu{\rm m})/{\rm erg\ s^{-1}})$>45.5) quasars with restframe ∼2–11 μm spectroscopy from AKARI and *Spitzer*. Their high luminosity allows a direct determination of the near-infrared quasar spectrum free from host galaxy emission. A semi-empirical model consisting of a single template for the accretion disk and two blackbodies for the dust emission successfully reproduces the 0.1–10 μm spectral energy distributions (SEDs). Excess emission at 1–2 μm over the best-fitting model suggests that hotter dust is necessary in addition to the ∼1200 K blackbody and the disk to reproduce the entire near-infrared spectrum. Variation in the extinction affecting the disk and in the relative strength of the disk and dust components accounts for the diversity of individual SEDs. Quasars with higher dust-to-disk luminosity ratios show slightly redder infrared continua and less prominent silicate emission. We find no luminosity dependence in the shape of the average infrared quasar spectrum. We generate a new quasar template that covers the restframe range 0.1–11 μm, and separate templates for the disk and dust components. Comparison with other infrared quasar composites suggests that previous ones are less reliable in the 2–4 μm range. Our template is the first one to provide a detailed view of the infrared emission on both sides of the 4 μm bump.

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E-mail contact: ahc@denebola.org
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The warm absorber in the radio-loud quasar 4C +74.26

Laura Di Gesu[1,2], Elisa Costantini[1]

[1] SRON, Netherlands Institute for Space Science.
[2] Department of Astronomy, University of Geneva, 16 Ch. d Ecogia, 1290, Versoix, Switzerland.

Outflows of photoionized gas are commonly detected in the X-ray spectra of Seyfert 1 galaxies. However, the evidence for this phenomenon in broad line radio galaxies, which are analogous to Seyfert 1 galaxies in the radio-loud regime, has so far been scarce. Here, we present the analysis of the X-ray absorption in the radio-loud quasar 4C +74.26. With the aim of characterizing the kinetic and the ionization conditions of the absorbing material, we fitted jointly the XMM-*Newton* Reflection Grating Spectrometer (RGS) and the *Chandra* High Energy Transmission Grating Spectrometer (HETGS) spectra, which were taken 4 months apart. The intrinsic continuum flux did not vary significantly during this time lapse. The spectrum shows the absorption signatures (e.g., Fe-UTA, O VII , and Ne VII – Ne X) of a photoionized gas outflow ($N_H \sim 3.5 \times 10^{21}$ cm^{-2}, $\log \xi \sim 2.6$, $v_{out} \sim 3600$ km s^{-1}) located at the redshift of source. We estimate that the gas is located outside the broad line region but within the boundaries of the putative torus. This ionized absorber is consistent with the X-ray counterpart of a polar scattering outflow reported in the optical band for this source. The kinetic luminosity carried by the outflow is insufficient to produce a significant feedback is this quasar. Finally, we show that the heavy soft X-ray absorption that was noticed in the past for this source arises mostly in the Galactic ISM.

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E-mail contact: laura.digesu@unige.ch
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The Pan-STARRS1 distant $z > 5.6$ quasar survey: more than 100 quasars within the first Gyr of the universe

E. Bañados[1,2], B. P. Venemans[1], R. Decarli[1], E. P. Farina[1], C. Mazzucchelli[1], F. Walter[1], X. Fan[3], D. Stern[4], E. Schlafly[1,5], K.C. Chambers[6], H-W. Rix[1], L. Jiang[7], I. McGreer[3], R. Simcoe[8], F. Wang[3,9], J. Yang[3,9], E. Morganson[10], G. De Rosa[11], J. Greiner[12], M. Baloković[13], W. S. Burgett[6], T. Cooper[8], P. W. Draper[14], H. Flewelling[6], K. W. Hodapp[6], H. D. Jun[4], N. Kaiser[6], R.-P. Kudritzki[6], E. A. Magnier[6], N. Metcalfe[14], D. Miller[8], J.-T. Schindler[3], J. L. Tonry[6], R. J. Wainscoat[6], C. Waters[6], Q. Yang[3,9]

[1] Max Planck Institut für Astronomie, Königstuhl 17, D-69117, Heidelberg, Germany
[2] The Observatories of the Carnegie Institute of Washington, 813 Santa Barbara Street, Pasadena, CA 91101, USA
[3] Steward Observatory, The University of Arizona, 933 North Cherry Avenue, Tucson, AZ 85721–0065, USA
[4] Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA
[5] Lawrence Berkeley National Laboratory, One Cyclotron Road, Berkeley, CA 94720, USA
Please note: affiliation list truncated. For a full list of affiliations, please see the paper.

Luminous quasars at $z > 5.6$ can be studied in detail with the current generation of telescopes and provide us with unique information on the first gigayear of the universe. Thus far these studies have been statistically limited by the number of quasars known at these redshifts. Such quasars are rare and therefore wide-field surveys are required to identify them and multiwavelength data are needed to separate them efficiently from their main contaminants, the far more numerous cool dwarfs. In this paper, we update and extend the selection for $z \sim 6$ quasars presented in Bañados et al. (2014) using the Pan-STARRS1 (PS1) survey. We present the PS1 distant quasar sample, which currently consists of 124 quasars in the redshift range $5.6 < z < 6.7$ that satisfy our selection criteria. Seventy-seven of these quasars have been discovered with PS1, and 63 of them are newly identified in this paper. We present composite spectra of the PS1 distant quasar sample. This sample spans a factor of ~ 20 in luminosity and shows a variety of emission line properties. The number of quasars at $z > 5.6$ presented in this work almost double the quasars previously known at these redshifts, marking a transition phase from studies of individual sources to statistical studies of the high-redshift quasar population, which was impossible with earlier, smaller samples.

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E-mail contact: ebanados@carnegiescience.edu
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Dissecting Galaxies: Spatial and Spectral Separation of Emission Excited by Star Formation and AGN Activity

Rebecca L. Davies[1], Brent Groves[1], Lisa J. Kewley[1], Michael A. Dopita[1], Elise J. Hampton[1], Prajval Shastri[2], Julia Scharwächter[3], Ralph Sutherland[1], Preeti Kharb[2], Harish Bhatt[2], Chichuan Jin[4], Julie Banfield[1,5], Ingyin Zaw[6], Bethan James[7], Stéphanie Juneau[8], & Shweta Srivastava[9]

[1]Research School of Astronomy and Astrophysics, Australian National University, Canberra, ACT 2611, Australia
[2]Indian Institute of Astrophysics, Sarjapur Road, Bengaluru 560034, India
[3]LERMA, Observatoire de Paris, PSL, CNRS, Sorbonne Universités, UPMC, F-75014 Paris, France
[4]Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstrasse, D-85748 Garching, Germany
[5]ARC Centre of Excellence for All-Sky Astrophysics (CAASTRO)
[6]New York University (Abu Dhabi) , 70 Washington Sq. S, New York, NY 10012, USA
[7]Institute of Astronomy, Cambridge University, Madingley Road, Cambridge CB3 0HA, UK
[8]CEA-Saclay, DSM/IRFU/SAp, 91191 Gif-sur-Yvette, France
[9]Astronomy and Astrophysics Division, Physical Research Laboratory, Ahmedabad 380009, India

The optical spectra of Seyfert galaxies are often dominated by emission lines excited by both star formation and AGN activity. Standard calibrations (such as for the star formation rate) are not applicable to such composite (mixed) spectra. In this paper, we describe how integral field data can be used to spectrally and spatially separate emission associated with star formation from emission associated with accretion onto an active galactic nucleus (AGN). We demonstrate our method using integral field data for two AGN host galaxies (NGC 5728 and NGC 7679) from the Siding Spring Southern Seyfert Spectroscopic Snapshot Survey (S7). The spectra of NGC 5728 and NGC 7679 form clear sequences of AGN fraction on standard emission line ratio diagnostic diagrams. We show that the emission line luminosities of the majority (> 85 per cent) of spectra along each AGN fraction sequence can be reproduced by linear superpositions of the emission line luminosities of one AGN dominated spectrum and one star formation dominated spectrum. We separate the Hα, Hβ, [N II]λ6583, [S II]$\lambda\lambda$6716, 6731, [O III]λ5007 and [O II]$\lambda\lambda$3726, 3729 luminosities of every spaxel into contributions from star formation and AGN activity. The decomposed emission line images are used to derive the star formation rates and AGN bolometric luminosities for NGC 5728 and NGC 7679. Our calculated values are mostly consistent with independent estimates from data at other wavelengths. The recovered star forming and AGN components also have distinct spatial distributions which trace structures seen in high resolution imaging of the galaxies, providing independent confirmation that our decomposition has been successful.

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E-mail contact: Rebecca.Davies@anu.edu.au
Paper is available at http://adsabs.harvard.edu/abs/2016MNRAS.462.1616D

The nuclear and extended mid-infrared emission of Seyfert galaxies

I. García-Bernete[1,2], C. Ramos Almeida[1,2], J.A. Acosta-Pulido[1,2], A. Alonso-Herrero[3,4,5], O. González-Martín[6], A. Hernán-Caballero[7,8], M. Pereira-Santaella[9], N. A. Levenson[10], C. Packham[5,11], E. S. Perlman[12], K. Ichikawa[11], P. Esquej[13] and T. Díaz-Santos[14].

[1]Instituto de Astrofísica de Canarias, Calle Vía Láctea, s/n, E-38205, La Laguna, Tenerife, Spain
[2]Departamento de Astrofísica, Universidad de La Laguna, E-38206, La Laguna, Tenerife, Spain
[3]Centro de Astrobiología, CSIC-INTA, ESAC Campus, E-28692, Villanueva de la Cañada, Madrid, Spain
[4]Department of Physics, University of Oxford, Oxford OX1 3RH, UK
[5]Department of Physics and Astronomy, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249, USA
Please note: affiliation list truncated. For a full list of affiliations, please see the paper.

We present subarcsecond resolution mid-infrared (MIR) images obtained with 8-10 m-class ground-based telescopes of a complete volume-limited (D_L <40 Mpc) sample of 24 Seyfert galaxies selected from the *Swift/BAT* nine month catalog. We use those MIR images to study the nuclear and circumnuclear emission of the galaxies. Using different methods to classify the MIR morphologies on scales of ∼400 pc, we find that the majority of the galaxies (75-83%) are extended or possibly extended and 17-25% are point-like. This extended emission is compact and it has low surface brightness compared with the nuclear emission, and it represents, on average, ∼30% of the total MIR emission of the galaxies in the sample. We find that the galaxies whose circumnuclear MIR emission is dominated by star formation show more extended emission (650±700 pc) than AGN-dominated systems (300±100 pc). In general, the galaxies with point-like MIR morphologies are face-on or moderately inclined (b/a∼0.4-1.0), and we do not find significant differences between the morphologies of Sy1 and Sy2. We used the nuclear and circumnuclear fluxes to investigate their correlation with different AGN and SF activity indicators. We find that the nuclear MIR emission (the inner ∼70 pc) is strongly correlated with the X-ray emission (the harder the X-rays the better the correlation) and with the [O IV] λ25.89 μm emission line, indicating that it is AGN-dominated. We find the same results, although with more scatter, for the circumnuclear emission, which indicates that the AGN dominates the MIR emission in the inner ∼400 pc of the galaxies, with some contribution from star formation.

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E-mail contact: igarcia@iac.es
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The Sloan Digital Sky Survey Reverberation Mapping Project: Velocity Shifts of Quasar Emission Lines

Yue Shen[1,2,*], W. N. Brandt[3,4,5], Gordon T. Richards[6], Kelly D. Denney[7,8,9], Jenny E. Greene[10], C. J. Grier[3,4], Luis C. Ho[11,12], Bradley M. Peterson[7,8], Patrick Petitjean[13], Donald P. Schneider[3,4], Charling Tao[14,15], Jonathan R. Trump[3,4,16]

[1]Department of Astronomy, University of Illinois at Urbana-Champaign, Urbana, IL 61801, USA; shenyue@illinois.edu
[2]National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, IL 61801, USA
[*]Alfred P. Sloan Research Fellow
[3]Department of Astronomy & Astrophysics, The Pennsylvania State University, University Park, PA, 16802, USA
Please note: affiliation list truncated. For a full list of affiliations, please see the paper.

Quasar emission lines are often shifted from the systemic velocity due to various dynamical and radiative processes in the line-emitting region. The level of these velocity shifts depends both on the line species and on quasar properties. We study velocity shifts for the line *peaks* (not the centroids) of various narrow and broad quasar emission lines relative to systemic using a sample of 849 quasars from the Sloan Digital Sky Survey Reverberation Mapping (SDSS-RM) project. The coadded (from 32 epochs) spectra of individual quasars have sufficient signal-to-noise ratio (SNR) to measure stellar absorption lines to provide reliable systemic velocity estimates, as well as weak narrow emission lines. The large dynamic range in quasar luminosity ($\sim 2\,$dex) of the sample allowed us to explore potential luminosity dependence of the velocity shifts. We derive average line peak velocity shifts as a function of quasar luminosity for different lines, and quantify their intrinsic scatter. We further quantify how well the peak velocity can be measured as a function of continuum SNR, and demonstrate there is no systematic bias in the velocity measurements when SNR is degraded to as low as ~ 3 per SDSS pixel ($\sim 69\,\mathrm{km\,s^{-1}}$). Based on the observed line shifts, we provide empirical guidelines on redshift estimation from [OII] λ3727, [OIII] λ5007, [NeV] λ3426, MgII, CIII], HeII λ1640, broad Hβ, CIV, and SiIV, which are calibrated to provide unbiased systemic redshifts in the mean, but with increasing intrinsic uncertainties of 46, 56, 119, 205, 233, 242, 400, 415, and 477 $\mathrm{km\,s^{-1}}$, in addition to the measurement uncertainties. These results demonstrate the infeasibility of measuring quasar redshifts to better than $\sim 200\,\mathrm{km\,s^{-1}}$ with only broad lines.

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E-mail contact: shenyue@illinois.edu
Preprint available at http://arxiv.org/abs/1602.03894

The complex circumnuclear environment of the broad-line radio galaxy 3C 390.3 revealed by Chandra HETG

F. Tombesi[1,2], J. N. Reeves[3,4], T. Kallman[1], C. S. Reynolds[2], R. F. Mushotzky[2], V. Braito[5], E. Behar[2,6], M. A. Leutenegger[1] and M. Cappi[7]

[1] X-ray Astrophysics Laboratory, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA
[2] Department of Astronomy, University of Maryland, College Park, MD 20742, USA
[3] Center for Space Science and Technology, University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250, USA
[4] Astrophysics Group, School of Physical and Geographical Sciences, Keele University, Keele, Staffordshire, ST5 5BG, UK
[5] INAF - Osservatorio Astronomico di Brera, Via Bianchi 46 I-23807 Merate (LC), Italy
[6] Department of Physics, Technion 32000, Haifa 32000, Israel
[7] INAF-IASF Bologna, Via Gobetti 101, I-40129 Bologna, Italy

We present the first high spectral resolution X-ray observation of the broad-line radio galaxy 3C 390.3 obtained with the high energy transmission grating (HETG) spectrometer on board the *Chandra* X-ray Observatory. The spectrum shows complex emission and absorption features in both the soft X-rays and Fe K band. We detect emission and absorption lines in the energy range between E=700–1000 eV associated with ionized Fe L transitions (Fe XVII–XX). An emission line at the energy of E$\simeq$6.4 keV consistent with the Fe Kα is also observed. Our best-fit model requires at least three different components: (i) a hot emission component likely associated with the hot interstellar medium in this elliptical galaxy with temperature kT=0.5 $\pm$ 0.1 keV; (ii) a warm absorber with ionization parameter logξ=2.3 $\pm$ 0.5 erg s^{-1} cm, column density logN_H=20.7 $\pm$ 0.1 cm^{-2}, and outflow velocity of v_{out}<150 km s^{-1}; (iii) a lowly ionized reflection component in the Fe K band likely associated with the optical broad line region or the outer accretion disk. These evidences suggest the possibility that we are looking directly down the ionization cone of this active galaxy and that the central X-ray source only photoionizes along the unobscured cone. This is overall consistent with the angle-dependent unified picture of active galactic nuclei.

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E-mail contact: ftombesi@astro.umd.edu
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Parsec-scale jet properties of the quasar PG 1302−102

P. Mohan[1], T. An[1,2], S. Frey[3], A. Mangalam[4], K. É. Gabányi[3,5] and E. Kun[6,7]

[1] Shanghai Astronomical Observatory, 80 Nandan Road, Shanghai 200030, China
[2] Key Laboratory of Radio Astronomy, Chinese Academy of Sciences, Nanjing 210008, China
[3] FÖMI, Satellite Geodetic Observatory, P.O. Box 585, H-1592 Budapest, Hungary
[4] Indian Institute of Astrophysics, Sarjapur Road, Koramangala, Bangalore 560034, India
[5] Konkoly Observatory, MTA Research Centre for Astronomy and Earth Sciences, P.O. Box 67, 1525 Budapest, Hungary
[6] Department of Experimental Physics, University of Szeged, Dóm tér 9, H-6720 Szeged, Hungary
[7] Department of Theoretical Physics, University of Szeged, Tisza Lajos krt 84-86, H-6720 Szeged, Hungary

The quasar PG 1302−102 is believed to harbour a supermassive binary black hole (SMBBH) system. Using the available 15 GHz and $2-8$ GHz, multi-epoch Very Long Baseline Array data, we constrain the pc-scale jet properties based on the inferred mean proper motion, including a bulk Lorentz factor $\geq 5.1 \pm 0.8$, jet inclination angle $\leq (11.4 \pm 1.7)$ degrees, projected position angle $= 31.8$ degrees, intrinsic half opening angle $\leq (0.9 \pm 0.1)$ degrees and a mean $2-8$ GHz spectral index of 0.31. A general relativistic helical jet model is presented and applied to predict quasi-periodic oscillations of ~ 10 days, power law power spectrum shape and a contribution of up to ~ 53 percent to the observed variable core flux density. The model is used to make a case for high resolution, moderately sampled, long duration radio interferometric observations to reveal signatures due to helical knots and distinguish them from those due to SMBBH orbital activity including a phase difference $\sim \pi$ and an amplitude ratio (helical light curve amplitude/SMBBH light curve amplitude) of $0.2-3.3$. The prescription can be used to identify helical kinematic signatures from quasars, providing possible candidates for further studies with polarization measurements. It can also be used to infer promising SMBBH candidates for the study of gravitational waves if there are systematic deviations from helical signatures.

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E-mail contact: pmohan@shao.ac.cn
Preprint available at http://arxiv.org/abs/1608.06684

The Gamma-Ray-emitting Quasar 0202+149: A CSS Revisited

T. An[1,2,3], Y.-Z. Cui[1,2], W.A. Baan[1,4], W.-H. Wang[1,3], P. Mohan[1]

[1] Shanghai Astronomical Observatory, Chinese Academy of Sciences, 200030 Shanghai, China
[2] School of Electrical and Electronic Engineering, Shanghai Institute of Technology, 201418, Shanghai, China
[3] Key Laboratory of Radio Astronomy, Chinese Academy of Sciences, 210008 Nanjing, China
[4] Netherlands Institute for Radio Astronomy ASTRON, P.O. Box 2, 7990-AA Dwingeloo, The Netherlands

PKS 0202+149 is a low-power radio source with blazar-like γ-ray AGN characteristics. We investigate its properties and classification in relation to its γ-ray characteristics. This source shows a hint of low frequency turnover at about 200 MHz. Radio imaging data of 0202+149 at different frequencies show differing morphologies on both kiloparsec (kpc) and parsec (pc) scales. The overall source shows a triple structure of a core and double lobes with a total projected size of ∼1.3 kpc. The compact source structure of 0202+149 is reminiscent of a compact steep spectrum (CSS) source. At pc scales a core-jet structure extends ∼25 pc (in projection) at a position angle perpendicular to the kpc-scale structure. The curved pc-scale structure with a jet and inner lobe suggests that the CSS nuclear activity has recently re-started although its power has been decreasing, while the kpc-scale lobes are relics of earlier activity. A maximum apparent superluminal motion of $\sim 16\,c$ is detected in the jet components, indicating a highly relativistic jet flow. The brightness temperature of the core is lower than the average value found for highly-beamed, γ-ray AGNs, indicating a lower radio power and a relatively lower Doppler boosting factor. The CSS radio classification indicates that blazar-like γ-ray properties can also be manifested in low-power CSS radio sources with the appropriate jet and beaming properties.

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E-mail contact: antao@shao.ac.cn
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VLBI observations of a flared optical quasar CGRaBS J0809+5341

T. An[1,2,3], Y.-Z. Cui[1,2], Z. Paragi[4], S. Frey[5], L. I. Gurvits[4,6], K. É. Gabányi[5,7]

[1] Shanghai Astronomical Observatory, Chinese Academy of Sciences, 200030 Shanghai, China
[2] School of Electrical and Electronic Engineering, Shanghai Institute of Technology, 201418, Shanghai, China
[3] Key Laboratory of Radio Astronomy, Chinese Academy of Sciences, 210008 Nanjing, China
[4] Joint Institute for VLBI ERIC, Postbus 2, 7990 AA Dwingeloo, the Netherlands
[5] FÖMI Satellite Geodetic Observatory, PO Box 585, H-1592 Budapest, Hungary
[6] Department of Astrodynamics and Space Missions, Delft University of Technology, Kluyverweg 1, 2629 HS Delft, the Netherlands
[7] Konkoly Observatory, MTA Research Centre for Astronomy and Earth Sciences, PO Box 67, H-1525 Budapest, Hungary

A bright optical flare was detected in the high-redshift ($z = 2.133$) quasar CGRaBS J0809+5341 on 2014 April 13. The absolute magnitude of the object reached -30.0 during the flare, making it the brightest one (in flaring stage) among all known quasars so far. The 15 GHz flux density of CGRaBS J0809+5341 monitored in the period from 2008 to 2016 also reached its peak at the same time. To reveal any structural change possibly associated with the flare in the innermost radio structure of the quasar, we conducted a pilot very long baseline interferometry (VLBI) observation of CGRaBS J0809+5341 using the European VLBI Network (EVN) at 5 GHz on 2014 November 18, about seven months after the prominent optical flare. Three epochs of follow-up KaVA (Korean VLBI Network and VLBI Exploration of Radio Astrometry Array) observations were carried out at 22 and 43 GHz frequencies from 2015 February 25 to June 4, with the intention of exploring a possibly emerging new radio jet component associated with the optical flare. However, these high-resolution VLBI observations revealed only the milliarcsecond-scale compact "core" that was known in the quasar from earlier VLBI images, and showed no sign of any extended jet structure. Neither the size, nor the flux density of the "core" changed considerably after the flare according to our VLBI monitoring. The results suggest that any putative radio ejecta associated with the major optical and radio flare could not yet be separated from the "core" component, or the newly-born jet was short-lived.

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E-mail contact: antao@shao.ac.cn
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Delayed triggering of radio Active Galactic Nuclei in gas-rich minor mergers in the local Universe

S. S. Shabala[1], A. Deller[2], S. Kaviraj[3], E. Middelberg[4], R. J. Turner[1], Y. S. Ting[5], J. R. Allison[6], T. A. Davis[3,7]

[1] School of Physical Sciences, Private Bag 37, University of Tasmania, Hobart, TAS 7001, Australia
[2] The Netherlands Institute for Radio Astronomy (ASTRON), Dwingeloo, The Netherlands
[3] Centre for Astrophysics Research, University of Hertfordshire, College Lane, Hatfield, Herts AL10 9AB, UK
[4] Astronomisches Institut der Ruhr-Universität Bochum, Universitätsstraße 150, D-44801 Bochum, Germany
[5] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[6] CSIRO Astronomy & Space Science, P.O. Box 76, Epping, NSW 1710, Australia
[7] School of Physics & Astronomy, Cardiff University, Queens Buildings, The Parade, Cardiff CF24 3AA, UK

We examine the processes triggering star formation and Active Galactic Nucleus (AGN) activity in a sample of 25 low redshift ($z < 0.13$) gas-rich galaxy mergers observed at milli-arcsecond resolution with Very Long Baseline Interferometry as part of the mJy Imaging VLBA Exploration at 20cm (mJIVE-20) survey. The high ($> 10^7$ K) brightness temperature required for an mJIVE-20 detection allows us to unambiguously identify the radio AGN in our sample. We find three such objects. Our VLBI AGN identifications are classified as Seyferts or LINERs in narrow line optical diagnostic plots; mid-infrared colours of our targets and the comparison of Hα star formation rates with integrated radio luminosity are also consistent with the VLBI identifications. We reconstruct star formation histories in our galaxies using optical and UV photometry, and find that these radio AGN are not triggered promptly in the merger process, consistent with previous findings for non-VLBI samples of radio AGN. This delay can significantly limit the efficiency of feedback by radio AGN triggered in galaxy mergers. We find that radio AGN hosts have lower star formation rates than non-AGN radio-selected galaxies at the same starburst age. Conventional and VLBI radio imaging shows these AGN to be compact on arcsecond scales. Our modeling suggests that the actual sizes of AGN-inflated radio lobes may be much larger than this, but these are too faint to be detected in existing observations. Deep radio imaging is required to map out the true extent of the AGN, and to determine whether the low star formation rates in radio AGN hosts are a result of the special conditions required for radio jet triggering, or the effect of AGN feedback.

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E-mail contact: stanislav.shabala@utas.edu.au
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Evidence for periodicity in 43-year-long monitoring of NGC 5548

E. Bon[1,2], S. Zucker[3], H. Netzer[4], P. Marziani[5], N. Bon[1,2], P. Jovanović[1,2], A. I. Shapovalova[6], S. Komossa[7], C. M. Gaskell[8], L. Č. Popović[1,2], S. Britzen[7], V. H. Chavushyan[9], A. N. Burenkov[6], S. Sergeev[10], G. La Mura[11], J. R. Valdés[9] and M. Stalevski[1,12,13]

[1]Astronomical Observatory, Volgina 7, 11060 Belgrade, Serbia;
[2]Isaac Newton Institute of Chile, Yugoslavia branch;
[3]Department of Geosciences, Tel-Aviv University, Tel-Aviv 6997801, Israel;
[4]School of Physics and Astronomy and the Wise Observatory, The Raymond and Beverly Sackler Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv 6997801, Israel;
[5]INAF, Osservatorio Astronomico di Padova, Padova, Italia;
[6]Special Astrophysical Observatory of the Russian AS, Nizhnij Arkhyz, Karachaevo-Cherkesia 369167, Russia;
[7]Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany;
[8]Department of Astronomy and Astrophysics, University of California at Santa Cruz, Santa Cruz, CA 95064;
[9]Instituto Nacional de Astrofsica, Óptica y Electrónica, Apartado Postal 51, CP 72000, Puebla, Pue, Mexico, Mexico;
[10] Crimean Astrophysical Observatory, P/O Nauchny, Republic of Crimea 298409, Russia;
[11]Dipartimento di Fisica e Astronomia "G. Galilei", Università degli Studi di Padova, Vicolo dell'Osservatorio 3, 35122 - Padova, Italy;
[12]Departamento de Astronomía, Universidad de Chile, Camino El Observatorio 1515, Casilla 36-D Santiago, Chile;
[13]Sterrenkundig Observatorium, Universiteit Gent, Krijgslaan 281-S9, Gent, 9000, Belgium

We present an analysis of 43 years (1972 to 2015) of spectroscopic observations of the Seyfert 1 galaxy NGC 5548. This includes 12 years of new unpublished observations (2003 to 2015). We compiled about 1600 Hβ spectra and analyzed the long-term spectral variations of the 5100 Å continuum and the Hβ line. Our analysis is based on standard procedures, including the LombScargle method, which is known to be rather limited to such heterogeneous data sets, and a new method developed specifically for this project that is more robust and reveals a 5700 day periodicity in the continuum light curve, the Hβ light curve, and the radial velocity curve of the red wing of the Hβ line. The data are consistent with orbital motion inside the broad emission line region of the source. We discuss several possible mechanisms that can explain this periodicity, including orbiting dusty and dust-free clouds, a binary black hole system, tidal disruption events, and the effect of an orbiting star periodically passing through an accretion disk.

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E-mail contact: ebon@aob.rs
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The different origins of high- and low-ionization broad emission lines revealed by gravitational microlensing in the Einstein cross

L. Braibant[1], D.Hutsemékers[1], D. Sluse[1], T. Anguita[2,3]

[1] Institut d'Astrophysique, Université de Liège, Allée du 6 Août 17, B5c, 4000, Liège, Belgium
[2] Departamento de Ciencias Fisicas, Universidad Andres Bello, Av. Republica 252, Santiago, Chile
[3] Millennium Institute of Astrophysics, 1515 Las Condes, Santiago, Chile

We investigate the kinematics and ionization structure of the broad emission line region of the gravitationally lensed quasar QSO2237+0305 (the Einstein cross) using differential microlensing in the high- and low-ionization broad emission lines. We combine visible and near-infrared spectra of the four images of the lensed quasar and detect a large-amplitude microlensing effect distorting the high-ionization CIV and low-ionization Hα line profiles in image A. While microlensing only magnifies the red wing of the Balmer line, it symmetrically magnifies the wings of the CIV emission line. Given that the same microlensing pattern magnifies both the high- and low-ionization broad emission line regions, these dissimilar distortions of the line profiles suggest that the high- and low-ionization regions are governed by different kinematics. Since this quasar is likely viewed at intermediate inclination, we argue that the differential magnification of the blue and red wings of Hα favors a flattened, virialized, low-ionization region whereas the symmetric microlensing effect measured in CIV can be reproduced by an emission line formed in a polar wind, without the need of fine-tuned caustic configurations.

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E-mail contact: lbraibant@ulg.ac.be
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Multifrequency study of a double–double radio galaxy J1706+4340

A. Marecki[1], M. Jamrozy[2] and J. Machalski[2]

[1] Toruń Centre for Astronomy, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5, PL-87-100 Toruń, Poland
[2] Astronomical Observatory, Jagiellonian University, ul. Orla 171, PL-30-244 Kraków, Poland

We report the outcome of multifrequency radio observations of a double–double radio source J1706+4340 carried out with the Very Large Array and Giant Metrewave Radio Telescope. After supplementing our own data with those available in the literature, we collected a considerable set of radio measurements covering the range from 74 to 8460 MHz. This has enabled us to perform a comprehensive review of physical properties of the source and its dynamical evolution analysis. In particular, we found that, while the age of the large-scale outer lobes is in the range $260-300$ Myr, the renewal of the jet activity, which is directly responsible for the double–double structure, took place only about 12 Myr ago after about 27-Myr long period of quiescence. Another important property of J1706+4340 we found is that the injection spectral indices and the jet powers for the inner and the outer doubles are very similar. This implies that it is the spin of the supermassive black hole rather than e.g. an instability of the accretion disc that is likely responsible for the jet production and its properties.

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E-mail contact: amr@astro.uni.torun.pl
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Direct probe of the inner accretion flow around the supermassive black hole in NGC 2617

Margherita Giustini[1,2], Elisa Costantini[1], Barbara De Marco[3], Jiri Svoboda[4], Sara Elisa Motta[5], Daniel Proga[6], Richard Saxton[2], Carlo Ferrigno[7], Anna Lia Longinotti[8], Giovanni Miniutti[9], Dirk Grupe[10], Smita Mathur[11], Benjamin John Shappee[12,13], Jos Luis Prieto[14,15], and Krzysztof Stanek[11]

[1]SRON Netherlands Institute for Space Research, Sorbonnelaan 2, 3584 CA Utrecht, the Netherlands
[2]XMM-Newton Science Operations Centre, ESA/ESAC, Apartado 78, 28692 Villanueva de la Cañada, Madrid, Spain
[3] Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstrasse 1, D-85748, Garching, Germany
[4] Astronomical Institute, Academy of Sciences, Bocní II 1401, CZ-14100 Prague, Czech Republic
[5]University of Oxford, Department of Physics, Astrophysics, Denys Wilkinson Building, Keble Road, Oxford OX1 3RH, UK
[6] Department of Physics and Astronomy, University of Nevada, Las Vegas, NV 89154, USA
[7]ISDC, University of Geneva, Chemin d'Écogia 16, CH-1290 Versoix, Switzerland
[8] Catedrática CONACYT - Instituto Nacional de Astrofísica, Óptica y Electrónica, Luis E. Erro 1, Tonantzintla, Puebla, C.P. 72840, México
[9]Centro de Astrobiología (CSIC-INTA), Dep. de Astrofísica; ESAC, PO Box 78, Villanueva de la Cañada, E-28692 Madrid, Spain
[10]Department of Earth and Space Science, Morehead State University, 235 Martindale Dr., Morehead, KY 40351, USA
[11]Astronomy Department, Ohio State University, Columbus, OH 43210, USA
[12]Carnegie Observatories, 813 Santa Barbara Street, Pasadena, CA 91101, USA
[13]Hubble, Carnegie-Princeton Fellow
[14] Núcleo de Astronomía de la Facultad de Ingeniería, Universidad Diego Portales, Av. Ejèrcito 441, Santiago, Chile
[15] Millennium Institute of Astrophysics, Santiago, Chile

NGC 2617 is a nearby ($z \sim 0.01$) active galaxy that recently switched from being a Seyfert 1.8 to be a Seyfert 1.0. At the same time, it underwent a strong increase of X-ray flux by one order of magnitude with respect to archival measurements. We characterise the X-ray spectral and timing properties of NGC 2617 with the aim of studying the physics of a changing-look active galactic nucleus (AGN). We performed a comprehensive timing and spectral analysis of two XMM-Newton pointed observations spaced by one month, complemented by archival quasi-simultaneous INTEGRAL observations. We found that, to the first order, NGC 2617 looks like a type 1 AGN in the X-ray band and, with the addition of a modest reflection component, its continuum can be modelled well either with a power law plus a phenomenological blackbody, a partially covered power law, or a double Comptonisation model. Independent of the continuum adopted, in all three cases a column density of a few 10^{23} cm^{-2} of neutral gas covering 20-40% of the continuum source is required by the data. Most interestingly, absorption structures due to highly ionised iron have been detected in both observations with a redshift of about $0.1c$ with respect to the systemic cosmological redshift. The redshifted absorber can be ascribed to a failed wind/aborted jets component, to gravitational redshift effects, and/or to matter directly falling towards the central supermassive black hole. In either case, we are probing the innermost accretion flow around the central supermassive black hole of NGC 2617 and might be even watching matter in a direct inflow towards the black hole itself.

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E-mail contact: m.giustini@sron.nl
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Long-Term X-ray Variability of Typical Active Galactic Nuclei in the Distant Universe

G. Yang[1,2], W. N. Brandt[1,2,3], B. Luo[4,1], Y. Q. Xue[5], F. E. Bauer[6,7,8,9], M. Y. Sun[10,1,5], S. Kim[6], S. Schulze[7,6], X. C. Zheng[5], M. Paolillo[11,12], O. Shemmer[13], T. Liu[5], D. P. Schneider[1,2], C. Vignali[14], F. Vito[1,2], J.-X. Wang[5]

[1] Department of Astronomy and Astrophysics, 525 Davey Lab, The Pennsylvania State University, University Park, PA 16802, USA
[2] Institute for Gravitation and the Cosmos, The Pennsylvania State University, University Park, PA 16802, USA
[3] Department of Physics, 104 Davey Laboratory, The Pennsylvania State University, University Park, PA 16802, USA
[4] School of Astronomy & Space Science, Nanjing University, Nanjing 210093, China
[5] CAS Key Laboratory for Researches in Galaxies and Cosmology, Center for Astrophysics, Department of Astronomy, University of Science and Technology of China, Chinese Academy of Sciences, Hefei, Anhui 230026, China
[6] Instituto de Astrofísica, Facultad de Física, Pontificia Universidad Católica de Chile, Casilla 306, Santiago 22, Chile
[7] Millennium Institute of Astrophysics, Nuncio Monseñor Sótero Sanz 100, Providencia, Santiago, Chile
[8] Space Science Institute, 4750 Walnut Street, Suite 205, Boulder, Colorado 80301
[9] EMBIGGEN Anillo, Concepción, Chile
[10] Department of Astronomy and Institute of Theoretical Physics and Astrophysics, Xiamen University, Xiamen, Fujian 361005, China
[11] Dipartimento di Fisica, Universita Federico II, Napoli 80126, Italy
[12] ASI Science Data Center, via del Politecnico snc, Roma 80126, Italy
[13] Department of Physics, University of North Texas, Denton, TX 76203, USA
[14] Universita di Bologná, Via Ranzani 1, Bologna, Italy

We perform long-term ($\approx$ 15 yr, observed-frame) X-ray variability analyses of the 68 brightest radio-quiet active galactic nuclei (AGNs) in the 6 Ms Chandra Deep Field-South (CFDS) survey; the majority are in the redshift range of 0.6–3.1, providing access to penetrating rest-frame X-rays up to $\approx 10 - 30$ keV. Twenty-four of the 68 sources are optical spectral type I AGNs, and the rest (44) are type II AGNs. The time scales probed in this work are among the longest for X-ray variability studies of distant AGNs. Photometric analyses reveal widespread photon-flux variability: 90% of AGNs are variable above a 95% confidence level, including many X-ray obscured AGNs and several optically classified type II quasars. We characterize the intrinsic X-ray luminosity (L_X) and absorption (N_H) variability via spectral fitting. Most (74%) sources show L_X variability; the variability amplitudes are generally smaller for quasars. A Compton-thick candidate AGN shows variability of its high-energy X-ray flux, indicating the size of reflecting material to be $\lesssim 0.3$ pc. L_X variability is also detected in a broad absorption line (BAL) quasar. The N_H variability amplitude for our sample appears to rise as time separation increases. About 16% of sources show N_H variability. One source transitions from an X-ray unobscured to obscured state while its optical classification remains type I; this behavior indicates the X-ray eclipsing material is not large enough to obscure the whole broad-line region.

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E-mail contact: gxy909@psu.edu
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