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From the Editor

The Active Galaxies Newsletter is produced monthly. The deadline for contributions is the last friday of the month. The Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter and are also available on the web page.
Matt Redman

Abstracts of recently accepted papers

The ROSAT Wide Field Camera Extragalactic Survey

R. Edelson[1,2], S. Vaughan[1], R. Warwick[1], E. Puchnarewicz[3], I. George[4,5]

[1] X-Ray Astronomy Group; Department of Physics and Astronomy; Leicester University; Leicester LE1 7RH; U.K.
[2] Department of Physics and Astronomy; University of California, Los Angeles; Los Angeles, CA 90095-1562; U.S.A.
[3] Mullard Space Science Laboratory; University College London; Holmbury St Mary; Dorking, Surrey RH5 6NT; U.K.
[4] Laboratory for High Energy Astrophysics; Code 662; NASA/Goddard Space Flight Center; Greenbelt, MD 20771; U.S.A.
[5] Universities Space Research Association

We report the results of a new analysis of the *ROSAT* Wide Field Camera (WFC) all-sky survey data, designed to detect extragalactic sources of extreme ultraviolet (EUV) radiation in regions of low Galactic N_H. We identify a total of 19 active galactic nuclei (AGN), more than double the number of confirmed AGN in the published WFC (2RE) survey. Our sample contains 8 narrow-line Seyfert 1 galaxies, making this the first reasonably-sized, complete sample of these extreme AGN, along with 6 broad-line Seyfert 1s and 5 BL Lacertae objects. These EUV-selected sources typically have steep soft X-ray spectra with a mean power-law energy index $\alpha_X \approx -2$. The derived AGN luminosity function is rather flat and appears to cut off above a luminosity of 10^{46} erg/s/keV, measured monochromatically at 200 eV. Narrow-line Seyfert 1s account for roughly half of the local ($z \approx 0$) volume emissivity in the EUV band.

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Dust lanes causing structure in the extended narrow line region of early-type Seyfert galaxies

A. C. Quillen[1], A. Alonso-Herrero[1], M. J. Rieke[1], Colleen McDonald[1], Heino Falcke[1,2], and G. H. Rieke[1]

[1] The University of Arizona, Steward Observatory, Tucson, AZ 85721 [2] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

We construct near-infrared to visible broad band NICMOS/WFPC color maps for 4 early-type Seyfert galaxies with S-shaped or one-sided ionization cones. We find that dust lanes are near or connected to many of the features seen in the [OIII] and

Hα+[NII] line emission maps. This suggests that much of the structure of line emission in these ionization cones is determined by the distribution of ambient dense galactic gas. Spiral arms, dust lanes caused by bars, or gaseous warps provide dense gas which when illuminated by a conical beam of ultraviolet photons can result in the complicated line emission morphologies observed.

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E-mail contact: aquillen@as.arizona.edu
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M84 - A Warp Caused By Jet Induced Pressure Gradients?

A. C. Quillen[1] and Gary A. Bower[2]

[1] The University of Arizona, Steward Observatory, Tucson, AZ 85721 [2] Kitt Peak National Observatory, National Optical Astronomy Observatories, P.O. Box 26732, Tucson, AZ 85726

In radio galaxies such as M84 dust features tend to be nearly perpendicular to radio jets yet are not aligned with the galaxy isophotes. The timescale for precession in the galaxy is short ($\sim 10^7$ years at 100 pc) suggesting that an alternative mechanism causes the gas disk to be misaligned with the galaxy. In M84 we estimate the pressure on the disk required to overcome the torque from the galaxy and find that it is small compared to the thermal pressure in the hot ambient ISM estimated from the X-ray emission. We therefore propose that pressure gradients in a jet associated hot interstellar medium exert a torque on the gas disk in M84 causing it to be misaligned with the galaxy isophotal major axis. We propose that AGN associated outflows or associated hot low density media in nearby radio galaxies could strongly affect the orientation of their gas disks on 100 pc scales. This mechanism could explain the connection between gas disk angular momentum and jet axes in nearby radio galaxies.

By integrating the light of the galaxy through a warped gas and dust disk we find that the geometry of gas disk in M84 is likely to differ that predicted from a simple precession model. We find that the morphology of the gas disk in M84 is consistent with a warped geometry where precession is caused by a combination of a galactic torque and a larger torque due to pressure gradients in the ambient X-ray emitting gas. Precession occurs at an axis between the jet and galaxy major axis, but nearer to the jet axis implying that the pressure torque is 2-4 times larger than the galactic torque. We estimate that precession has occurred about this particular axis for about 10^7 years. A better model to the morphology of the disk is achieved when precession takes place about an elliptical rather than circular path. This suggests that the isobars in the hot medium are strongly dependent on angle from the jet axis.

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E-mail contact: aquillen@as.arizona.edu
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Ionized Ultraviolet and Soft-X-ray Absorptions in the Low Redshift Active Galactic Nucleus PG1126−041

T.G. Wang,[1,2] W. Brinkmann,[3] W. Wamsteker[4], W. Yuan[3] and J.X. Wang[1]

[1] Center for Astrophysics, University of Science and Technology of China, Hefei, 230026 Anhui, China.
[2] The Institute of Physical and Chemical Research (RIKEN), 2-1, Hirosawa, Wako, Saitama, 351-0198, Japan
[3] Max-Planck-Institut für extraterrestrische Physik, Postfach 1603, D-85740 Garching, Germany.
[4] ESA IUE Observatory, P.O.Box 50727, 28080 Madrid, Spain

We present here the analysis of ultraviolet spectra from IUE and an X-ray spectrum from *ROSAT* PSPC observations of the X-ray weak, far-infrared loud AGN, PG 1126−041 (Mrk 1298).

The first UV spectra taken in June 1992, simultaneously with ROSAT, show strong absorption lines of NV, CIV and SiIV, extending over a velocity range from -1000 to -5000 km s^{-1} with respect to the corresponding line centre. Our analysis shows that the Broad Emission Line Region (BELR) is, at least partially, covered by the material causing these absorption lines. In the IUE spectrum taken in Jan. 1995, the continuum was a factor of two bright er and the UV absorption lines are found to be considerably weaker than in 1992, but only little variation in the emission line fluxes is found. With UV spectral indices of $\alpha_{uv} \simeq 1.82$ and 1.46 for the 1992 and 1995 data, the far UV spectrum is steep. Based on the emission line ratios and the broad band spectral energy distribution, we argue that the steepness of the UV spectrum is unlikely to be due to reddening.

The soft X-ray emission in the ROSAT band is weak. A simple power-law model yields a very poor fit with a UV-to-X-ray spectral index $\alpha_{uvx} = 2.32$. Highly ionized (warm) absorption is suggested by the *ROSAT* data. After correcting for a warm absorber, the optical to X-ray spectral slope is close to the average of $\alpha_{uvx} \simeq 1.67$ for radio quiet quasars.

From photoionization calculations we find: (1) A single zone absorption model cannot explain simultaneously the UV absorption

lines and the ionized X-ray absorption if metal abundances are solar. Furthermore, in order to be consistent with the equivalent width of the observed $Ly\alpha$ absorption line, the turbulent velocity of the warm absorber must be less than 190 km s^{-1}, which imposes serious constraints on a disk wind model. (2) The UV absorption lines and their variability cannot be explained by a single zone model with solar abundances and the large variability in the absorption lines suggest that CIV and NV absorption lines are not severely saturated. (3) The absorption of the ionizing continuum by warm material strongly affects the emission line spectrum.

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E-mail contact: wang@crab.riken.go.jp

Clues on the obscured active nucleus of NGC 1365

Hartmut Schulz[1], Stefanie Komossa[2], C. Schmitz[3], A. Muecke[4]

[1] Astronomisches Institut der Ruhr-Univ., D-44780 Bochum, Germany
[2] Max-Planck-Institut für extraterrestrische Physik, Giessenbachstrasse, D-85740 Garching, Germany
[3] Institut für Geowissenschaften, Univ. Jena, Germany
[4] Dept. of Physics, Univ. Adelaide, Australia

We have analyzed optical spectra (ESO-CASPEC) from the composite starburst-Seyfert galaxy NGC 1365 taken on the nucleus and the following positions (relative to nucleus): 2″N, 2″W; 2″S; 4″S; 5″S; 10″S and 20″W). A nuclear broad-line component indicative of the AGN source is confirmed in Hβ and Hα. Narrow-line widths vary between 150 and 200 km s^{-1}. Extranuclear line ratios in the observed regions are mostly consistent with the lines being formed in HII regions. One of the exceptions is a rise of [OIII]λ5007/Hβ from 0.5 to 5 within 5″ (from west to east) across the nucleus suggesting the transition from gas ionized by stars to gas ionized by the active nucleus.

Faint emission-line gas observed 20″ W of the nucleus (called region II) shows line ratios lying in the AGN part of diagnostic diagrams. While at first glance shocks by bar streaming motions appear to be a suggestive explanation for these line ratios we stress that there is no positive evidence for the velocities $>$ 300 km/s required for this mechanism. Another, presently more likely, explanation is that region II belongs to the far cone of the bipolar nuclear outflow which can be glimpsed through the dusty disk. Photoionization of a single-density cloud system by a diluted AGN continuum reproduces the measured line ratios, but leads via the ionization parameter to an intrinsic Hα luminosity of the obscured AGN of $\sim 10^{42}$ erg/s of which less than $\sim$ 4% are observed in the central few arcsec. Dust obscuration could explain Hα but its concomitant gas column cannot account for the lack of Seyfert-1 typical hard X-rays from the nucleus.

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E-mail contact: skomossa@xray.mpe.mpg.de
preprint and related papers available at http://www.xray.mpe.mpg.de/~skomossa/

The X-ray emission from broad absorption line quasars

W. Brinkmann[1], T. Wang[2], M. Matsuoka[2] and W. Yuan[3]

[1] Max–Planck–Institut für Extraterrestrische Physik, Giessenbachstrasse, D-85740 Garching, FRG
[2] Cosmic Radiation Laboratory, RIKEN, 2-1 Hirosawa, Wako-shi Saitama 351-01, Japan
[3] Yunnan Observatory, CAS, P.O. Box 110, Kumming, Yunnan 6500011, P. R. China

Pointed ASCA observations as well as archival ROSAT data are used for a study of the X-ray emission of the three BAL Quasars LBQS 2212-1759, PG 1411+442, and PG 0043+039. All three objects are found to be X-ray quiet, possibly due to substantial intrinsic absorption with $N_H > 10^{23}$ cm^{-2} but might have intrinsically a more typical spectral energy distribution. This picture is supported by explicit spectral fits to the combined ROSAT/ASCA data of the nearby bright object PG 1411+442. An analysis of the large number of radio-quiet quasars not detected in the ROSAT All-Sky Survey indicates that perhaps only a small fraction of BAL quasars have not been recognized before and that the number of intrinsically X-ray quiet quasars must be small.

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E-mail contact: wpb@mpe.mpg.de

Thesis abstract

A Unifying View on Blazars

Giovanni Fossati

Thesis work conducted at: International School for Advanced Studies (SISSA/ISAS), via Beirut 4, 34014 Trieste, Italy

Current address: Center for Astrophysics and Space Sciences, University of California at San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0424, USA

Electronic mail: gfossati@ucsd.edu

Ph.D dissertation directed by: Prof. Gabriele Ghisellini and Dr. Annalisa Celotti

Ph.D degree awarded: October 1998

Blazars are radio–loud Active Galactic Nuclei (AGN) characterized by strong variability, high and variable polarization, and high luminosity. They are core dominated, flat spectrum radio sources. Radio spectra smoothly join the infrared-optical-UV spectra, and in all these bands flux is highly variable and polarized. These extreme properties are successfully interpreted in terms of synchrotron radiation produced in relativistic jets and beamed into our direction due to plasma moving relativistically close to the line of sight (e.g. Blandford and Rees 1978).
This interpretation is strongly supported by direct observations of superluminal motions observed in radio cores in VLBI data (Vermeulen and Cohen 1994), and constitutes the basis for the unified scheme of radio-loud AGN (Urry and Padovani, 1995).
As was recently discovered by the Compton Gamma Ray Observatory many blazars are strong and variable sources of high energy γ–rays. In a few sources, the spectrum extends up to the TeV energies. The γ–ray radiation forms a separate spectral component, with the luminosity peak located in the MeV–TeV range. Variability of GeV/TeV radiation itself provides evidence for relativistic speeds of radiating plasma (Maraschi, Ghisellini and Celotti 1992).

Why to study blazars ?

Because of their special properties, blazars offer an important probe of the very central region of AGNs and the opportunity to shed light on the mechanisms of energy extraction from the putative central black hole where jets form, a fundamental goal of AGN research. The problem of energy production and jet formation/acceleration can certainly enlighten the physics of (spinning ?) black holes. The first step is to understand which are the fundamental physical parameters and processes at work in these extreme power engines which are supermassive black holes and relativistic jets, able for instance to power extended structures laying at several Mega parsecs distance.
Moreover, in blazars jets most probably strong relativistic shocks occur, whose physics is poorly known. In this respect, it is noteworthy the intriguing possibility that blazars may also be the acceleration sites of exceptionally high energy ($E > 10^{19}$ eV) cosmic rays (Biermann 1995).
The goal of my work was to make progress in the identification of the physical parameters ruling the rich phenomenology of blazars: the investigation of the mutual relationships among them turned out to be especially enlightening.

(Our) Questions on Blazars

For a deeper understanding of the fundamental mechanisms at work in these sources we think it is crucial to address the questions:

- within the blazar phenomenon which is the physical origin of the difference among BL Lac objects and even more broadly between BL Lacs and Flat Spectrum Radio Quasars (FSRQ) ?
- is it possible to identify continuity among them, with a limited number of physical properties determining the observational characteristics of all blazars?
- γ–ray observations have raised again the question of similarities/differences of in the γ–ray properties of the various blazars subclasses. Understanding this issue is essential to assess the role of different radiative mechanisms and to verify whether the idea of blazars as a unitary class can be maintained.

In this thesis, we address these issues from both the observational and the theoretical side, following several lines of research, which we are going to illustrate in the following Chapters.

In the introductory Chapter we present the framework in which we will be discussing the problematic of blazars. We will briefly go through the basic phenomenology, illustrate the reasons supporting the study of Spectral Energy Distributions (SED), and discuss the important change in blazars research occurred in the last few years, when we "moved" from the orientation–based unification scheme towards the more complex picture based directly on physical properties. This is the new and main result of the work described in this thesis.

In the Introduction particular emphasis is given to BL Lac objects, because the most important progress, leading to the change of "paradigm" has being done starting from the study of the few complete samples of BL Lacs, available. Current ideas about the nature of the relation (similarities) between BL Lac objects and FSRQ are then reviewed. We point out the relevance of the study of the high energy emission, X and γ–ray bands, which constitutes a fundamental tile in the picture that we are going to study.

We then illustrate in Chapter 2 the very basic ingredients of blazars emission models, in particular synchrotron and inverse Compton radiative processes, and the effects of relativistic beaming. We report a handful of equations useful to derive estimates and constraints on physical properties, expressing them in terms of observational SED properties.

In these first two Chapters we anticipate in many instances the new results of our work, in order to present them as part of the general scenario of blazars unification.

In the second part of this thesis (Chapters 3, 4, 5, 6) we enter into the details of the work, which lead to the proposal of our new (physical) unification scenario.

In Chapter 3 we report on the results of Montecarlo simulations of complete samples of BL Lacs, performed to test the new scenarios arising from the remnants of the "orientation paradigm".

In Chapter 4 we focus on a restricted sample of blazars selected on the basis of their γ–ray and soft-X–ray detection, in order to investigate the phenomenology and relationship between high energy properties.

In the last two chapters we concentrate on the full broad band, radio to γ–ray, spectral distributions, with two complementary approaches. A purely observational one based on complete *sub–samples* of blazars (Chapter 5), and a more theoretical approach, by modeling individually the SEDs of all the γ–ray sources with sufficient available data to constrain their physical parameters (Chapter 6). This allows us to derive trends between the physical quantities underlying the correlations between the observed ones.

Finally, we summarize the emerging unifying picture and synthetically discuss a few developments, consequences and perspectives arising in/from this "new" picture of blazars.

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