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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

Star formation and evolution in accretion disks around massive black holes

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We develop an exploratory model for the outer, gravitationally unstable regions of accretion disks around massive black holes. We consider black holes of mass 10^6 to 10^{10} $M_\odot$, and primeval or solar abundances. In a first step we study star formation and evolution in a purely gaseous marginally unstable disk, and we show that unstable fragments should collapse rapidly and give rise to compact objects (planets or protostars), which then accrete at a high rate and in less than 10^6 years acquire a mass of a few tens of $M_\odot$, according to a mechanism first proposed by Artymowicz, Lin and Wampler (1993). When these stars explode as supernovae, the supernova shells break out of the disk, producing strong outflows. We show that the gaseous disk is able to support a large number of massive stars and supernovae while staying relatively homogeneous. An interesting aspect is that the residual neutron stars can undergo other accretion phases, leading to other (presumably powerful) supernova explosions. In a second step we assume that the regions at the periphery of the disk provide a quasi stationary mass inflow during the lifetime of quasars or of their progenitors, i.e. $\sim 10^8$ yrs, and that the whole mass transport is ensured by the supernovae, which induce a transfer of angular momentum towards the exterior, as shown by the numerical simulations of Rozyczka, Bodenheimer and Lin (1995). Assuming that the star formation rate is proportional to the growth rate of the gravitational instability, we solve the disk structure and determine the gas and the stellar densities, the heating being provided mainly by the stars themselves. We find self-consistent solutions in which the gas is maintained in a state very close to gravitational instability, in a ring located between 0.1 and 10 pc for a black hole mass of $10^6 M_\odot$, and between 1 and 100 pc for a black hole mass of $10^8 M_\odot$ or larger, whatever the abundances, and for relatively low accretion rates ($\leq 10\%$ of the critical accretion rate). For larger accretion rates the number of stars becomes so large that they inhibit any further star formation, and/or the rate of supernovae is so high that they distroy the homogeneity and the marginal stability of the disk. We postpone the study of this case.

Several consequences of this model can be envisioned, besides the fact that it proposes a solution to the problem of the mass transport in the intermediate region of the disk where global instabilities do not work. As a first consequence, it could explain the high velocity metal enriched outflows implied by the presence of the broad absorption lines in quasars. As a second consequence it could account for a pregalactic enrichment of the intergalactic medium, if black holes formed early in the Universe. Finally it could provide a triggering mechanism for starbursts in the central regions of galaxies. A check of the model would be to detect

a supernova exploding within a few parsecs from the center of an AGN, an observation which can be performed in the near future.

Accepted by A & A

example:

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The effect of an attenuated continuum on the coronal line spectrum of NGC 1068 and the Circinus galaxy.

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We present photoionization models of the optical and IR coronal line spectrum in NGC 1068 and the Circinus galaxy. The line fluxes have been calculated using (a) a non-thermal (nuclear) continuum source and (b) the non-thermal continuum plus a UV bump due to a stellar cluster. We take into account the effect of attenuation of these continua by gas with column density 10^{22} cm^{-2} located between the nucleus and the coronal line region. The calculated coronal line ratios are in a good agreement with those observed in NGC 1068 for a model in which about 40% of the line emission comes from gas illuminated by unattenuated, non-thermal continuum, and about 60% from gas illuminated by attenuated, non-thermal continuum. The electron density of the coronal line emitting gas in NGC 1068 is found to be 10^4 cm^{-3}. In the Circinus galaxy the coronal line emission comes from gas with electron density 10^3 cm^{-3} illuminated entirely by attenuated, non-thermal continuum. The derived ionization parameters for both coronal line regions are very similar, but the different densities imply a higher ionizing photon flux in NGC 1068, consistent with the higher observed excitation state of the line emitting gas in that galaxy. A possible geometry of the coronal line region of both galaxies is discussed, in which the distribution of the attenuating gas may be strongly affected by the relative strength of the nuclear radio-jet. The stronger radio-jet in NGC 1068 may have cleared a channel through the NLR allowing some unattenuated nuclear continuum to illuminate part of the coronal line region.

Accepted by A&A

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Preprint available at astro-ph/9901038 and http://ledas-www.star.le.ac.uk/Preprint (under January 1999)

The giant X-ray outbursts in NGC 5905 and IC 3599: Follow-up observations and outburst scenarios

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Huge amplitude X-ray outbursts in a few galaxies were reported in the last few years. As one of the exciting possibilities to explain these observations, tidal disruption of a star by a central supermassive black hole has been proposed. In the present paper, we perform a detailed discussion of this and other possible scenarios for the X-ray outburst in NGC 5905, and a comparison of NGC 5905 and IC 3599 in outburst as well as in quiescence. To this end we present (i) a thorough analysis of all *ROSAT* PSPC X-ray observations of NGC 5905 and new HRI data, (ii) optical photometry of NGC 5905 quasi-*simultaneous* to the X-ray outburst and on longer terms, (iii) the first post-outburst optical spectra of NGC 5905 and high-resolution post-outburst spectra of IC 3599, and (iv) photoionization models for the high-excitation emission lines that were discovered in the optical outburst spectrum of IC 3599. The investigated outburst models include, besides the tidal disruption event, a supernova in dense medium, an accretion-disk instability, an event of extreme gravitational lensing, the X-ray afterglow of a GRB, and the possibility of a warm-absorbed hidden Seyfert nucleus in the center of the galaxy. The successful models, all involving the presence of a central supermassive black hole, are selected and implications are discussed. The optical spectra of both galaxies in quiescence are carefully examined for signs of *permanent* low-level Seyfert-activity. Whereas IC 3599 shows several signs of activity, none is revealed for NGC 5905. At present, and among the X-ray bursts, this makes NGC 5905 the only safe candidate for a tidal disruption event in an otherwise *non-active* galaxy. The physical conditions in the HII emission-line gas are also investigated. We briefly comment on a search for further highly variable objects on the basis of *ROSAT* observations. Several with factors 10-20 are found; all of them are known to harbour warm absorbers.

A&A, in press

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preprint available at astro-ph/9901141 and as *MPE preprint* 458

Complex variability pattern in NGC 4151. II. Variable absorption features

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We found and identified the blueshifted variable absorption features in the NGC 4151 optical spectra obtained in 1992–1996. Two of these features identified with He I λ4471 and λ7065 lines have been investigated in detail. The most striking change in the He I λ4471 equivalent width was its strengthening between ≈JD2450212–JD2450315. We present some indications of the extremely low-ionization state of absorber in this period of observations. We do not find clear evidence for a correlation (neither inverse nor direct) of equivalent widths with the state of the nucleus activity. This probably means that strong changes in the covering factor (or something else) affect this correlation. The decomposition method based on the different behavior of broad emission lines and absorption lines allows us to separate these spectral features, and to obtain evidence that the H_α, H_β and H_γ absorption lines are also present. The presence of the absorption lines cause the variations of the broad emission profiles to become more complicated. Possible explanations for the absorption variability are discussed.

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Morphology of the 12 μm Seyfert Galaxies: I. Hubble Types, Axial Ratios, Bars, and Rings

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We have compared the morphological characteristics of the 891 galaxies in the Extended 12 μm Sample (E12GS), and assessed the effect of the 12 μm selection criterion on galaxy properties. The normal spirals in the E12GS have the same axial ratios, morphological types, and bar and ring fractions as other normal spirals. The HII/starburst galaxies have a higher incidence of bars, and more than twice the normal rate of "peculiar" morphologies, both of which are attributable to relatively recent disturbances.

The 12 μm Seyferts show a small (10%) deficiency of edge-on disks. This is caused by extinction, but is a much less severe effect than in optically-selected samples. There is a similar modest deficit of highly inclined HII/starburst galaxies in the 12 μm sample.

The galaxies with active nuclei (AGNs: Seyferts and LINERs) have the same incidence of bars as normal spirals, but show rings significantly more often than normal galaxies or starbursts. The LINERs have elevated rates of *inner* rings, while the Seyferts have *outer* ring fractions several times those in normal galaxies. The different formation times of bars and rings suggest an interpretation of these differences. Bars form relatively quickly, and indicate that material is recently being transported (by redistribution of angular momentum) to the center of the galaxy, where it is likely to trigger a short (e.g., $\lesssim 10^8$ yrs) burst of star formation. Outer rings may result from similar disturbances, but require much more time to form. They would then be associated with more intense nuclear activity if it takes 10^9 years or more for the mass transfer to reach the center and raise the black hole accretion rate, by which time the bar has dissolved or begun to do so. Inner rings form before outer ones, with a formation time more comparable to bars. Thus it may be that after an interaction or instability triggers an infall of gas, the galaxy in the earliest stage is likely to show enhanced star formation in its center, while later it is more likely to show LINER activity, and still later likely to be a Seyfert.

The trends we find with morphology and nuclear activity are not biased either by the distances of the galaxies, or by the slightly elevated recent star formation rates shown by the 12 μm galaxies in general.

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Preprints are available through the preprint server http://xxx.sissa.it or by contacting the authors.

HST FOC spectroscopy of the NLR of NGC 4151. I. Gas kinematics.

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We present the results from a detailed kinematic analysis of both ground-based, and *Hubble Space Telescope*/Faint Object Camera long-slit spectroscopy at sub-arcsec spatial resolution, of the narrow-line region of NGC 4151. In agreement with previous work, the extended emission gas ($R > 4''$) is found to be in normal rotation in the galactic plane, a behaviour that we were able to trace even across the nuclear region, where the gas is strongly disturbed by the interaction with the radio jet, and connects smoothly with the large scale rotation defined by the neutral gas emission.

The HST data, at $0''.029$ spatial resolution, allow us for the first time to truly isolate the kinematic behaviour of the individual clouds in the inner narrow-line region. We find that, underlying the perturbations introduced by the radio ejecta, the general velocity field can still be well represented by planar rotation down to a radius of $\sim 0''.5$ (30 pc), distance at which the rotation curve has its turnover.

The most striking result that emerges from our analysis is that the galaxy potential derived fitting the rotation curve changes from a "dark halo" at the ENLR distances to dominated by the central mass concentration in the NLR, with an almost Keplerian fall-off in the $1'' < R < 4''$interval. The observed velocity of the gas at $0''.5$ implies a mass of $M \sim 10^9$ $M_\odot$ within the inner 60 pc. The presence of a turnover in the rotation curve indicates that this central mass concentration is extended. The first measured velocity point (outside the region saturated by the nucleus) would imply an enclosed mass of $\sim 5 \times 10^7$ $M_\odot$ within $R \sim 0''.15$ (10 pc) which represents an upper limit to any nuclear point mass.

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preprint available as astro-ph/9901415

Announcements

Postdoctoral Research Position in Astronomy

THE OHIO STATE UNIVERSITY, Department of Astronomy, 174 West 18th Avenue, Columbus, Ohio 43210,
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Attention: Ms. Dena Bruedigam

Applications are invited for a postdoctoral research associateship in the field of multiwavelength observations of active galactic nuclei. It is expected that one two-year position will be available, pending the availability of funding.

The successful candidate will have primary responsibility for reduction and analysis of Hubble Space Telescope UV spectra obtained with STIS as part of a multiwavelength monitoring program on a narrow-line Seyfert 1 galaxy. This program is being carried out by the International AGN Watch consortium (see http://www.astronomy.ohio-state.edu/ agnwatch/). Professor Bradley M. Peterson is the Principal Investigator for the HST program, which will also involve X-ray and ground-based optical observations.

Applicants must have a Ph.D. degree in Astronomy or Astrophysics completed at the time of the appointment, which is expected to be in September 1999. Experience in spectroscopic observations of AGNs and/or experience with HST observations, particularly with STIS, is desirable. Annual salary will be about $37,000 per year.

The successful applicant will also have opportunities to pursue related independent research, and will be entitled to apply for observing time on Ohio State facilities on the same basis as other researchers and faculty at Ohio State. Ohio State holds a 25Observatory.

Closing date for applications is 1 March 1999. A complete application will consist of a resume that includes a CV, bibliography, and a statement of research interests; it should be sent to the above address. Applicants must arrange to have three letters of reference sent by the same date. Applicants who have applied for a Columbus Postdoctoral Fellowship within the last few months need only inform us that they also wish to be considered for this position. The Ohio State University is an Affirmative Action, Equal Opportunity Employer. Women and minority candidates are encouraged to apply.

Sampler data release from the Two Micron All Sky Survey

The Two Micron All Sky Survey (2MASS) announces the public availability of the 2MASS Sampler Data Release. The Sampler data products can be accessed from the IPAC/2MASS Web site at http://www.ipac.caltech.edu/2mass/ or directly from the NASA/Infrared Science Archive site at http://irsa.ipac.caltech.edu/.

The objective of the 2MASS Sampler is to introduce the astronomical community to the content and format of the 2MASS datasets, and to the web-based Access Tools, to provide an opportunity for the 2MASS project to receive community feedback in preparation for a large 1999 Spring data release, and to enable the community to carry out scientific investigations with the 2MASS dataset for the first time.

The 2MASS Sampler consists of a Point Source Catalog containing 227,197 objects, an Extended Source Catalog containing 2,133 resolved sources, and 5,658 compressed 512x1024 pixel (1"/pixel) images, covering about 63 square degrees of the northern sky.

The 2MASS webpage contains general information and documentation about this data release. Assistance with the Sampler is available via the 2MASS Help Desk at 2mass@ipac.caltech.edu.

A CD-ROM containing the Sampler data is also available.

The Two Micron All Sky Survey is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center, funded by the NASA and the NSF.

The Active Galaxies Newsletter is available on the World Wide Web. You can access it via the University of Manchester home page :- http://www.ast.man.ac.uk/~mpr/agn/