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Abstracts - Thesis Abstracts - Jobs - Meetings

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 Complex X-ray Spectrum of 3C 273: *ASCA* Observations

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Results obtained from 9 X-ray observations of 3C 273 performed by *ASCA* are presented (for a total exposure time of about 160 000 s). The analysis and interpretation of the results is complicated by the fact that 4 of these observations were used for on-board calibration of the CCDs spectral response. In particular, we had to pay special attention to the low energy band and 5–6 keV energy range where systematic effects could distort a correct interpretation of the data.

The present standard analysis shows that, in agreement with official recommendations, a conservative systematic error (at low energies) of $\sim$ 2–3 $\times$ 10^{20} cm^{-2} must be assumed when analyzing *ASCA* SIS data. A soft-excess, with variable flux and/or shape, has been clearly detected as well as flux and spectral variability that confirm previous findings with other observatories. An anti-correlation is found between the spectral index and the flux in the 2-10 keV energy range. With the old response matrices, an iron emission line feature with EW $\sim$ 50–100 eV was initially detected at $\sim$ 5.6-5.7 keV ($\sim$ 6.5-6.6 keV in the quasar frame) in 6 observations and, in two occasions, the line was resolved ($\sigma \sim$ 0.2-0.6 keV). Comparison with the Crab spectrum indicates however that this feature was mostly due to remaining calibration uncertainties between 5–6 keV. Indeed, fitting the data with the latest publicly available calibration matrices, we find that the line remains unambiguously significant in (only) the two observations with lowest fluxes where it is weak (EW $\sim$ 20-30 eV), narrow and consistent with being produced by Fe K_α emission from neutral matter.

Overall, the observations are qualitatively consistent with a variable, non-thermal X-ray continuum emission, i.e., a power law with $\Gamma \sim 1.6$ (possibly produced in the innermost regions of the radio-optical jet), plus underlying "Seyfert-like" features, i.e., a soft-excess and Fe K_α line emission. The data are consistent with some contribution (up to a few 10% level in the *ASCA* energy band) from a "Seyfert-like" direct continuum emission, i.e. a power law with $\Gamma \sim 1.9$ plus a reflection component, as well. When the continuum (jet) emission is in a low state, the spectral features produced by the Seyfert-like spectrum (soft-excess, iron line and possibly a steep power law plus a reflection continuum) are more easily seen.

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The profiles of polarized broad Hα lines in radio galaxies

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We present spectropolarimetric observations of 7 broad-line radio galaxies. We find significantly polarized broad $H\alpha$ emission in 4 objects including two, Arp 102B and 3C 390.3, which have double-peaked line profiles. In these objects the prominent red- and blue-shifted peaks of the broad Hα line have no clear counterparts in polarized flux. This conflicts with theoretical predictions for a relativistic line-emitting disk with an electron scattering atmosphere, one of the leading models advanced to account for the double-peaked lines. The shapes and widths of the polarized line profiles can be explained if, as expected in unified schemes, the scattering occurs near the poles of an obscuring torus. However, the observed polarization position angles favour geometries in which the scattering plane is perpendicular to the radio jet. A configuration in which Hα photons emitted by a bi-conical flow are scattered off the inner wall of the torus has this property, and would also produce a single-peaked scattered line profile. With the exception of 3C 227, the sample as a whole conforms to the general trend in powerful radio galaxies for the optical polarization to be aligned with the radio source axis, favouring toroidal rather than polar scattering.

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ROSAT HRI discovery of luminous extended X-ray emission in NGC 6240

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We report the detection of luminous extended X-ray emission in NGC 6240 on the basis of ROSAT HRI observations of this ultraluminous IR galaxy. The spatial structure and temporal behavior of the X-ray source were analyzed. We find that $\gtrsim 70\%$ of the soft X-ray emission is extended beyond a radius of $5''$. Strong emission can be traced out to a radius of $20''$ and weaker emission extends out to $\sim 50''$. With a luminosity of at least $L_x \simeq 10^{42}$ erg/s this makes NGC 6240 one of the most luminous X-ray emitters in *extended* emission known. Evidence for a nuclear compact variable component is indicated by a drop of 32% in the HRI count rate as compared to the PSPC data taken one year earlier. No short-timescale variability is detected. The HRI data, which represent the first high-resolution study of the X-ray emission from NGC 6240, complement previous spectral fits to ROSAT PSPC data (Schulz et al. 1998; A&A 330, 823) that suggested a two-component model consisting of thermal emission from shocked gas immersed in a starburst wind plus a powerlaw source attributed to scattered light from an obscured AGN.

We discuss several models to account for the extended and compact emission. Although pushed to its limits the starburst outflow model is tenable for the essential part of the *extended* emission. For the AGN-type component we propose a model consisting of a near-nuclear 'warm scatterer' that explains the apparent fading of the X-ray flux within a year as well as the strong FeKα complex seen in an ASCA spectrum.

Astronomy & Astrophysics, in press

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Modelling the ENLR in NGC 1068

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We present photoionization models of the high excitation gas in the Extended Narrow Line Region (ENLR) of NGC 1068. The ENLR line fluxes have been calculated allowing for attenuation of the central-source ionizing continuum as a function of distance from the centre. Diffuse continuum emission from low density ENLR gas is included as an important secondary source of ionization. The observed high excitation emission further than 25 arcsec from the centre of NGC 1068 can be fitted by photoionization models using a central-source luminosity of 3.6×10^{44} erg s^{-1} between $10^{14.6}$ and $10^{18.4}$ Hz, with the continuum

shape attenuated by nuclear gas with an integrated column density of $N_h = 10^{22}$ cm^{-2}. The reflected soft X-ray continuum from the attenuating gas could be responsible for about 10% of the observed, resolved circumnuclear soft X-ray continuum extending out to 15 arcsec from the centre (Wilson et al 1992).

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NGC 5548, a case study for active galactic nuclei. Inconsistencies of photoionized models for the BLR

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Our purpose is to build a photoionization model for the Broad Line Region (BLR) of NGC 5548, based on observations performed during the first period of the AGN Watch series and on acompilation of EUVE, ROSAT, GINGA and OSSE observations. This provides us the line fluxes, their variations and those of the underlying continuum, as well as the overall spectral distribution. ¿From these properties alone, without any assumption on the geometry of the BLR, we put into evidence three inconsistencies: an "energy budget problem", a "line ratio problem", and a "line variation problem". We discuss different possibilities to resolve these problems (a peculiar geometry, a large reddening, an incorrect estimate of the continuum flux irradiating the BLR, etc...). The most likely explanation is that, either a remote but still photoionized region, or a non radiatively heated region, contributes to the broad line spectrum. We favor the second alternative. Furthermore, a very dense and hot medium, for instance the atmosphere of the accretion disk, could account for the observed HeII 4686/1640 line ratio.

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Nature of 60μm emission in 3C 47, 3C 207 and 3C 334

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We try to explain the unusually high far-infrared emission seen by IRAS in the double-lobed radio-loud quasars 3C 47, 3C 207 and 3C 334. High resolution cm–mm observations were carried out to determine their radio core spectra, which are subsequently extrapolated to the far-infrared in order to determine the strength of the synchrotron far-infrared emission. The extrapolated flux densities being considerably lower than the observed values, a significant nonthermal far-infrared component is unlikely in the case of 3C 47 and 3C 334. However, this component could be responsible for the far-infrared brightness of 3C 207. Our analysis demonstrates that nonthermal emission cannot readily account for the difference between quasars and radio galaxies in the amount of their far-infrared luminosity. On the other hand, a significant role for this mechanism is likely; full sampling of the mm-submm spectral energy distributions is needed to address the issue quantitatively.

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The Soft X-ray Spectrum of Scattering–Dominated AGN

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This paper discusses the properties of scattering–dominated active galactic nuclei (AGN). We define these to be AGN for which the direct line-of-sight to the continuum source is obscured by Compton-thick material. The aim is to construct, for the first time, a model consistent with X-ray line luminosities, line ratios and various luminosity indicators. The ASCA spectra of six such sources show several X-ray lines that can be reliably measured, mostly due to highly ionized magnesium, silicon sulphur and iron. These enableus to investigate the physical conditions of the scattering material. The sources show evidence of He-like and H-like iron lines that are likely to be produced in hot (T$\sim 10^6$ K) photoionized gas. By measuring the EW of the lines, and by constructing a diagnostic line-ratio diagram, we demonstrate that the silicon and magnesium lines are produced by the same gasemitting the highly ionized iron lines. The properties of this gas are rather different from the properties of warm absorbers in type I AGN. Neutral 6.4 keV iron lines are also detected, originating in a different component which can be either Compton-thin or Compton-thick. The best measured iron lines suggest an enhancement of n_{Fe}/n_H by a factor ~ 2 compared to solar, in both the hot and cool Compton-thin components. We further show that in four of the sources, the Fe K_α(6.4 keV)/H_β(λ4861Å) line ratio is consistent with that predicted for typical narrow line region clouds, and the reddening corrected H_β is known, provided the column density is larger than $\sim 10^{22.5}\ cm^{-2}$, α_{ox} is smaller than 1.3. For some sources, this is a viable alternative to the commonly assumed Compton thick medium as the origin of the 6.4 keV iron line.

Subject headings: galaxies:abundances - galaxies:Seyfert - galaxies:active - line:formation - X-ray:galaxies

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Does the optical–to–X-ray energy distribution of quasars depend on optical luminosity?

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We report on a detailed analysis of the correlation between the optical-UV and X-ray luminosities of quasars by means of Monte Carlo simulations, using a realistic luminosity function. We find, for a quasar population with an intrinsically constant, mean X-ray loudness $\overline{\alpha}_{\rm ox}$, that the simulated $\alpha_{\rm ox} - L_{\rm o}$ relation can exhibit various 'apparent' properties, including an increasing $\overline{\alpha}_{\rm ox}$ with $L_{\rm o}$, similar to what has been found from observations. The determining factor for this behavior turns out to be the relative strength of the dispersions of the luminosities, i.e. their deviations from the mean spectral energy distribution at the optical and X-ray bands, such that a dispersion larger for the optical luminosity than for the X-ray luminosity tends to result in an apparent correlation. We suggest that the observed $\alpha_{\rm ox} - L_{\rm o}$ correlation can be attributed, at least to some extent, to such an effect, and is thus not an underlying physical property. The consequences of taking into account the luminosity dispersions in an analysis of the observed luminosity correlations is briefly discussed. We note that similar considerations might also apply for the Baldwin effect.

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Dissertation abstract

Very High Energy Gamma-ray Astrophysics: detection of the Active Galactic Nucleus Mrk501 and cosmological consequences

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The CAT (Cherenkov Array at Themis) telescope is a new gamma-ray detector working between 250 GeV and 20 TeV since september 1996.

This thesis presents the new techniques developed to provide good perfomance: very fast electronics and small photomultipliers. Many tests performed in the laboratory showed that the trigger and read-out system work properly. An original χ^2 analysis method is used to reconstruct physical parameters. For the first time, gamma-ray events are recorded by two independant detectors on the same site, making the Cherenkov atmospheric method reliable.

During 1997, the active galactic nucleus Mrk501 displayed intense gamma emission. Higher than the Crab Nebula level, the flux is quite hard and shows a short time scale variability. This detection allowed a comparison of data from many ground-based experiments and gave interesting astrophysical results: *self-synchrotron compton* jets model is favoured. The cosmic infrared background, an important radiation field to understand galaxy formation, can also be estimated with this spectrum.

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