



# THE <sup>DAVID</sup> DUNLAP DOINGS

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## ABSTRACT 11

The mass of LMC X-3  
Is larger than we like to see  
In ordinary neutron stars,  
In spite of all our error bars.  
The primary which we can see:  
A normal star of middle B -  
Except for some continuum  
Arising from its little chum,  
Appears to be exactly right  
In size, and its amount of light.  
And so we judge its normal weight  
Should lie between just 4 and 8,  
Which may imply its other role:  
Companion to a blackish hole.

*From a paper submitted to Ap.J. (Letters), entitled "Discovery of a Massive Unseen Star in LMC X-3" by A.P. Cowley, D. Crampton, J.B. Hutchings, R. Remillard and J.E. Penfold.*

C O N G R A T U L A T I O N S

To *Chris Stagg* who passed the Ph.D. general examination.

To *Petrusia Bojetchko Kowalsky* who completed the requirements for the M.Sc.  
(with John Lester).

To *Doug Welch* who completed the requirements for the M.Sc. (with Bob McLaren).

## COVER STORY

The Editors were struck by the poetic touch added to the recent report of a black hole candidate in LMC X-3 and so have reproduced it on the cover of this issue. The appearance of this important paper also prompted us to ask another question whose answer has been supplied below by *Doug Gies*.

### Whatever Happened to Cyg X-1?

Readers of the "Doings" might be interested in an update on mass estimates of the other black hole candidate, Cygnus X-1. The basic data on the radial velocity behaviour and light variations of the visible component are now well established. In addition, the accumulated DDO spectra have provided a wealth of information on line profiles and equivalent widths. A study of line profiles yields another measure of the system dimensions, the rotational broadening. The rotational broadening is particularly interesting since it establishes a mathematical relationship between the size of the star and the inclination of the binary system. I've been using Stefan Mochnecki's program GENSYN to model the geometry of the binary system and match the observed light curve, line broadening and radial velocity variations. Depending on the size of the star relative to the Roche filling limit, the procedure determines a unique set of system parameters in order to reproduce the observed characteristics. The size of the star is constrained by the Roche critical surface (upper limit) and the distance estimates (lower limit). The result is a secondary mass between 10 and 20 solar masses, still well above the neutron star limit, and comparable to LMC X-3.

P o t o u r r i

Tom Bolton attended the meetings of the Joint Science Working Group for STARLAB at GSFC on 31 January - 1 February.

Dr. David Smith is visiting DA on "leave of absence" from Sky and Telescope.

John Percy delivered a seminar at UWO on 25 February.

Armando Arellano-Ferro had a successful run on the IUE in late Feb., continuing a programme with Barry Madore to find hot companions to intermediate type supergiants.

Tom Bolton has been appointed by NRC to the SAC of the CFHT.

Rob Roeder reports:

On Nov. 19 of last year I presented the colloquium to the Physics Dept. at the U. of Alberta, talking about Quasars and Gravitational Lenses. I had dinner at the Israel's with Doug and Joan Hube and Austin Gulliver. On Feb. 9, I gave an updated version of the talk as the colloquium to the joint Depts. of Physics and Astronomy at the U. of Western Ontario, where I enjoyed discussing Theoretical Astronomy with Mike Marlborough, Romas Mitalas, and John Landstreet. I should also mention that Charles Dyer, Martin Duncan and I were at the Texas Symposium last Dec. 12-17 in Austin, where we all presented poster papers.

Bob Garrison and Chris Corbally have just returned from a "4 out of 4" clear run on CFHT with all instrumentation and telescope control working perfectly. Chris reports Rick and Nancy McGonegal have settled in now with the arrival of their furniture and are finding it not too difficult to enjoy their island paradise from atop an enormous, orange 4WD chevy. They send best wishes to old acquaintance - as does Peter Wizinowich, whose transport occasionally changes from 4 wheels to 4 hooves!

Helen Hogg attended the AURA celebrations of the 25th Anniversary of Kitt Peak National Observatory in and around Tucson February 14-16.

## WINTER SCHOOL IN INDIA

by Phil Kronberg

In January, I was one of a group of lecturers invited from North America and Europe to the "Winter School on Extragalactic Energetic Sources" at Bangalore, India. The Winter School was attended by approximately 100 scientists, mostly astronomers, but also other physicists in related fields from all over India. It was organized by the Tata Institute of Fundamental Research in association with the Raman Research Institute, the Indian Space Research Organization, the Indian Institute of Astrophysics, and the Indian Institute of Science. The other foreign lecturers were Geoffrey Burbidge (KPNO), Marshall Cohen (Caltech), Robert Laing (NRAO), Steve Murray and Leon van Speybroeck (C.F.A.), Martin Rees (I.O.A.), Peter Strittmatter (Steward Obs.); the Indian lecturers: J.V. Narlikar, Gopal Krishna, Kumar Chitre, V. Radhakrishnan, Ramesh Narayan, and Govind Swarup.

Lectures at the Summer School will be published in the form of a proceedings. These will form a very useful text book on extragalactic topics such as experimental cosmology, optical and infrared observations of extragalactic radio sources, recent VLBI results and theory, extragalactic x-ray astronomy, etc.

I also took advantage of my stay in India to visit the Proton Decay Experiment 2.3 km below ground in the Kolar Gold Mine not far from Bangalore. Other sightseeing tours of interest included a visit to the low frequency radio telescope at Ooty and the Tata Institute's research facilities there, and a 2½ hour elephant ride in the Bandipur Wildlife Park in South India.

### An Observing Trip at K.P.N.O.

by Louis Noreau

On the last two weeks of January, I travelled to K.P.N.O. to observe with a CCD camera mounted at the Cassegrain focus of the #1 0.9 meter telescope. I had applied for "open time" on this instrument in October, but I learned that it was granted to me less than two weeks before. I had to rush to get plane tickets and accommodation reservations with such a short notice!

I arrived in Tucson on January 18. My run was to start on the 21 but I planned to show up early in order to meet some of the CCD specialists: Bill Schoening and Toronto graduate Lindsey Davis. I wanted to get more details on the art of CCD observing and a user's manual. It was my first optical run since a 4-meter run a year and a half ago, so I was feeling a bit rusty about optical observing. I therefore planned to be on the mountain one night early to get some practical experience by looking over the shoulders of the previous observer, and get used to staying up until the morning. It was quite a thrill to climb again the peak and it was pleasant to see it covered with fresh snow. However, a bad surprise was waiting for me: the CCD Dewar had a vacuum problem and was brought down to Tucson to be pumped, so the night was wasted.

After a day of anxious waiting, Bill Schoening finally appeared on the mountain around sunset with the Dewar. He introduced me to the operation of the telescope and camera control computers, the focus and alignment tests with the CCD and how to use

the "golden" autoguider. I still remember his motto: 'in case of difficulty, look in my manual'. He left for lunch and sleep around 22:30; I was now on my own. The operation went smoothly and I was able to secure a few frames before it clouded up at the end of the night.

The first hours of the second night were cloudy, but I was able to register some flat fields on the sky before a complete overcast.

As the sun was setting for the third night, I was getting quite discouraged about whether I would be able to obtain some decent data. The cloud situation was far from being perfect but at least I was able to get some pictures with B,V and R filters (as well as without filters) of one of my galaxies, NGC 3448.

I left the same day in the too early afternoon for the Tucson headquarters to start data reduction. It was a painless but long process. During that time I stayed in the "AURA" guest apartments. I must have calculated my data reduction time well as I had only one evening free when I finished.

I am quite happy with the experience I acquired on the small telescope. I must say that in a sense it is more "natural" astronomy than radio astronomy which is my usual technique. I found the use of the CCD absolutely painless and I would advise everybody to invest in one! Perhaps with the ever decreasing price and improvement of home computers and of electronics components amateurs could even have their own CCD system before the end of the century.

#### *Clouded out at Palomar*

*They tell me it's been a bad year (already) for observing in Southern California; they are twenty-five percent over their average seasonal rainfall and my impression was that all of the excess fell during our January run of three-nights on the 5 m. at Palomar Mountain. We only got enough time between fronts to open up, focus and set the chopping before low cloud and more rain sealed us shut for the duration.*

*No doubt about it, the run was a complete bust, but there was one good piece of observing ... from my sister's front lawn in Los Angeles. The launch path of IRAS the new and highly sophisticated infrared satellite went right over the house and provided a spectacular twilight display of colour. The news reports said that the new telescope in orbit had such sharp optics that "it could see a speck of dust at one mile". I guess that re-emphasizes two things: (1) the press still doesn't appreciate the fact that the main function of telescopes is not to magnify images and (2) the U.S. is a long way from going metric. Still they build damn good rockets and telescopes - too bad they can't control the weather.*

*Barry F. Madore*

The Astronomy Data Network

by Stefan Mochnacki

The data network linking the Observatory and the Department to the VAXes and the University of Toronto Computer Services centre continues to be expanded and improved. We now have three serial lines connecting the 74-inch dome to the DDO switchboard; an 8-channel GANDALF multiplexer system connects the Observatory to a switchboard at the Department of Astronomy downtown via leased telephone lines. The Departmental switchboard in turn has connections to the Physics/Astronomy VAX facility and the UTCS PACX network, which in turn gives access to IBM, DEC-10 and VAX computers at the St. George and Erindale campuses.

At the 74-inch telescope, we now take RETICON spectra and immediately store them on floppy disks using the on-line microNOVA MP100 computer; while a subsequent exposure is being taken, the microNOVA can be commanded to transmit the previously recorded spectra to the VAX downtown via the network. Meanwhile, the observer is sitting at another terminal running his or her reduction programme, reading the files which the microNOVA has set up on the VAX. In this way the observer can do full reductions at the telescope using the programme of choice, without in any way interfering with the taking and recording of the data. For example, some of us use RETICENT, while others may prefer IDL for reductions on the VAX; data recording and data reductions are parallel operations not interfering with each other or compromising the integrity of data.

The power of this approach is already obvious. We have been evaluating the performance of the Reticon detector and tracing down hardware problems much more quickly than would have been possible without the network link. This is due to the versatility of general reduction programmes such as RETICENT and IDL running on the VAX. The microNOVA does not have to be programmed to reproduce the sophisticated capabilities already available on the VAX, saving much valuable labour as a result.

The simple plug-in switchboard set-up, devised by Bill Weller and Shenton Chew, has received the best form of praise by being imitated for the entire Physics/Astronomy VAX installation. We use 3-wire RS-232 connections throughout, with XON/XOFF flow control. By using high-quality shielded twisted-pair cables, we have had no trouble in transmitting at 4800 baud over distances approaching 1000 feet. Frank Hawker and Dave Earlam have done much of the wiring.

Although transmission of spectroscopic data presents no problems over the network, two-dimensional digitized images are too big to be transmitted. It is clear that one or two years from now a new computer will be needed at the Observatory itself to handle data from the PDS microdensitometer; furthermore, existing facilities are not suited for an expansion of word-processing and data-base handling capacity. The VAX is primarily a research number-cruncher, and UTCS offers rather primitive office services. The photon-counting spectrometer to be built at the Observatory in the coming year also will increase the data-processing load. The network has been set up symmetrically so that a computer at the Observatory can be used just as easily from downtown as a computer downtown can be used from the Observatory.

## Why Hawaii?

As I was passing through Customs Pre-Clearance at Toronto International the officer stopped me for the usual "show-and-tell" session. Name, citizen of what country etc. Destination? "Hawaii" I replied. "Hawaii?" he countered. "Hawaii" I reiterated. "No, Hawaii?" he insisted. "The Big Island out in the Pacific" I offered. With a waving of hands and a look of incredulity my uniformed friend slowly asked "No, no, no! Why? Why Hawaii? Why are you going to Hawaii?" Non-English speaking Chilean customs officials respond well to "astronomer" and "observatory" illustrated by pointing at the ceiling but it was clear that his American counterpart was not going to take kindly to pantomime. I politely responded "Pleasure".

And indeed the observing was a pleasure. Wendy Freedman and I met with René Racine before going to the summit and he assured us that the camera and telescope had been fine tuned in many ways since our last visit. René was tremendously helpful and indeed the telescope performed flawlessly, except on the second night with about half an hour to go the system decided to stop the telescope dead in its track(ing)s. When you've already been up in the cage for most of the night and it's  $-10^{\circ}\text{C}$  at the prime focus you don't try to solve such problems. You come down.

Three nights of crystal clear dark skies and some of the longest exposures we've ever taken (3 hours on baked IIIa-J emulsions) resulted in a beautiful first-epoch set of plates aimed at the discovery of Cepheids in M81 and M101. All that Bob McLaren reported on during his return trip to Toronto in January is true. The telescope is working very well; now we can worry about doing science to match the facilities.

Barry F. Madore

## *GASA Gossip: Astronomers do it at Night*

*It begins precisely at 5:00 pm. The elevator doors open and the army of cleaning ladies moves to the attack. Swiftly but not silently they sweep through the department; doors opening and closing; garbage cans emptied; bang, crash, smash; bang, crash, smash. Anyone, planning to go home for dinner, is quickly driven from their office.*

*Those of us who are left after the wave of mops and brooms has passed by face our most difficult decision of the day. Where will we eat dinner? Peace in the Middle East can probably be reached with less discussion than five graduate students arguing over whether to splurge and go to Swiss Chalet or to settle for a double burger with cheese at Harvey's. Of course, there's always Mother's or Sam's or Country Style or ...*

*After dinner and an Alka Seltzer we are back at DA and raring to go. The new hot spot is room 1408 where all the computer terminals have been gathered into a sort of VAX sweat shop. There you can find many a student hunched over his "machine", the silence only disturbed by the tapping of keys, the infernal beeping of the terminals and the sound of students cursing under their breath. Sitting there having fallen into the same arithmetic trap for the nth time, just as you are considering whether to throw the terminal or yourself off the 15th floor, someone mentions the magic word. Coffee!*

*After a caffeine fix you're good for another couple of hours of Input-Output Conversion Errors, Array Overflows and Attempts to Read Non-Existent Records. Before you know it, the clock on the wall says it's time to give up and go home. The program will run for sure tomorrow night.*

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COLLOQUIA\*

- January 31  
(Monday) Professor Kenneth Lande, University of Pennsylvania,  
"Search for the Decay of the Proton - Is Matter Unstable?"
- January 31<sup>†</sup>  
(Monday) Dr. Robert McLaren, University of Toronto  
"CFHT : Present Status and Future Prospects"
- February 2 Armando Arellano-Ferro, University of Toronto  
"Small-Amplitude Yellow Supergiants. Study of Their  
Pulsation Properties"
- February 16 Gerry Grieve, University of Toronto  
"UBVRI Observations of Magellanic Supergiants and  
Cepheids"
- February 23 Doug Gies and Neb Duric, University of Toronto  
G2000 Current Literature Seminar
- March 2 Chris Corbally, University of Toronto  
"Close Southern Visual Binaries"

\*Unless otherwise noted, colloquia are held on Wednesdays at 4:00 PM. in Room MP 137  
with TEA at 3:30 in the Reference Room, MP 1404.

<sup>†</sup>Monday January 31 at 4:00 PM in Room 118.

PAPERS SUBMITTED

- R.C. Bignell  
E.R. Seaquist VLA Observations of the Luminous SNR in NGC 4449
- P.P. Kronberg  
W. Reich Search for Large Scale Extensions of the Quasars  
3C 273, 3C 345 and 3C 380
- C.W. McAlary  
R.A. McLaren  
R. McGonegal  
J. Maza A Near-Infrared and Optical Study of X-Ray Selected  
Seyfert Galaxies I. Observations