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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 day 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

Resolving the nuclear dust distribution of the Seyfert 2 galaxy NGC 3081

C. Ramos Almeida[1], M. Sánchez-Portal[2], A. M. Pérez-García[3,4], J. A. Acosta-Pulido[3,4], M. Castillo[2], A. Asensio Ramos[3,4], J. I. González-Serrano[5], A. Alonso-Herrero[6], J. M. Rodríguez Espinosa[3,4], E. Hatziminaoglou[7], D. Coia[2], I. Valtchanov[2], M. Pović[8], P. Esquej[6], C. Packham[9] and B. Altieri[2]

[1] Department of Physics and Astronomy, University of Sheffield, Sheffield, S3 7RH, UK
[2] Herschel Science Centre, INSA/ESAC, Madrid, Spain
[3] Instituto de Astrofísica de Canarias, C/Vía Láctea, s/n, E-38205, La Laguna, Tenerife, Spain
[4] Departamento de Astrofísica, Universidad de La Laguna, E-38205, La Laguna, Tenerife, Spain
[5] Instituto de Física de Cantabria, CSIC-Universidad de Cantabria, E-39005, Santander, Spain
[6] Centro de Astrobiología, INTA-CSIC, E-28850, Madrid, Spain
[7] European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching bei München, Germany
[8] Instituto de Astrofísica de Andalucía (CSIC), Apdo. 3004, 18080, Granada, Spain
[9] Astronomy Department, University of Florida, 211 Bryant Space Science Center, P.O. Box 112055, Gainesville, Florida, USA

We report far-infrared (FIR) imaging of the Seyfert 2 galaxy NGC 3081 in the range 70-500 μm, obtained with an unprecedented angular resolution, using the Herschel Space Observatory instruments PACS and SPIRE. The 11 kpc (∼70") diameter star-forming ring of the galaxy appears resolved up to 250 μm. We extracted infrared (1.6-500 μm) nuclear fluxes, that is active nucleus-dominated fluxes, and fitted them with clumpy torus models, which successfully reproduce the FIR emission with small torus sizes. Adding the FIR data to the near- and mid-infrared spectral energy distribution (SED) results in a torus radial extent of $R_o=4\pm_1^2$ pc, as well as in a flat radial distribution of the clouds (i.e. the q parameter). At wavelengths beyond 200 μm, cold dust emission at T=28±1 K from the circumnuclear star-forming ring of 2.3 kpc (∼15") in diameter starts making

a contribution to the nuclear emission. The dust in the outer parts of the galaxy is heated by the interstellar radiation field (19±3 K).

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E-mail contact: c.ramos@sheffield.ac.uk,
preprint available at http://arxiv.org/abs/1107.2420

Measuring space-time variation of the fundamental constants with redshifted submillimetre transitions of neutral carbon

S. J. Curran[1], A. Tanna[1], F. E. Koch[1], J. C. Berengut[1], J. K. Webb[1], A. A. Stark[2] and V. V. Flambaum[1]

[1]School of Physics, University of New South Wales, Sydney NSW 2052, Australia
[2]Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge MA 02138, U.S.A.

We compare the redshifts of neutral carbon and carbon monoxide in the redshifted sources in which the $^3\mathrm{P}_1 \to {}^3\mathrm{P}_0$ fine structure transition of neutral carbon, [C I], has been detected, in order to measure space-time variation of the fundamental constants. Comparison with the CO rotational lines measures $F \equiv \alpha^2/\mu$, where α is the fine structure constant and μ is the electron-proton mass ratio, which is the same combination of constants obtained from the comparison $^2\mathrm{P}_{3/2} \to {}^2\mathrm{P}_{1/2}$ fine structure line of singly ionised carbon, [C II]. However, neutral carbon has the distinct advantage that it may be spatially coincident with the carbon monoxide, whereas [C II] could be located in the diffuse medium between molecular clouds, and so any comparison with CO could be dominated by intrinsic velocity differences. Using [C I], we obtain a mean variation of $<\Delta F/F>= (-3.6\pm8.5)\times10^{-5}$, over $z = 2.3-4.1$, for the eight[C I] systems, which degrades to $(-1.5\pm11)\times10^{-5}$, over $z = 2.3-6.4$ when the two [C II] systems are included. That is, zero variation over look-back times of 10.8–12.8 Gyr. However, the latest optical results indicate a spatial variation in α, where $\Delta\alpha/\alpha$ describes a dipole and we see the same direction in $\Delta F/F$. This trend is, however, due to a single source for which the [C I] spectrum is of poor quality. This also applies to one of the two [C II] spectra previously used to find a zero variation in α^2/μ. Quantifying this, we find an anti-correlation between $|\Delta F/F|$ and the quality of the carbon detection, as measured by the spectral resolution, indicating that the typical values of $\gtrsim 50\ \mathrm{km\,s^{-1}}$, used to obtain a detection, are too coarse to reliably measure changes in the constants. From the fluxes of the known $z \gtrsim 1$ CO systems, we predict that *current instruments are incapable of the sensitivities required to measure changes in the constants through the comparison of CO and carbon lines*. We therefore discuss in detail the use of ALMA for such an undertaking and find that, based upon the current CO detections *only*, the *Full Array* configuration is expected to detect ~ 100 galaxies in [C I] at better than $10\ \mathrm{km\,s^{-1}}$ spectral resolution, while potentially resolving the individual molecular cloud complexes at redshifts of $z \gtrsim 3$. This could provide $\gtrsim 1000$ individual systems with which to obtain accurate measurements of space-time variation of the constants at look-back times in excess of 11 Gyr.

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The influence of the jet opening angle on the appearance of relativistic jets

T. Boutelier[1], G. Henri[1], P.O. Petrucci[1]

[1] UJF-Grenoble 1 / CNRS-INSU, Institut de Planétologie et dAstrophysique de Grenoble (IPAG) UMR 5274, Grenoble, F-38041, France

We reinvestigate the problem of the appearance of relativistic jets when geometrical opening is taken into account. We propose a new criterion to define apparent velocities and Doppler factors, which we think being determined by the brightest zone of the jet. We numerically compute the apparent velocity and the Doppler factor of a non homokinetic jet using different velocity profiles. We argue that if the motion is relativistic, the high superluminal velocities $\beta_{app} \simeq \gamma$, expected in the case of an homokinetic jet, are only possible for geometrical collimation smaller than the relativistic beaming angle γ^{-1}. This is relatively independent of the jet velocity profile. For jet collimation angles larger than γ^{-1}, the apparent image of the jet will always be dominated by parts of the jet traveling directly towards the observer at lorentz factors $< \gamma$ resulting in maximal apparent velocities smaller

than γ. Furthermore, getting rid of the homokinetic hypothesis yields a complex relation between the observing angle and the Doppler factor, resulting in important consequences for the numerical computation of AGN population and unification scheme model.

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E-mail contact: pierre-olivier.petrucci@obs.ujf-grenoble.fr

Turbulent and fast motions of H_2 gas in active galactic nuclei

K. M. Dasyra[1,2] and F. Combes[2]

[1] Laboratoire AIM, CEA/DSM-CNRS-Université Paris Diderot, Irfu/Service dAstrophysique, CEA Saclay, F-91191 Gif-sur-Yvette, France
[2] Observatoire de Paris, LERMA (CNRS:UMR8112), 61 Av. de l´ Observatoire, F-75014, Paris, France

Querying the *Spitzer* archive for optically-selected active galactic nuclei (AGN) observed in high-resolution-mode spectroscopy, we identified radio and/or interacting galaxies with highly turbulent motions of H_2 gas at a temperature of a few hundred Kelvin. Unlike all other AGN that have unresolved H_2 line profiles at a spectral resolution of ~600, 3C236, 3C293, IRAS09039+0503, MCG-2-58-22 and Mrk463E have intrinsic velocity dispersions exceeding 200 km s^{-1} for at least two of the rotational S0, S1, S2, and S3 lines. In a sixth source, 4C12.50, a blue wing was detected in the S1 and S2 line profiles, indicating the presence of a warm molecular gas component moving at -640 km s^{-1} with respect to the bulk of the gas at systemic velocity. Its mass is 5.2×10^7 M_{sun}, accounting for more than one fourth of the H_2 gas at 374K, but less than 1% of the cold H_2 gas computed from CO observations. Because no diffuse gas component of 4C12.50 has been observed to date to be moving at more than 250 km s^{-1} from systemic velocity, the H_2 line wings are unlikely to be tracing gas in shock regions along the tidal tails of this merging system. They can instead be tracing gas driven by a jet or entrained by a nuclear outflow, which is known to emerge from the west nucleus of 4C12.50. It is improbable that such an outflow, with an estimated mass loss rate of 130 M_{sun} yr $^{-1}$, entirely quenches the star formation around this nucleus.

A&A letters, in press

E-mail contact: kalliopi.dasyra@obspm.fr,
preprint available at http://arxiv.org/abs/1108.2888

Hot-dust clouds with pure-graphite composition around Type-I Active Galactic Nuclei

Rivay Mor[1] and Benny Trakhtenbrot[1]

[1] School of Physics and Astronomy and the Wise Observatory, The Raymond and Beverly Sackler Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv 69978, Israel

We fitted the optical to mid-infrared (MIR) spectral energy distributions of ~15,000 type-I, $0.75 < z < 2$, active galactic nuclei (AGNs) in an attempt to constrain the properties of the physical component responsible for the rest-frame near-infrared (NIR) emission. We combine optical spectra from the Sloan Digital Sky Survey and MIR photometry from the preliminary data release of the Wide-field Infrared Survey Explorer. The sample spans a large range of AGN properties: luminosity, black hole mass, and accretion rate. Our model has two components: a UV-optical continuum source and very hot, pure-graphite dust clouds. We present the luminosity of the hot-dust component and its covering factor, for all sources, and compare it with the intrinsic AGN properties. We find that the hot-dust component is essential to explain the (rest) NIR emission in almost all AGNs in our sample, and that it is consistent with clouds containing pure-graphite grains and located between the dust-free broad-line region and the "standard" torus. The covering factor of this component has a relatively narrow distribution around a peak value of ~0.13, and it correlates with the AGN bolometric luminosity. We suggest that there is no significant correlation with either black hole mass or normalized accretion rate. The fraction of hot-dust-poor AGNs in our sample is ~15%-20%, consistent with previous studies. We do not find a dependence of this fraction on redshift or source luminosity.

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E-mail contact: rivay@wise.tau.ac.il,
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Optical Variability and Colour Behaviour of 3C 345

Jianghua Wu[1], Xu Zhou[1], Jun Ma[1], and Zhaoji Jiang[1]

[1] National Astronomical Observatories, Chinese Academy of Sciences, 20A Datun Road, Chaoyang District, Beijing 100012, China

The colour behaviour of blazars is a subject of much debate. One argument is that the BL Lac objects show bluer-when-brighter chromatism while the flat-spectrum radio quasars (FSRQs) display redder-when-brighter trend. Base on a 3.5-year three-colour monitoring programme, we studied the optical variability and colour behaviour of one FSRQ, 3C 345. There is at least one outburst in this period. The overall variation amplitude is 2.640 mags in the i band. Intra-night variability was observed on two nights. The bluer-when-brighter and redder-when-brighter chromatisms were simultaneously observed in this object when using different pairs of passbands to compute the colours. The bluer-when-brighter chromatism is a shared property with the BL Lacs, while the redder-when-brighter trend is likely due to two less variable emission features, the Mg II line and the blue bump, at short wavelengths. With numerical simulations, we show that some other strong but less variable emission lines in the spectrum of FSRQs may also significantly alter their colour behaviour. Then the colour behaviour of an FSRQ is linked not only to the emission process in the relativistic jet, but also to the redshift, the passbands used for computing the colour and the strengths of the less variable emission features relative to the strength of the non-thermal continuum.

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Reverberation Mapping of the Intermediate Mass Nuclear Black Hole in SDSS J114008.71+030711.4

Stephen Rafter[1], Shai Kaspi[1], Ehud Behar[1], Wolfram Kollatschny[2], Matthias Zetzl[2]

[1] Physics Department, the Technion, Haifa 32000, Israel
[2] Institut für Astrophysik, Universität Göttingen, Friedrich-Hund Platz 1, 37077 Göttingen, Germany

We present the results of a reverberation mapping (RM) campaign on the black hole (BH) associated with the active galactic nucleus (AGN) in SDSS J114008.71+030711.4 (hereafter GH08). This object is selected from a sample of 19 candidate intermediate mass BHs ($M_{BH} < 10^6$ $M_\odot$) found by Greene & Ho (2004) in the Sloan Digital Sky Survey (SDSS). We used the Hobby-Eberly Telescope to obtain 30 spectra over a period of 178 days in an attempt to resolve the reverberation time lag (τ) between the continuum source and the broad line region (BLR) in order to determine the radius of the BLR (R_{BLR}) in GH08. We measure τ to be 2 days with an upper limit of 6 days. We estimate the AGN luminosity at 5100 Å to be $\lambda L_{5100} \approx 1.1 \times 10^{43}$ erg s^{-1} after deconvolution from the host galaxy. The most well calibrated $R_{BLR}-L$ relation predicts a time lag which is 4 times larger than what we measure. Using the measured Hβ full-width-at-half-maximum of 703 $\pm$ 110 km s^{-1} and an upper limit for $R_{BLR} = 6$ light days, we find $M_{BH} \lesssim 5.8 \times 10^5$ $M_\odot$ as an upper limit to the BH virial mass in GH08, which implies super$-$Eddington accretion. Based on our measured M_{BH} we propose that GH08 may be another candidate to add to the very short list of AGNs with $M_{BH} < 10^6$ $M_\odot$ determined using RM.

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

Supermassive Black Hole Growth in Starburst Galaxies over Cosmic Time: Constraints from the Deepest *Chandra* Fields

D. A. Rafferty[1,2], W. N. Brandt[1], D. M. Alexander[3], Y. Q. Xue[1], F. E. Bauer[4,5], B. D. Lehmer[3,6,7], B. Luo[1] and C. Papovich[8]

[1]Department of Astronomy and Astrophysics, Pennsylvania State University, University Park, PA 16802, USA
[2]Sterrewacht Leiden, Leiden University, P.O. Box 9513, 2300 RA, Leiden, The Netherlands
[3]Department of Physics, Durham University, Durham, DH1 3LE, UK
[4]Space Science Institute, 4750 Walnut Street, Suite 205, Boulder, Colorado 80301
[5]Pontificia Universidad Católica de Chile, Departamento de Astronomía y Astrofísica, Casilla 306, Santiago 22, Chile
[6]The Johns Hopkins University, Homewood Campus, Baltimore, MD 21218, USA
[7]NASA Goddard Space Flight Centre, Code 662, Greenbelt, MD 20771, USA
[8]Department of Physics, Texas A&M University, 4242 TAMU, College Station, TX 77843, USA

We present an analysis of deep multiwavelength data for $z \approx 0.3$–3 starburst galaxies selected by their 70 μm emission in the Extended-*Chandra* Deep Field-South and Extended Groth Strip. We identify active galactic nuclei (AGNs) in these infrared sources through their X-ray emission and quantify the fraction that host an AGN. We find that the fraction depends strongly on both the mid-infrared color and rest-frame mid-infrared luminosity of the source, rising to $\sim$ 50–70% at the warmest colors ($F_{24\mu\mathrm{m}}/F_{70\mu\mathrm{m}} \lesssim 0.2$) and highest mid-infrared luminosities (corresponding to ultraluminous infrared galaxies), similar to the trends found locally. Additionally, we find that the AGN fraction depends strongly on the star formation rate of the host galaxy (inferred from the observed-frame 70 μm luminosity after subtracting the estimated AGN contribution), particularly for more luminous AGNs ($L_{0.5-8.0\ \mathrm{keV}} \gtrsim 10^{43}$ erg s^{-1}). At the highest star formation rates ($\sim$ 1000 M$_\odot$ yr^{-1}), the fraction of galaxies with an X-ray detected AGN rises to $\approx$ 30%, roughly consistent with that found in high-redshift submillimeter galaxies. Assuming that the AGN fraction is driven by the star formation rate (rather than stellar mass or redshift, for which our sample is largely degenerate), this result implies that the duty cycle of luminous AGN activity increases with the star formation rate of the host galaxy: specifically, we find that luminous X-ray detected AGNs are at least $\sim$ 5–10 times more common in systems with high star formation rates ($\gtrsim$ 300 M$_\odot$ yr^{-1}) than in systems with lower star formation rates ($\lesssim$ 30 M$_\odot$ yr^{-1}). Lastly, we investigate the ratio between the supermassive black hole accretion rate (inferred from the AGN X-ray luminosity) and the bulge growth rate of the host galaxy (approximated as the star formation rate) and find that, for sources with detected AGNs and star formation (and neglecting systems with low star formation rates to which our data are insensitive), this ratio in distant starbursts agrees well with that expected from the local scaling relation assuming the black holes and bulges grew at the same epoch. These results imply that black holes and bulges grow together during periods of vigorous star formation and AGN activity.

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E-mail contact: rafferty@strw.leidenuniv.nl

Ionized outflows in SDSS type 2 quasars at z∼0.3-0.6

M. Villar-Martín[1,2], A. Humphrey[3], R. González Delgado[1], L. Colina[2], S. Arribas[2]

[1]Instituto de Astrofísica de Andalucía (CSIC), Glorieta de la Astronomía s/n, 18008 Granada, Spain
[2]Centro de Astrobiología (INTA-CSIC), Carretera de Ajalvir, km 4, 28850 Torrejón de Ardoz, Madrid, Spain
[3]Instituto Nacional de Astrofísica, Optica y Electrónica (INAOE), Aptdo. Postal 51 y 216, 72000 Puebla, México

We have analyzed the spatially integrated kinematic properties of the ionized gas within the inner $r \leq$few kpc in 13 optically selected SDSS type 2 quasars at $z \sim$0.3-0.6, using the [OIII]$\lambda\lambda$4959,5007 lines. The line profiles show a significant asymmetry in 11 objects. There is a clear preference for blue asymmetries, which are found in 9/13 quasars at 10% intensity level. In coherence with studies on other types of active and non active galaxies, we propose that the asymmetries are produced by outflows where differential dust extinction is at work. This scenario is favoured by other results we find: in addition to quiescent ambient gas, whose kinematic properties are consistent with gravitational motions, we have discovered highly perturbed gas in all objects. This gas emits very broad lines ($R = \frac{FWHM[OIII]}{FWHM_{stars}} \geq$2). While the quiescent gas shows small or null velocity shifts relative to the systemic velocity, the highly perturbed gas trends to show larger shifts which, moreover, are blueshifts in general. Within a given object, the most perturbed gas trends to have the largest blueshift as well. All together support that the perturbed gas, which is responsible for the blue asymmetries of the line profiles, is outflowing. The outflowing gas is located within the quasar ionization cones, in the narrow line region. The relative contribution of the outflowing gas to the total [OIII] line flux varies from object to object in the range ∼10-70%. An anticorrelation is found such that, the more perturbed the outflowing gas is, the lower its relative contribution is to the total [OIII] flux. This suggests that outflows with more perturbed kinematics involve a smaller fraction of the total mass of ionized gas. Although some bias affects the sample, we argue that ionized gas outflows are a common phenomenon in optically selected type 2 quasars at $0.3 \leq z \leq 0.6$.

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E-mail contact: villarmm@cab.inta-csic.es
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Black Hole Mass Estimates Based on C IV are Consistent with Those Based on the Balmer Lines

R.J. Assef[1,2,3], K.D. Denney[1,4], C.S. Kochanek[1,5], B.M. Peterson[1,5], S. Kozłowski[1], N. Ageorges[6], R.S. Barrows[7], P. Buschkamp[6], M. Dietrich[1], E. Falco[8], C. Feiz[9], H. Gemperlein[6], A. Germeroth[9], C.J. Grier[1], R. Hofmann[6], M. Juette[10], R. Khan[1], M. Kilic[8], V. Knierim[10], W. Laun[11], R. Lederer[6], M. Lehmitz[11], R. Lenzen[11], U. Mall[11], K.K. Madsen[12], H. Mandel[9], P. Martini[1,5], S. Mathur[1,5], K. Mogren[1], P. Mueller[9], V. Naranjo[11], A. Pasquali[11], K. Polsterer[10], R.W. Pogge[1,5], A. Quirrenbach[9], W. Seifert[9], D. Stern[2], B. Shappee[1], C. Storz[11], J. Van Saders[1], P. Weiser[13] and D. Zhang[1]

[1] Department of Astronomy, The Ohio State University, 140 W. 18th Ave., Columbus, OH 43210, USA
[2] Jet Propulsion Laboratory, California Institute of Technology, MS 169-530, 4800 Oak Grove Drive, Pasadena, 91109, USA
[3] NASA Postdoctoral Program Fellow
[4] DARK Fellow, Dark Cosmology Centre, Niels Bohr Institute, University of Copenhagen, Juliane Maries Vej 30, 2100 Copenhagen, Denmark
[5] The Center for Cosmology and Astroparticle Physics, The Ohio State University, 191 West Woodruff Avenue, Columbus, OH 43210, USA
[6] Max-Planck-Institut fuer Extraterrestrische Physik, Giessenbachstr., D-85748 Garching, Germany
[7] Arkansas Center for Space and Planetary Sciences, University of Arkansas, Fayetteville, AR 72701
[8] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[9] Landessternwarte, ZAH, Koenigstuhl 12, D-69117 Heidelberg, Germany
[10] Astron. Institut der Ruhr Univ. Bochum, Universitaetsstr. 150, D-44780 Bochum, Germany
[11] Max-Planck-Institut fuer Astronomie, Koenigstuhl 17, D-69117 Heidelberg, Germany
[12] California Institute of Technology, 1200 E. California Blvd, Pasadena, CA 91125, USA
[13] Fachhochschule fuer Technik und Gestaltung, Windeckstr. 110, D-68163 Mannheim, Germany

Using a sample of high-redshift lensed quasars from the CASTLES project with observed-frame ultraviolet or optical and near-infrared spectra, we have searched for possible biases between supermassive black hole (BH) mass estimates based on the C IV, Hα and Hβ broad emission lines. Our sample is based upon that of Greene, Peng & Ludwig, expanded with new near-IR spectroscopic observations, consistently analyzed high S/N optical spectra, and consistent continuum luminosity estimates at 5100Å. We find that BH mass estimates based on the FWHM of C IV show a systematic offset with respect to those obtained from the line dispersion, σ_l, of the same emission line, but not with those obtained from the FWHM of Hα and Hβ. The magnitude of the offset depends on the treatment of the He II and Fe II emission blended with C IV, but there is little scatter for any fixed measurement prescription. While we otherwise find no systematic offsets between C IV and Balmer line mass estimates, we do find that the residuals between them are strongly correlated with the ratio of the UV and optical continuum luminosities. This means that much of the dispersion in previous comparisons of C IV and Hβ BH mass estimates are due to the continuum luminosities rather than any properties of the lines. Removing this dependency reduces the scatter between the UV- and optical-based BH mass estimates by a factor of approximately 2, from roughly 0.35 to 0.18 dex. The dispersion is smallest when comparing the C IV σ_l mass estimate, after removing the offset from the FWHM estimates, and either Balmer line mass estimate. The correlation with the continuum slope is likely due to a combination of reddening, host contamination and object-dependent SED shapes. When we add additional heterogeneous measurements from the literature, the results are unchanged. Moreover, in a trial observation of a remaining outlier, the origin of the deviation is clearly due to unrecognized absorption in a low S/N spectrum. This not only highlights the importance of the quality of the observations, but also raises the question if whether cases like this one are common in the literature, further biasing comparisons between C IV and other broad emission lines.

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E-mail contact: roberto.j.assef@jpl.nasa.gov,
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