| Active Galaxies Newsletter | *An electronic publication dedicated to the observation and theory of active galaxies* |
| --- | --- |
| No. 189 — DECEMBER 2012 | Editor: Melanie Gendre (agnews@manchester.ac.uk) |

*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

### Fueling the central engine of radio galaxies. II. The footprints of AGN feedback on the ISM of 3C 236

**A. Labiano[1], S. García-Burillo[2], F. Combes[3], A. Usero[2], R. Soria-Ruiz[2], G. Tremblay[4], R. Neri[5], A. Fuente[2], R. Morganti[6,7] and T. Oosterloo[6,7]**

[1] Centro de Astrobiología (CSIC-INTA), Carretera de Ajalvir km. 4, 28850 Torrejón de Ardoz, Madrid, Spain.
[2] Observatorio Astronómico Nacional, Alfonso XII, 3, 28014, Madrid, Spain.
[3] Observatoire de Paris, LERMA & CNRS: UMR8112, 61 Av. de l'Observatoire, 75014 Paris, France.
[4] European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching bei München, Germany.
[5] IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 St. Martin d'Héres Cedex, France.
[6] Netherlands Foundation for Research in Astronomy, Postbus 2, 7990 AA, Dwingeloo, The Netherlands.
[7] Kapteyn Astronomical Institute, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands.

*Context.* There is growing observational evidence of active galactic nuclei (AGN) feedback on the interstellar medium (ISM) of radio-quiet and radio-loud galaxies. While AGN feedback is expected to be more common at high- redshift objects, studying local universe galaxies helps to better characterize the different manifestations of AGN feedback.
*Aims.* Molecular line observations can be used to quantify the mass and energy budget of the gas affected by AGN feedback. We study the emission of molecular gas in 3C 236, a Faranoff-Riley type 2 (FR II) radio source at $z\sim0.1$, and search for the footprints of AGN feedback. The source 3C 236 shows signs of a reactivation of its AGN triggered by a recent minor merger episode. Observations have also previously identified an extreme HI outflow in this source.
*Methods.* The IRAM Plateau de Bure interferometer (PdBI) was used to study the distribution and kinematics of molecular gas in 3C 236 by imaging with high spatial resolution ($0.6''$) the emission of the 2–1 line of $^{12}$CO in the nucleus of the galaxy. We searched for outflow signatures in the CO map. We also derived the star-formation rate (SFR) in 3C 236 using data available from the literature at UV, optical, and IR wavelengths, to determine the star-formation efficiency (SFE) of molecular gas.
*Results.* The CO emission in 3C 236 comes from a spatially resolved $\sim1.4''$(2.6 kpc-) diameter disk characterized by a regular

rotating pattern. Within the limits imposed by the sensitivity and velocity coverage of the CO data, we do not detect any outflow signatures in the cold molecular gas. The disk has a cold gas mass $M(H_2)\sim2.1\times10^9$ $M_\odot$. Based on CO we determine a new value for the redshift of the source $z_{CO}$=0.09927±0.0002. The similarity between the CO and HI profiles indicates that the deep HI absorption in 3C 236 can be accounted for by a rotating HI structure. This restricts the evidence of HI outflow to only the most extreme velocities. In the light of the new redshift value, the analysis of the ionized gas kinematics reveals a fast ($\sim$1000 km s$^{-1}$) outflow. Outflow signatures in the CO emitting gas, are nevertheless absent in the warm molecular gas emission traced by infrared $H_2$ lines. The SFE in 3C 236 is consistent with the value measured in *normal* galaxies, which follow the canonical Kennicutt-Schmidt (KS) relation. This result, confirmed to hold in other *young* radio sources examined in this work, is in stark contrast with the SFE that is lower by a factor 10-50 that has been claimed to characterize *evolved* powerful radio galaxies.
*Conclusions.* There are no signs of ongoing AGN feedback to the molecular ISM of 3C 236. The recent reactivation of the AGN in 3C 236 (about $10^5$yr ago) is a likely explanation for the *early* evolutionary status of its molecular disk.

Accepted by Astronomy & Astrophysics

E-mail contact: alvaro.labiano@cab.inta-csic.es,
preprint available at ArXiv:1210.8039

## The Dynamic Evolution of Young Extragalactic Radio Sources

**Tao An[1,2,3] and Willem A. Baan[2]**

[1] Shanghai Astronomical Observatory, Chinese Academy of Sciences, 200030 Shanghai, China
[2] ASTRON, P.O. Box 2, 7990-AA Dwingeloo, The Netherlands
[3] Key Laboratory of Radio Astronomy, Chinese Academy of Sciences, 210008 Nanjing, China

The evolution of symmetric extragalactic radio sources can be characterized by four distinct growth stages of the radio luminosity versus size of the source. The interaction of the jet with the ambient medium results in the formation and evolution of sources with non-standard (flaring) morphology. In addition, cessation or restarting of the jet power and obstruction of the jet will also result in distinct morphological structures. The radio source population may thus be classified in morphological types that indicate the prevailing physical processes. Compact symmetric objects (CSOs) occupy the earliest evolutionary phase of symmetric radio sources and their dynamical behavior is fundamental for any further evolution. Analysis of CSO dynamics is presented for a sample of 24 CSOs with known redshift and hotspot separation velocity and with a large range of radio power. Observables such as radio power, separation between two hotspots, hotspot separation velocity, and kinematic age of the source are found to be generally consistent with the self-similar predictions for individual sources that reflect the varying density structure of the ambient interstellar medium. Individual sources behave different from the group as a whole. The age and size statistics confirm that a large fraction of CSOs does not evolve into extended doubles.

Published by the Astrophysical Journal, Volume 760, page 77

E-mail contact: antao@shao.ac.cn, baan@astron.nl,
online version available at Preprints.html

## Kinematics of the Compact Symmetric Object OQ 208 - revisited

**Fang Wu[1,2,3], Tao An[1,3], Willem A. Baan[4], Xiao-Yu Hong[1,3], Carlo Stanghellini[5], Sandor Frey[6], Hai-Guang Xu[7], Xiang Liu[8,3], Jingying Wang[7]**

[1] Shanghai Astronomical Observatory, Chinese Academy of Sciences, 200030 Shanghai, China
[2]Graduate University of the Chinese Academy of Sciences, 100049 Beijing, China
[3] Key Laboratory of Radio Astronomy, Chinese Academy of Sciences, 210008 Nanjing, China
[4] ASTRON, P.O. Box 2, 7990-AA Dwingeloo, The Netherlands
[5]Istituto di Radioastronomia - INAF, via Gobetti 101, 40129 Bologna, Italy
[6]FOMI Satellite Geodetic Observatory, PO Box 585, H-1592 Budapest Hungary
[7]Department of Physics, Shanghai Jiao Tong University, Shanghai, 200240, China
[8]Xinjiang Astronomical Observatory, Chinese Academy of Sciences, Urumqi 830011, China

Aims. A long timeline kinematic study of the archetypal CSO OQ 208 sheds light on the physical properties of the most compact radio sources. Methods. Archival data from the VLBA at 15 GHz over a time span of 13.6 yr are used to investigate the kinematics of the radio source. The flux density monitoring data obtained at the Michigan 26-meter radio telescope are also

used as supplementary information. Results. At 8.4 and 15 GHz, the two lobes are resolved into two sub-components, identified as hotspots. A knotty jet is linked with the NE hotspot and traces back toward the geometric center. The core is too weak to be detected. Significant flux density variation is found in the primary hotspots with the maximum level of 62% (NE1) and 19% (SW1). The peak in the flux density of NE1 leads that of SW1 by approximately 5.00 yr, suggesting that the northeast lobe is advancing and the southwest lobe is receding. This light travel difference indicates a radial distance difference between the two hotspots of 1.53 pc, which indicates an inclination angle of about 80.8 degree between the radio jet and the line of sight. The angular separation rate between NE1 and SW1 is 0.027 mas/yr (or 0.133 c). The inner jet knot moves at 0.047 mas/yr (or 0.230 c), about 3.5 times the hotspot advancing speed. Conclusions. The large viewing angle and the modest jet speed suggest a mildly relativistic jet. The jet axis is close to the plane of the sky. The separation rate and the distance between the two primary hotspots result in a kinematic age of 255±17 yr, confirming that OQ 208 is indeed a young radio source. In addition to the hotspot advancing motions, sideways motions provide evidence that the lobes are obstructed by the external interstellar medium.

Accepted by Astronomy & Astrophysics

E-mail contact: antao@shao.ac.cn,
Preprint available at ArXiv:1211.4287

## Spectroastrometry of rotating gas disks for the detection of supermassive black holes in galactic nuclei. III. CRIRES observations of the Circinus galaxy

**A. Gnerucci[1], A. Marconi[1], A. Capetti[2], D. J. Axon†[3,4], A. Robinson[3]**

[1] Dipartimento di Fisica e Astronomia, Università degli Studi di Firenze, Firenze, Italy
[2] INAF - Osservatorio Astronomico di Torino, Strada Osservatorio 20, 10025 Pino Torinese, Italy
[3] Physics Department, Rochester Institute of Technology, 85 Lomb Memorial Drive, Rochester, NY 14623, USA
[4] School of Mathematical & Physical Sciences, University of Sussex, Falmer, Brighton, BN2 9BH, UK
† 1951-2012

We present new CRIRES spectroscopic observations of the Br$\gamma$ emission line in the nuclear region of the Circinus galaxy, obtained with the aim of measuring the black hole (BH) mass with the spectroastrometric technique. The Circinus galaxy is an ideal benchmark for the spectroastrometric technique given its proximity and secure BH measurement obtained with the observation of its nuclear $H_2O$ maser disk. The kinematical data have been analyzed both with the classical method based on the analysis of the rotation curves and with the new method developed by us and based on spectroastrometry. The classical method indicates that the gas disk rotates in a gravitational potential resulting from an extended stellar mass distribution and a spatially unresolved dynamical mass of $(1.7 \pm 0.2) \times 10^7\ M_\odot$, concentrated within $r < 7$ pc, corresponding to the seeing-limited resolution of the observations. The new method is capable of probing the gas rotation at scales which are a factor $\sim 3.5$ smaller than those probed by the rotation curve analysis, highlighting the potential of spectroastrometry. The dynamical mass which is spatially unresolved with the spectroastrometric method is a factor $\sim 2$ smaller, $7.9^{+1.4}_{-1.1} \times 10^6\ M_\odot$ indicating that spectroastrometry has been able to spatially resolve the nuclear mass distribution down to 2 pc scales. This unresolved mass is still a factor $\sim 4.5$ larger than the BH mass measurement obtained with the $H_2O$ maser emission indicating that, even with spectroastrometry, it has not been possible to resolve the sphere of influence of the BH. Based on literature data, this spatially unresolved dynamical mass distribution is likely dominated by warm molecular gas and it has been tentatively identified with the circum-nuclear torus which prevents a direct view of the central BH in Circinus. This mass distribution, with a size of $\sim$ 2pc, is similar in shape to that of the star cluster of the Milky Way suggesting that a molecular torus, forming stars at a high rate, might be the earlier evolutionary stage of the nuclear star clusters which are common in late type spirals.

Accepted by Astronomy & Astrophysics

E-mail contact: alessandro.marconi@unifi.it,
preprint available at arXiv:1211.0943

*We wish to honor the memory of our great friend and colleague David Axon. He will be greatly missed by all of us.*

## The shape of broad-line profiles in AGN

**W. Kollatschny, M. Zetzl**

Institut für Astrophysik, Universität Göttingen, Friedrich-Hund Platz 1, D-37077 Göttingen, Germany

We present a study of the broad optical/UV emission line profiles in AGN (active galactic nuclei) to get information on the dominant velocity components (turbulence, rotation, etc.) in the central broad-line region (BLR). We introduce line broadening simulations of emission line profiles and compare these results with the largest homogeneous data set of reverberation-mapped AGN. The underlying broad-line profiles in AGN are Lorentzian profiles caused by turbulence in the line emitting region. The turbulent velocities are different for the different line emitting regions of H$\gamma$, H$\alpha$, Ly$\alpha$, CIII$\lambda$1909, HeII$\lambda$1640, and SiIV$\lambda$1400. The turbulent velocities go from $400\,\mathrm{km\,s^{-1}}$ for H$\beta$ up to $3{,}800\,\mathrm{km\,s^{-1}}$ for Ly$\alpha$+NV$\lambda$1240. The dominating broadening mechanism of these profiles is broadening due to rotation. The rotation velocities causing the line profile broadening go from $500\,\mathrm{km\,s^{-1}}$ up to $6{,}500\,\mathrm{km\,s^{-1}}$. Here we present interrelations between observed emission line widths (FWHM) and their related rotational velocities to correct for the contribution of the turbulence to the broad-line profiles.

Accepted by A&A

E-mail contact: wkollat@astro.physik.uni-goettingen.de,
preprint available at ArXiv:1211.3065

## A Deep *Chandra* Observation of the AGN Outburst and Merger in Hickson Compact Group 62

**D. A. Rafferty[1], L. Bîrzan[1], P. E. J. Nulsen[2], B. R. McNamara[2,3,4], W. N. Brandt[5], M. W. Wise[6], and H. J. A. Röttgering[1]**

[1] Leiden Observatory, Leiden University, P.O. Box 9513, 2300 RA Leiden, The Netherlands
[2] Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, U.S.A.
[3] Department of Physics and Astronomy, University of Waterloo, Waterloo, N2L 2G1 Ontario, Canada
[4] Perimeter Institute for Theoretical Physics, Waterloo, N2L 2YS Ontario, Canada
[5] Department of Astronomy and Astrophysics, Pennsylvania State University, University Park, PA 16802, USA
[6] ASTRON (Netherlands Institute for Radio Astronomy), P.O. Box 2, 7990 AA Dwingeloo, The Netherlands

We report on an analysis of new *Chandra* data of the galaxy group HCG 62, well known for possessing cavities in its intragroup medium (IGM) that were inflated by the radio lobes of its central active galactic nucleus (AGN). With the new data, a factor of three deeper than previous *Chandra* data, we re-examine the energetics of the cavities and determine new constraints on their contents. We confirm that the ratio of radiative to mechanical power of the AGN outburst that created the cavities is less than $10^{-4}$, among the lowest of any known cavity system, implying that the relativistic electrons in the lobes can supply only a tiny fraction of the pressure required to support the cavities. This finding implies additional pressure support in the lobes from heavy particles (e.g., protons) or thermal gas. Using spectral fits to emission in the cavities, we constrain any such volume-filling thermal gas to have a temperature $kT > 4.3$ keV. For the first time, we detect X-ray emission from the central AGN, with a luminosity of $L_{2-10\ \mathrm{keV}} = (1.1 \pm 0.4) \times 10^{39}$ erg s$^{-1}$ and properties typical of a low-luminosity AGN. Lastly, we report evidence for a recent merger from the surface brightness, temperature, and metallicity structure of the IGM.

Accepted by MNRAS

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

## The Global Implications of the Hard X-ray Excess in Type 1 AGN

**M.M. Tatum[1], T.J. Turner[1], L. Miller[1], J.N. Reeves[1,3]**

[1] Department of Physics, University of Maryland Baltimore County, Baltimore, MD 21250
[2] Dept. of Physics, University of Oxford, Denys Wilkinson Building, Keble Road, Oxford OX1 3RH, U.K.
[3] Astrophysics Group, School of Physical and Geographical Sciences, Keele University, Keele, Staffordshire ST5 5BG, U.K

Recent evidence for a strong 'hard excess' of flux at energies $\geq 20$ keV in some *Suzaku* observations of type 1 Active Galactic Nuclei (AGN) has motivated an exploratory study of the phenomenon in the local type 1 AGN population. We have selected all type 1 AGN in the *Swift* Burst Alert Telescope (BAT) 58-month catalog and cross-correlated them with the holdings of the *Suzaku* public archive. We find the hard excess phenomenon to be a ubiquitous property of type 1 AGN. Taken together, the spectral hardness and equivalent width of Fe K$\alpha$ emission are consistent with reprocessing by an ensemble of Compton-thick clouds that partially cover the continuum source. In the context of such a model, $\sim 80\%$ of the sample has a hardness ratio consistent with $> 50\%$ covering of the continuum by low-ionization, Compton-thick gas. More detailed study of the three hardest X-ray spectra in our sample reveal a sharp Fe K absorption edge at $\sim 7$ keV in each of them, indicating that blurred reflection is not responsible for the very hard spectral forms. Simple considerations place the distribution of Compton-thick

clouds at or within the optical broad line region.

Accepted by ApJ.

E-mail contact: mtatum1@umbc.edu,
preprint available at arXiv:1211.3403

## Variability in quasar broad absorption line outflows III. What happens on the shortest time-scales?

**D. M. Capellupo[1,2], F. Hamann[1], J. C. Shields[3], J. P. Halpern[4], and T.A. Barlow[5]**

[1]Department of Astronomy, University of Florida, Gainesville, FL 32611-2055
[2]School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel
[3]Department of Physics & Astronomy, Ohio University, Athens, OH 45701
[4]Department of Astronomy, Columbia University, New York, NY 10027
[5]Infrared Processing and Analysis Center, California Institute of Technology, Pasadena, CA 91125

Broad absorption lines (BALs) in quasar spectra are prominent signatures of high-velocity outflows, which might be present in all quasars and could be a major contributor to feedback to galaxy evolution. Studying the variability in these BALs allows us to further our understanding of the structure, evolution, and basic physical properties of the outflows. This is the third paper in a series on a monitoring programme of 24 luminous BAL quasars at redshifts $1.2 < z < 2.9$. We focus here on the time-scales of variability in C IV $\lambda$1549 BALs in our full multi-epoch sample, which covers time-scales from 0.02−8.7 yr in the quasar rest-frame. Our sample contains up to 13 epochs of data per quasar, with an average of 7 epochs per quasar. We find that both the incidence and the amplitude of variability are greater across longer time-scales. Part of our monitoring programme specifically targeted half of these BAL quasars at rest-frame time-scales $\leq$2 months. This revealed variability down to the shortest time-scales we probe (8−10 days). Observed variations in only portions of BAL troughs or in lines that are optically thick suggest that at least some of these changes are caused by clouds (or some type of outflow substructures) moving across our lines of sight. In this crossing cloud scenario, the variability times constrain both the crossing speeds and the absorber locations. Specific results also depend on the emission and absorption geometries. We consider a range of geometries and use Keplerian rotational speeds to derive a general relationship between the variability times, crossing speeds, and outflow locations. Typical variability times of order ∼1 year indicate crossing speeds of a few thousand km/s and radial distances near ∼1 pc from the central black hole. However, the most rapid BAL changes occurring in 8-10 days require crossing speeds of 17 000 − 84 000 km s$^{-1}$ and radial distances of only 0.001−0.02 pc. These speeds are similar to or greater than the observed radial outflow speeds, and the inferred locations are within the nominal radius of the broad emission line region.

Accepted by MNRAS

E-mail contact: danielc@wise.tau.ac.il,
preprint available at ArXiv:1211.4868

# Jobs Adverts

## Post-doc position in relativistic jet astrophysics
## Jagiellonian University, Krakow, Poland
## Deadline: 25th January 2013

**Email contact: mio@oa.uj.edu.pl**
**Further Information: http://www.oa.uj.edu.pl**

The High Energy Astrophysics Department at the Astronomical Observatory has announced a new post-doc position. The successful candidate will work in a group led by Prof. Michal Ostrowski on a wide range of topics related to relativistic jet physics. Candidates interested in such topics as: analytic or numerical modelling of particle acceleration processes and radiative processes in jets, reconnection processes in relativistic plasmas, observational multiwavelength data spectral and time variability analysis, or GRB jet modelling are particularly invited to apply. The group is involved in a number of international collaborative projects and is a partner in the H.E.S.S. VHE gamma ray observatory and the CTA project.The position is offered for a one year, with a possible extension of up to 2 additional years. We offer a salary at the upper level for a post-doc in Poland.Cracow is an ancient city, the old capital of Poland, and the Jagiellonian University, one of the two largest universities in the country, is also one of the oldest in Europe, with over 650 years of history. The Astronomical Observatory, part of the Faculty of Physics, Astronomy and Applied Computer Science, hosts a number of scientific groups involved in different fields of astrophysical research. In addition to high-energy astrophysics, these include optical astronomy, radioastronomy, MHD plasma simulations, observational and theoretical cosmology.

Applications and detailed inquiries about the position should be addressed to M. Ostrowski, E-mail: mio@oa.uj.edu.pl . The applicant should provide a motivation letter, CV, list of publications and contact details of 2 or 3 astrophysicists who are ready to provide him a letter of recommendation. The application deadline is January 25th, 2013, with a possible extension until a suitable candidate is selected.