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ADDRESS CHANGES

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 Do not forget to update your
 own e-mail address

DUES ANNOUNCEMENT

No dues increase this year, but remember, that in order to encourage members to pay dues promptly in September, thus avoiding the expense of many reminders, dues are as follows:-

<i>If paid before October 1st, after October 1st</i>		
<i>Regular:</i>	<i>\$45</i>	<i>\$55</i>
<i>Students & Retirees:</i>	<i>\$20</i>	<i>\$25</i>

- EDITORIAL -

One of the joys of attending **CASCA** meetings in Penticton is the opportunity to renew one's acquaintance with Okanagan wines in the climate in which they are grown. **CASCA-95**, with the help of the LOC, was no exception. Unfortunately, it was probably the last chance for most of us to do this in association with **CASCA** (See Don Morton's article on developments at HIA, page 5)!

The meeting itself started off with a Sunday morning Scientific Session, followed by the Education Session. This was a change from previous years when the Ed. Session has usually been tagged on at the end of the meeting. Ken Tapping, his committee, and all presenters did a great job in building on the high standard set in previous sessions. For all of us the highlight of the session was the two talks by David Levy. The gist of both talks was, I think, that we should not try too hard to teach young people science so that they can become scientists. We need to

communicate our enthusiasm for our subject, tell people what is like to be a scientist or astronomer, and make them aware of what science is and the method involved. Once we can get them interested in the questions, their natural curiosity will not only provide the answers but also stimulate them to ask more questions.

David's *Personal Perspectives on Comet Shoemaker-Levy 9* for *The Helen Sawyer Hogg Public Lecture* on Sunday evening was attended by a good mixed crowd which looked to be split about 50/50 between locals, many of them children, and **CASCA** participants. This was a great example of a multimedia presentation. There was a little bit of everything, from science to poetry, and slides to video clips, each interspersed with music, humour and nostalgia. For the first time in my life I witnessed a standing ovation at the end of a scientific talk. David spent a good deal of time answering questions and provided a magnificent answer to a young girl, whom I judged

to be about 7 years old. "Look up at the sky and pick your very own star. Then do your utmost to learn everything you can about that star, from its name to what it is made of and more."

The evening took on something of a mystical nature for me when the first thing I saw upon leaving the auditorium, and looking up at the sky, was Jupiter rising over the hills to the east. Hopefully that little girl also noticed, and we will be hearing great things from her in the future!

Monday started with the presentation of *The Plaskett Medal* to Michael Richer. For an abstract of Michael's thesis, and indeed those of all the nominees for the award, see the *Thesis Abstracts* starting on page 20.

A debate currently under way within both **CASCA** and **RASC** right now was addressed by Doug Hube. This involves the future of **JRASC**. A summary of Doug's discussion will, I am sure, be published in said journal. The idea of having a separate "popular" journal in Canada seems to have already

been addressed by Terence Dickinson and The National Museum of Science and Technology with the publication of the premiere edition of **SkyNews**. Perhaps the **RASC** could join this group, thus providing a strong base for the continued existence of one "popular" magazine with a Canadian perspective on astronomy.

The **JRASC** could then continue to publish refereed, technical papers for the **CASCA** community. Indeed, it seems to me that the Canadian Community has established a respectable enough reputation for good science over the last few decades that with a larger number of papers in **JRASC** (or **JCASCA**) the journal could become just as widely read and respected as some of the Journals produced south of the

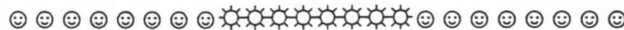
49th parallel. Turn around time for papers would be substantially improved in many cases I would think.

As Chair of the Education Committee, **CASCA-95** provided me with a chance to discuss with various people the possibility of setting up a database of astronomical educational software which could be accessed through the **CASCA** homepage. Such a database would not be effective unless there was a description and/or review accompanying information about the software listed. If you are using any Educational packages please forward details to jpenfold@mtroyal.ab.ca. Include publisher, price, type of machine you are using it on, and a short description of the program's features and the context in which you are using it. This will be added to an

Educational Software section at <http://bear.ras.ucalgary.ca/CASCA/cass-index.html>.

Other regular features of **CASCA** meetings in Penticton, which will also be missed, are the **DRAO** Barbecue and volleyball game, as well as John Galt's Collection of Unrideable Bicycles. As always, John provided a demonstration of the bicycles for all. This time there was a twist, as John showed that one of them really was unrideable!

In spite of all the doom and gloom generated by the impending announcement about budget cuts within **NRC** & **NSERC** I think most people left Penticton with a positive feeling thanks to President Bill Harris' comment that, even in the face of all the cutbacks, we are managing to maintain the level of science we are doing.



ADASS-95

22 - 25 October 1995, NOAO,
Tucson, AZ
softconf@noao.edu (Jeannette Barnes)
<http://iraf.noao.edu/ADASS/adass.html>
<ftp://iraf.noao.edu>
cd iraf/conf/adass-95

187th Meeting of the AAS

14 - 18 January 1996, San Antonio, TX
swri::hunter (Hunter Waite)

High Sensitivity Radio Astronomy

22 - 26 January 1996, University of
Manchester
hsra@jb.man.ac.uk (Janet Easton)

CASCA 1996 - New Windows on the Universe

1 - 4 June 1996, Queen's University,
Kingston, Ont.
hanes@bill.phy.queensu.ca
(David Hanes)

188th Meeting of the AAS

9 - 13 June 1996, Madison, WI
bless@sal.wisc.edu (Bob Bless)

-- THE GALACTIC PLANE SURVEY PROJECT --**CANADIAN UNIVERSITY
RESEARCHERS**

C. Carignan, Montréal
 J. Irwin, Queen's
 G. Joncas, Laval
 M. Fich, Waterloo
 N. Ghazzali, Laval
 D. Leahy, Calgary
 P. Martin, CITA
 W. McCutcheon, UBC
 S. Pineault, Laval
 D. Routledge, Alberta
 N. St-Louis, Montréal
 R. Taylor, Calgary
 F. Vaneldik, Alberta

NRC RESEARCHERS

D. Crabtree, CADC
 P. Dewdney, DRAO
 J. Galt, DRAO
 A. Gray, DRAO
 L. Higgs, DRAO
 T. Landecker, DRAO
 G. Moriarty-Schieven, DRAO
 C. Purton, DRAO
 R. Roger, DRAO
 K. Tapping, DRAO
 T. Willis, DRAO

INTERNATIONAL RESEARCHERS

C. Beichman, Cal Tech
 N. Duric, U of New Mexico
 D. Green, Cambridge
 C. Heiles, UC, Berkeley
 M. Heyer, U of Massachusetts
 W. Langer, Jet Propulsion Lab
 D. Watson, U of Rochester
 H. Wendker, Hamburger
 Sternwarte
 Zhang X., Beijing Astronomical
 Observatory

Understanding our origins, ultimately from diffuse gas and dust in the interstellar medium (ISM) in our Galaxy, has a long-standing prominence among the compelling challenges in natural science. The Milky Way is a grand ecosystem. Far from a homogeneous and tranquil environment, the ISM displays large density and temperature variations. Velocity fields are turbulent, often supersonic. This highly disturbed state is maintained by energy input from the stars, be it during the birthing process, an adolescent venting, or, as so often, a violent death. Nevertheless, there exist pockets of quiescence where dense, cold gas can become self-gravitating. The life cycles of stars and the ISM are therefore tightly intertwined.

Only recently have astrophysicists appreciated the importance and complexity of this ecosystem. Our vantage point within it allows us the potential to observe in detail the relevant interactions, the underpinnings of a comprehensive theory. We have reached a stage where fundamental advances in this area require a revolutionary approach. Our international partnership, led by Canadian scientists, has developed a concerted observational and theoretical attack, the principal goal being the creation and scientific analysis of a database of panoramic, high resolution images of all major components of the ISM.

This project is only now possible because of the convergence of recent technical developments. Imaging of the molecular component of the ISM, traced by the CO molecule, is underway at the Five Colleges Radio Astronomy Observatory, with funding from NSF. Production of images of the dust component, seen through its infrared emission, is in progress at the California Institute of Technology, with funding from NASA. Our collaboration also includes a new proposal to NASA to launch a Mid-range Explorer class satellite to image our Galaxy in the infrared cooling lines of several atomic species in the ISM. In Canada we are engaging on an ambitious project with the newly upgraded DRAO. Among world facilities, the Synthesis Telescope is uniquely capable of producing the tens of thousands of images of the structure and dynamics of the prime component of the ISM, atomic hydrogen. Simultaneously the ST will produce radio continuum and polarization images at two frequencies to probe the relativistic particle and magnetic components. Complementary continuum images at even lower frequencies are being obtained at the Mullard Radio Astronomy Observatory of Cambridge University and the Beijing Astronomical Observatory. All of this spectral imaging is at comparable angular resolution (1 arc minute), and the database we intend to develop, use, and make available to the international community will merge all of these products.



An ADASS '95 Update

The Preliminary Program includes in it registration and hotel information along with a call for abstracts. The Preliminary Program (as a PostScript file) and registration material are available by anonymous FTP to *iraf.noao.edu* in the *iraf/conf/adass-95/* directory. Registrations are being accepted electronically using the *adassvreg.txt* form in this directory.

Abstract submission and demo request instructions and forms are also available in the FTP archive on *iraf.noao.edu* in the *iraf/conf/adass-95/abstracts/* directory or by sending an empty email message to *adassvab-request@noao.edu*. Please submit all abstracts electronically following the instructions in the README and *adassvab.tex* files.

All materials are also available over the WWW through the URL:

<http://iraf.noao.edu/ADASS/adass.html>

Important Dates to Remember

August 15: Deadline for early registration
 Deadline for abstract submissions
 Deadline for demo requests

September 21: Deadline for hotel reservations

October 12: Deadline for late registration

October 22-25: ADASS V, Tucson, AZ

For further information about ADASS '95 please send email to *softconf@noao.edu*.

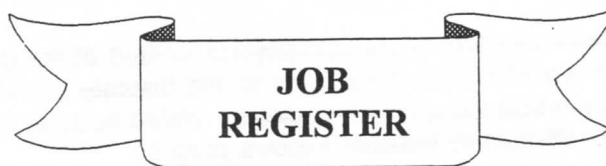
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HIA / L'IHA

The Herzberg Institute of Astrophysics requires an Adaptive Optics Scientist to support the development of the Gemini Adaptive Optics System. For further details, please contact Andy Woodsworth, (604)-363-0024, *wdswrth@dao.nrc.ca*.

L'Institut Herzberg d'astrophysique est à la recherche d'un(e) scientifique qui a des connaissances spécialisées en optique adaptative, et qui fera partie de l'équipe chargée de réaliser le système d'optique adaptative pour les télescopes Gemini. Pour plus d'information, s'adresser à Andy Woodsworth, (604)-363-0024, *wdswrth@dao.nrc.ca*.



**CANADIAN INSTITUTE FOR THEORETICAL ASTROPHYSICS/
INSTITUT CANADIEN D'ASTROPHYSIQUE THEORIQUE**

POSTDOCTORAL FELLOWSHIPS

CITA is a national centre for theoretical astrophysics located at the University of Toronto. The Institute expects to offer several postdoctoral fellowships with a starting date of 1 September, 1996. The appointments will be of two to three years duration. Funds will be available for travel and other research expenses. Fellows are expected to carry out original research in theoretical astrophysics under the general supervision of the faculty at CITA, whose interest include: cosmology, high energy astrophysics, interstellar matter, nuclear and relativistic astrophysics, particle astrophysics, solar physics, star and planet formation, and galactic and solar system dynamics.

In each instance applicants should send:

- a curriculum vitae
- statement of research interests
- and arrange for three letters of recommendation to be sent to the Director of CITA

RESEARCH ASSOCIATE POSITIONS

CITA is a national centre for theoretical astrophysics located at the University of Toronto. The Institute expects to offer one or more research associate positions with a starting date of 1 September, 1996; applicants should have an excellent research record in astrophysics and postdoctoral experience. The appointments will be of three to five years duration. Funds will be available for travel and other research expenses. The primary duty is to carry out original research in theoretical astrophysics, but research associates are also expected to work with postdoctoral fellows and to assist with administration of the Institute.

All applicants for research associate positions are also considered automatically for postdoctoral fellowships.

In accordance with Canadian immigration regulations, this advertisement is directed to Canadian Citizens and permanent residents. In accordance with its Employment Equity Policy, The University of Toronto encourages applications from qualified women and men, members of visible minorities, aboriginal peoples and persons with disabilities.

All applications and letters should be sent to:

Professor Scott Tremaine, Director
Canadian Institute for Theoretical Astrophysics
University of Toronto, 60 St. George Street
Toronto, Ontario, CANADA, M5S 1A7

**DEADLINE FOR APPLICATIONS AND ALL LETTERS
OF RECOMMENDATION IS 1 DECEMBER, 1995**

Please do not send applications by FAX or electronic mail.

CITA NATIONAL FELLOWS

CITA is a national centre for theoretical astrophysics located at the University of Toronto. As part of its mandate to promote research throughout Canada, the Institute provides partial support for postdoctoral fellows working in theoretical astrophysics or closely related fields at Canadian universities other than the University of Toronto, through its National Fellows program.

The responsibility for identifying and nominating potential CITA National Fellows who will work at a given university lies with the faculty at that university. Only faculty at Canadian universities may submit nominations. For each prospective fellow, the nomination portfolio should consist of:

- a curriculum vitae and bibliography;
- a statement of proposed research;
- a support letter from the faculty member submitting the nomination, stating how the applicant is expected to contribute to the local research program;
- 3 letters of recommendation for each candidate

There is no limit on the number of nominations per faculty member or per university; however, any faculty member submitting more than one nomination is asked to rank the nominees in order of preference, with reasons given for the ordering. The application will be examined by CITA Council and ranked along with, and using the same standards as, applications for postdoctoral research fellow positions to be held at CITA.

We expect to award up to three new National Fellowships for the 1996-97 academic year. **The deadline for nominations is 1 December, 1995** for fellowships to start in 1996-1997. If necessary, nominations may be sent in without a complete set of letters of recommendation; letters of recommendation not included in the nomination package will be accepted if they reach CITA no later than January 2. Nomination portfolios should be sent to:

Prof. Scott Tremaine, Director,
Canadian Institute for Theoretical Astrophysics,
University of Toronto, 60 St. George Street,
Toronto, Ontario, CANADA, M5S 1A7

CITA will notify the nominator of each successful candidate that a CITA National Fellowship has been awarded and will guarantee funding of \$17,500 per year for up to two years towards the fellow's salary. It will then be up to the nominator to contact and recruit the applicant. All hiring will be done through the nominator's university. The remainder of the fellow's salary must be raised from research grants or the nominator's university. Note that the maximum stipend from NSERC funds (including the \$17,500 from CITA) cannot exceed the NSERC ceiling (currently \$27,500) although (i) there is no restriction on the use of non-NSERC funds to supplement the stipend; (ii) there is no restriction on the total stipend paid if the appointment is made as a Research Associate.

It is expected that the Fellow will spend at least 80% of his/her time resident at the nominator's home university unless alternative arrangements are approved in advance by both the nominator and the Director of CITA. Although there is no obligation for CITA National Fellows to spend part of their fellowship at CITA in Toronto, we encourage such visits and would normally provide support for up to two visits per year. Fellows are permitted to supplement their postdoctoral stipends by teaching up to one half-course per year, subject to prior approval by the Director of CITA.

Fellows are expected to acknowledge CITA in all publications written or researched while holding the Fellowship, either by listing CITA as an affiliation, or by acknowledging partial salary support from CITA, or by using the title "CITA National Fellow".

**Developments at the Herzberg
Institute of Astrophysics
by Donald C. Morton
1995 July 7**

The Federal Government's recent Program Review resulted in a 17% reduction of the budget of the National Research Council over 3 years. Following this announcement in the spring budget, senior managers at NRC prepared plans which our governing Council approved on June 22. All of NRC is affected and some parts will see major changes.

The President and Council recognized the international prominence of Canadian astronomy and the essential role of HIA in providing research facilities for university staff and students. Consequently the present HIA astronomy budget of \$10M/yr for salaries, operations and capital will be reduced by only \$1M/yr leaving us with \$9M/yr beginning April 1998. The President wanted to assure that we had sufficient resources to establish a base for a viable future.

Nevertheless this reduction will have a significant effect on HIA. Since our operations and capital funds already are barely adequate, we must reduce our salary budget by \$1M/yr. As a result we shall lose about 17 dedicated members of our staff from DAO, DRAO and the JCMT Group during the next 3 years.

In arriving at a plan to cope with this reduction, HIA Management adopted some guiding objectives. Such a plan must:

- *help to maintain the worldwide recognition of Canadian astronomy, as evidenced by the recent NSERC discipline review.*
- *provide Canadians with access to leading research facilities.*
- *provide instruments and software for these facilities, so that we can be full intellectual partners.*
- *consider the Canadian demand for each facility in allocating priorities.*
- *maintain our international commitments so that we do not harm our reputation for joining future projects, and*
- *encourage staff research relevant to HIA facilities.*

HIA will continue as an integral part of NRC, but we must reduce the range of our activities. We shall move towards supporting two optical and one radio facility in recognition of the much larger

**Développements à l'Institut
Herzberg d'astrophysique
par Donald C. Morton
7 juillet 1995**

Le Gouvernement fédéral a récemment procédé à une réévaluation de ses programmes. Cette réévaluation entraînera des compressions de 17% dans le budget du Conseil national de recherches Canada au cours des trois prochaines années. A la suite de cette annonce dans le budget du printemps, les dirigeants du CNRC ont préparé des plans que le Conseil a approuvés le 22 juin dernier. Tous les secteurs du CNRC sont touchés, et certains secteurs vont subir des changements majeurs.

Le Président et le Conseil reconnaissent l'importance de l'astronomie canadienne au niveau international et le rôle essentiel, pour les chercheurs universitaires et les étudiants, que joue l'IHA dans l'opération et le maintien des installations de recherche. En conséquence, le budget annuel de l'IHA de \$10M réserve à l'astronomie pour les salaires, les opérations et les dépenses de capital, sera réduit de seulement \$1M pour passer à \$9M d'ici mars 1998. Le Président a ainsi voulu s'assurer que nous aurions les ressources nécessaires pour maintenir une base solide pour le futur.

Cette réduction aura néanmoins des effets importants sur l'IHA. Etant donné que les fonds pour nos opérations et nos dépenses de capital sont déjà à peine suffisants, nous devons diminuer notre masse salariale annuelle de \$1M. Nous perdrons donc au total 17 membres dévoués de notre personnel à l'OFA, à l'OFRA et au groupe du TJCM au cours des trois prochaines années.

Afin de préparer un plan d'action qui tienne compte de cette réduction, la direction de l'IHA a adopté les objectifs suivants:

- *aider au maintien de la réputation internationale de l'astronomie canadienne mise en évidence par une récente étude du CRSNG,*
- *donner accès aux Canadiens à des installations de recherche de premier plan,*
- *fournir des instruments et des logiciels à ces installations pour que nous y soyons des partenaires intellectuels à part entière,*
- *établir les priorités en fonction de la demande pour chaque installation,*
- *maintenir nos engagements internationaux pour ne pas nuire à notre participation à des projets futurs, et*

number of university astronomers whose primary interest is optical astronomy. Thus we shall continue our participation in the Gemini 8-m telescopes, and in the CFHT, although we are reviewing the role of the latter in the 8-m era and we have requested the CFHT management to develop a plan to reduce its cost.

We also shall continue with the JCMT, at least until the present agreement expires in 2009, unless another partner wishes to withdraw. However we shall review the JCMT programme and we have asked the Director to examine his costs and priorities. At the same time we shall continue to support the investigation of options for participation in a future international radio facility through a committee consisting of Ernie Seaquist (Chairman), Peter Dewdney, Claude Carignan, Russ Taylor and Christine Wilson.

Dominion Astrophysical Observatory

At the DAO we shall give priority to supporting our Gemini partnership through the building of instruments and the development of data handling and archiving systems. Work on other projects, including those for CFHT, will occur only as the Gemini commitments permit. We shall continue to operate the local 1.8- and 1.2-m telescopes as long as there is a strong demand from university users, but we must reduce our support by March 1998 so that users will have to do more for themselves and accept fewer instrument changes.

Dominion Radio Astrophysical Observatory

The Galactic Plane Survey already is underway at DRAO with the active participation of university astronomers. They have demonstrated their commitment by pooling their NSERC grants to support a post-doctoral fellow at DRAO. We shall observe fields for this survey at least until March 1998, and give them priority over other proposals. We shall minimize staff loss before March 1998, but then we must find a way to operate with fewer employees. There are no plans at this time to close the observatory. Observations will continue as funds permit and the demand from Canadian users remains strong.

James Clerk Maxwell Telescope

The Ottawa Group will give priority to delivering receiver B3 to Hawaii, now scheduled for February 1996, and it will provide upgrades to other receivers under contract with the JCMT. We shall develop the MIDAS correlator for the telescope, if the JCMT issues a contract and HIA has a project plan that does not put other activities at risk if difficulties

- encourager le personnel à mener des recherches pertinentes aux installations de l'IHA.

L'IHA demeurera au sein du CNRC, mais nous devons réduire le champ de nos activités. Nous supporterons donc deux installations optiques et une installation radio puisqu'il y a un plus grand nombre d'astronomes universitaires dont l'intérêt principal est l'astronomie optique. Nous continuerons de participer au projet Gemini et au TCFH quoique nous étudions le rôle de ce dernier dans l'ère des télescopes de 8m. Nous avons demandé à la Direction du TCFH de produire un plan visant à en réduire le budget total.

Nous allons aussi continuer de participer au TJCM au moins jusqu'à la fin du présent accord en 2009 à moins qu'un autre partenaire décide de se retirer. Nous allons étudier le programme du TJCM, et nous avons demandé à son directeur d'examiner ses coûts et ses priorités. De plus, nous allons continuer d'explorer les options pour une collaboration en vue de la construction d'une future installation radio internationale par l'entremise du comité composé de Ernie Seaquist (président), Peter Dewdney, Claude Carignan, Russ Taylor et Christine Wilson.

Observatoire fédéral d'astrophysique

En ce qui concerne l'OFA, nous allons donner priorité au partenariat Gemini avec la construction d'instruments et le développement de systèmes de gestion et d'archivage de données. Les ressources pour les autres projets, incluant le TCFH, dépendront de nos engagements au projet Gemini. Les télescopes de 1,8 et 1,2 m de l'OFA resteront ouverts tant que la demande des chercheurs universitaires restera forte, mais nous devons réduire notre support d'ici mars 1998. Les usagers devront donc faire plus par eux-mêmes et devront se contenter de changements d'instrument moins fréquents.

Observatoire fédéral de radio astrophysique

Le Relevé du Plan Galactique est déjà en cours à l'OFRA avec la participation active d'astronomes universitaires. Ils ont démontré leur engagement à ce projet en finançant une position d'associé de recherche à l'OFRA avec leurs octrois du CRSNG. L'observation des champs du Relevé continuera au moins jusqu'au mois de mars 1998. Le Relevé aura priorité sur les autres demandes de temps. Avant mars 1998, les pertes d'emploi seront minimisées, mais nous devons trouver un moyen d'opérer avec moins d'employés par après. Présentement, il n'y a aucun plan de fermeture de l'Observatoire. Les observations continueront tant que

arise. However, we must cease our work with planar arrays in collaboration with the University of Alberta.

Consolidation

Our Council reaffirmed its earlier decision to consolidate all of HIA's astronomy activities in British Columbia. Already I have moved to Victoria and the transfer of administrative services is beginning. Thus the essential question is whether to move the JCMT Group from Ottawa to Penticton, where we would establish a strong base for Canadian radio astronomy, or to Victoria, where we would begin to build a strong base for Canadian astronomy.

It is time for a clear decision. I have received all the relevant information and advice, and the financial pressures now make consolidation imperative. Soon the JCMT Group, with reduced staff, will be isolated in Ottawa. Several considerations affected my final proposal to NRC Management.

1. *It is very unlikely that any new major international radio facility which we might join will be at Penticton, because its latitude is too high for the desired sky coverage, and its altitude is too low for millimetre observations.*

2. *HIA cannot afford to operate multiple sites in the long term. Our budget cannot cover duplicate shops, libraries, administration, or computer maintenance.*

3. *HIA cannot afford a dispersed technical staff for development work. Although some expertise must be specialized for optical or radio instruments, there is much in digital electronics, cryogenics, software, and mechanical design which can be shared.*

The conclusion is that all of HIA eventually must be located in Victoria. Since we cannot justify moving staff twice, the JCMT Group will move to Victoria as soon as possible. The timing for individuals will depend on the schedule of instrument work, and the provision of space at DAO, but I do not anticipate anyone left in Ottawa past the summer of 1997. Sometime in the future, when accommodation permits, we also shall move the DRAO staff required for development work and retain in Penticton telescope operations staff as long as observing continues.

The Future

A major goal in this plan for HIA is to put us in a good position for the future in spite of the reduced resources. I believe that we shall do so by concentrating our efforts in one location. We soon shall have radio and optical astronomers working

les fonds seront disponibles et que la demande des usagers canadiens demeurera forte.

Télescope James Clerk Maxwell

La priorité du groupe d'Ottawa devra être la livraison, prévue pour février 1996, du récepteur B3 à Hawaii de même que les améliorations aux autres récepteurs comme le stipule son contrat avec le TJCM. Nous développerons le corrélateur MIDAS si le TJCM émet un contrat à cet effet, et si l'IHA a un plan pour le projet qui ne mettra pas en péril d'autres activités en cas de difficultés. Cependant, les travaux sur les réseaux plans entrepris en collaboration avec l'Université de l'Alberta cesseront.

Consolidation

Le Conseil a réaffirmé sa décision antérieure de rassembler toutes les activités astronomiques de l'IHA en Colombie-Britannique. J'ai déjà déménagé à Victoria, et le transfert des services administratifs est commencé. Une question essentielle se pose: doit-on déménager le groupe TJCM d'Ottawa à Penticton pour y établir une base solide pour la radio-astronomie canadienne, ou à Victoria où nous commencerions à établir une base solide pour l'astronomie canadienne?

Il est temps de prendre une décision. J'ai reçu toute l'information et les conseils pertinents, et les pressions financières rendent une telle consolidation inévitable. Le groupe TJCM, avec ses effectifs réduits, sera bientôt isolé à Ottawa. Plusieurs considérations ont influencé ma proposition finale à la direction du CNRC:

1. *Il est improbable que toute installation radio internationale à laquelle nous voudrions participer sera construite à Penticton. La latitude du site est trop élevée pour bien couvrir le ciel, et son altitude est trop basse pour des observations millimétriques.*

2. *L'IHA ne peut se permettre d'opérer plusieurs sites à long terme. Notre budget ne peut pas couvrir la duplication des ateliers, des bibliothèques, de l'administration ou de la gestion informatique.*

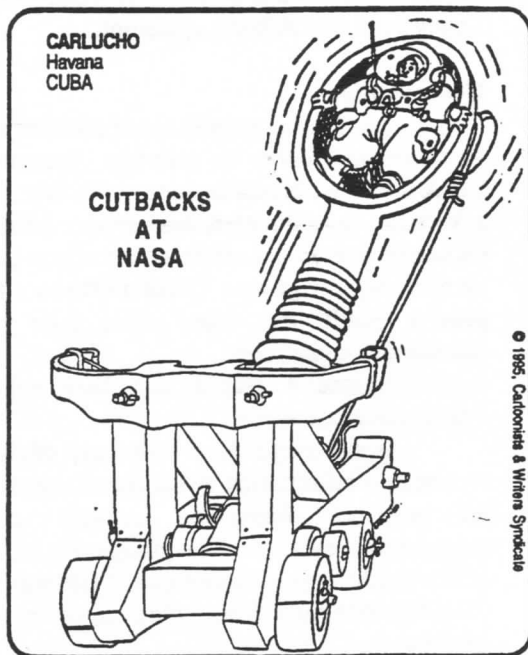
3. *L'IHA ne peut se permettre d'avoir son personnel technique aux quatre coins du pays pour les travaux de développement. Bien que certains secteurs soient propres aux instruments radios ou optiques, il y en a d'autres tels que l'électronique, les cryogènes, les logiciels et la conception mécanique qui peuvent très bien être partagés.*

La conclusion qui s'impose est que l'ensemble de l'IHA doit être déménagé à Victoria. Comme nous ne pouvons justifier de déménager le

together and eventually we shall have synthesis and submillimetre radio astronomers in the same building. We have much to learn from each other. There will be a pool of staff for development to work with scientists on specific projects, including potential new radio partnerships.

At the same time we shall investigate ways to involve young astronomers in our instrumentation projects in order to build future expertise at our universities.

Wit of the WORLD



CANADIAN USAGE OF THE JCMT

Canada owns a 25% share of the James Clerk Maxwell Telescope (JCMT), the world's largest and foremost sub-millimetre wavelength telescope, which is located near the summit of Mauna Kea. The members of CASCA may be very interested to know just how large an astronomical community in Canada the JCMT supports.

- During the 1995 observing season (Feb. 1995 - Jan. 1996), 65 proposals were submitted to the Canadian Time Allocation Group (CTAG), 30 in semester A (Feb-July) and 35 in semester B (Aug-Jan). This represents an overall oversubscription rate > 3 .
- These 65 proposals represented 81 different investigators (54 in sem. A, 52 in sem. B), of whom **44 were Canadian** (30 in sem. A, 36 in sem. B).
- There were 34 different P-Is (23 in sem. A, 28 in sem. B), of whom 29 were Canadian.

groupe TJCM à deux reprises, ce groupe déménagera à Victoria aussitôt que possible. Le déménagement de chaque employé dépendra de l'horaire des travaux d'instrumentation et de la disponibilité d'espaces de travail à l'OFA, mais j'anticipe qu'il n'y aura plus personne à Ottawa après l'été 1997. Le personnel de l'OFRA impliqué dans les travaux de développement sera éventuellement transféré, mais le personnel chargé des observations demeurera à Penticton tant que les observations se poursuivront.

Le futur

Le but principal de ce plan pour l'IHA est d'assurer un avenir prometteur en dépit de nos ressources réduites. Je crois que nous atteindrons ce but en concentrant tous nos efforts en un seul endroit. Nous aurons bientôt des astronomes des domaines optiques et radios travaillant ensemble dans le même édifice. Nous avons beaucoup à apprendre les uns des autres. Les travaux de développement bénéficieront d'une équipe technique qui travaillera avec les scientifiques sur des projets spécifiques tels que de nouveaux partenariats potentiels en radio-astronomie.

Nous devons aussi trouver des moyens d'impliquer les jeunes astronomes dans nos projets d'instrumentation pour assurer la relève dans nos universités.

Thus in 1995, ~20% of active Canadian astronomy researchers applied to use the JCMT. Furthermore, 34 of these 44 Canadian astronomers were successful in obtaining time on the telescope this year.

These statistics do not include *Service Observing* (CANSERV), which provides access to the telescope on a much less formal basis for projects generally requiring 4 hours or less. This program has been remarkably successful in providing telescope access and publishable observational data, especially for new users and students.

To be kept up-to-date on regular and CANSERV proposal deadlines, a JCMT e-mail exploder is available by subscription (send an e-mail message to redman@hiaras.hia.nrc.ca with name and affiliation). Telescope descriptions are available on the web at <http://www.jach.hawaii.edu> and <http://www.hia.nrc.ca>.

Help with proposals, etc., can be obtained by calling the Herzberg Institute of Astrophysics at (613)-993-6539.

Gerald Moriarty-Schieven,
Chair, JCMT-CTAG,
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CITA ANNUAL REPORT 1994 ICAT

Canadian Institute for Theoretical Astrophysics / Institut canadien d'astrophysique théorique

The following is an abbreviated version of the 1994 CITA Annual Report. Due to space constraints, we have not included more than a very brief summary of the scientific activities at CITA in 1994. The full report is available on request from citadmin@cita.utoronto.ca.

Foreword

The Canadian Institute for Theoretical Astrophysics is a nationally supported research centre for studies in theoretical astronomy and related subjects, hosted by the University of Toronto and receiving research support from an NSERC collaborative special project grant as well as the Canadian Institute for Advanced Research. CITA's primary missions are to foster interaction within the Canadian theoretical astrophysics community and to serve as an international centre of excellence for theoretical studies in astrophysics. In this report, we review the main activities at CITA during 1994. This report has been prepared by Robert Malaney and Matthew Holman.

Personnel Changes In 1993

Four new staff joined CITA in 1994: James Murray (Monash), Kevin Rauch (Caltech), John Tsai

(NASA Ames) and Matt Holman (MIT) were appointed research fellows. They joined research associates Robert Malaney, Glenn Starkman, and Chris Thompson and research fellows Brian Chaboyer, Jim Chiang, Andrew Jaffe, Man Hoi Lee, Janna Levin, Izumi Murakami, Rob Nelson, Christophe Pichon, Dmitri Pogosyan, Derek Richardson, Dave Syer, Seshadri Sridhar, and Jihad Touma. Dick Bond was Acting Director while Scott Tremaine was on leave with a Killam Fellowship, spending the summer and fall at Cambridge University.

A number of our research fellows left during the past year. Francis Bernardeau returned to France in October to take up a permanent position at the Service de Physique Théorique in Saclay. Arif Babul began an appointment as Assistant Professor in the Department of Physics at New York University. Scott Grossman became a postdoctoral fellow at Northwestern University. Man Hoi Lee went to Queen's University as a CITA National Fellow. Mike Nowak went to the University of Colorado for a postdoctoral fellowship. CIAR Scholar Glenn Starkman began an appointment as Assistant Professor in the Department of Physics at Case-Western University. Rien van de Weygaert took up a five-year research position at the Max Planck Institut für Astrophysik in Garching.

Faculty and research fellows have been involved in the supervision of six Ph.D. and two Masters students from the University of Toronto: K. King, S.-H. Kim, J. Wadsley, P. Wiegert from Astronomy, and Y. Lithwick, E. Poon, A. Sanderson and G. Squires from Physics. Two undergraduates, P. Barmby (UBC), and Andre Brown (Queen's), also conducted research at CITA during 1994.

Reinhardt Fellows were Chris Pritchett (Victoria) in spring 1994, Alan Coley (Dalhousie) and Denis Leahy (Calgary) in Fall 1994.

Although the bulk of the support for CITA's research staff comes from our NSERC Collaborative Special Program grant and from research grants to individual faculty members, support also came from NSERC Postdoctoral Fellowships (Chaboyer, Richardson), an NSERC International Fellowship (Murakami), a NATO SERC Fellowship (Syer) and from the Canadian Institute for Advanced Research (Starkman).

National Fellows 1993

A program started in 1988 solicits nominations from universities across Canada for "CITA National Fellows". These research fellows are jointly supported by CITA and the nominating university; although they work primarily at the nominating university, visits to CITA and collaboration with CITA staff are encouraged. CITA Council awards these fellowships using the same selection criteria as those for CITA research fellowships. The National Fellows in 1994 were:

- G. Hayward (Ph.D. University of Alberta), held at the University of Alberta (1992-1994)
- D. McManus (Ph.D. University of Alberta 1991), held at Dalhousie University (1994-1995)
- D. Salopek (Ph.D. University of Toronto 1989), held at University of Alberta (1993-1995)
- R. Sczerba (Ph.D. N. Copernicus Astronomical Centre 1991), held at the University of Calgary (1994-1996)
- X. Shi (Ph.D. University of Chicago 1994), held at Queen's University (1994-1996)

CITA Visitors

CITA has a vigorous visitors program bringing a number of Astronomy and Physics faculty members from other Canadian universities and from abroad for both extended stays and shorter visits.

Visitors to CITA in 1994 included:

- L. Bildsten, California Institute of Technology
- T. Broadhurst, Johns Hopkins University, Baltimore
- M. Butler, Saint Mary's University, Halifax
- Y. Cao, Caltech, Pasadena
- C.J. Clarke, Institute of Astronomy, Cambridge.
- S. Colombi, Fermilab Astrophysics Center
- P. Demarque, Yale University, New Haven
- P. Dewdney, DRAO, Penticton

- J. English, Queen's University, Kingston
- M. Fich, University of Waterloo, Waterloo
- N. Gnedin, Princeton / MIT.
- P. Goldreich, Caltech, Pasadena
- A. Gray, DRAO, Penticton
- R.N. Henriksen, Queen's University, Kingston.
- M. Heyer, FCRAO, Amherst
- L. Higgs, DRAO, Penticton
- G. Joncas, Laval University, Quebec City
- G. Kauffman, UC Berkeley
- T. Landecker, DRAO, Penticton
- D. Leahy, University of Calgary, Calgary
- D.N.C. Lin, Lick Observatory, UC Santa Cruz
- J. Narlikar, IUCAA, Pune, India
- R. Nityananda, Raman Research Institute, Bangalore
- M. Normandeau, University of Calgary, Calgary
- J. Peacock, Royal Observatory, Edinburgh
- S. Pineault, Laval University, Quebec City
- A. Pouquet, Observatoire de Nice, Nice
- C. Pritchett, University of Victoria, British Columbia
- C. Purton, JCMT, Hilo
- R. Pudritz, McMaster University, Hamilton
- G. Quinlan, University of California, Santa Cruz
- K. Ratnatunga, Johns Hopkins University, Baltimore
- C. Rogers, DRAO, Penticton
- D. Routledge, University of Alberta, Edmonton
- K. Schleich, University of British Columbia, Vancouver
- S. Selipsky, Yale University, New Haven
- D. Spergel, Princeton University
- J.F. Sygnet, Institut d'astrophysique de Paris
- A. Taylor, Queen Mary College, England
- A. R. Taylor, NRAO, Socorro
- J.P. Vader, Space Telescope Science Institute
- F. Vaneldik, University of Alberta, Edmonton
- J.C.L. Wang, JILA, University of Colorado
- R. Webster, University of Melbourne, Australia
- D. Witt, University of British Columbia, Vancouver
- L. Widrow, Queen's University, Kingston

CIAR and CITA

The Canadian Institute for Advanced Research (CIAR) supports a number of Programs chosen for the high intellectual promise and interdisciplinary character. The CIAR Cosmology Program has nodes at UBC (Director and Fellow Bill Unruh, Fellow Ian Affleck), at the University of Alberta (Fellows Valery Frolov, Werner Israel and Don Page) and at CITA (Fellows Dick Bond and Nick Kaiser). Glenn Starkman was a CIAR Scholar in 1994. The intellectual interaction between CIAR Fellows and other CITA visitors and researchers, and the administrative cooperation between CITA and CIAR in attracting excellent cosmologists, continues to make Toronto and Canada a lively place for research in theoretical cosmology.

Facilities

CITA occupies the 12th floor of the McLennan Physical Laboratories at the downtown campus of the University of Toronto.

CITA's primary compute servers are DEC Alpha AXP systems. In 1993 we used money from an NSERC equipment grant to purchase our first two AXP servers, a 32Mb 3000/400S and a 256Mb 3000/500S. The combined computational power of these two systems is approximately that of the entire SGI 4D/280 which had been our main compute server in previous years (and of which CITA held only a three-eighths share). The configuration provides us with one system for large-memory jobs, and another one for jobs with more modest memory requirements. In 1994 a pair of much larger AXP servers (two DEC 2100/A500MP systems with four CPUs each; 256 Mb in one system, 1024 Mb in the other) were acquired through an NSERC major equipment grant. CITA and CITA grantholders own a 50% share of these systems.

The computer servers are supplemented with a network of four AXP workstations, eleven Silicon Graphics Indigos and Personal IRISes, eight Sun SPARCstations, and approximately a dozen X terminals. The SGI systems are used to support research activity demanding 3--D scientific visualization. The disk capacity available to the network currently exceeds 40Gb.

Several Sun-3/50 workstations are still in service, now used primarily by short-term visitors and by students. We are planning to phase out our remaining Sun3s over the next year or two, replacing them with X terminals and/or more powerful workstations.

Other recent acquisitions include a Tektronix dye-sublimation colour printer, for producing high-quality colour prints and transparencies.

CITA Council

CITA is both an Institute within the School of Graduate Studies of the University of Toronto, and a non-profit corporation (CITA, Inc.). Relations between the two CITAs are governed by a Letter of Agreement between CITA Inc. and the University of Toronto that was signed in 1989. The CITA Council consists of seven members, five selected from the CITA Inc. membership of over 50 researchers in co-operation with the Canadian Astronomical Society (of which they must also be members), and two *ex officio*: the Director of CITA and the Dean of the School of Graduate Studies of the University of Toronto or his designate. Paul Gooch (Vice-Dean, School of Graduate Studies, University of Toronto) and Kim Innanen (York University), Chair of the Council, finished their terms on the Council during 1994. Members of CITA Council for the second half of 1994 were:

- Pierre Bastien, Université de Montréal
- Richard Bond, CITA Acting Director
- John Britton (Vice-Dean, School of Graduate Studies, University of Toronto)
- Dave Hartwick, University of Victoria
- R. Henriksen, Queen's University, Chair
- George Mitchell, St. Mary's University
- Lorne Nelson, Bishop's University

Conferences supported by CITA

CITA supports scientific workshops and meetings in Canada on subjects of interest to theoretical astrophysics. Meetings supported by CITA in 1994 were:

- "*Lake Louise Institute on Particle Physics and Cosmology*", February 20--26, organizer D. Page (Alberta).
- "*Lake Traverse Cosmology Workshop*", Algonquin Park, September 7--11, organizer L. Widrow (Queen's).
- "*Galactic Ecosystem Workshop*", University of Toronto, December 9--10, organizer P.G. Martin (CITA).

Scientific Accomplishments 1994

Research at CITA covers a broad range of fields in astrophysical theory. Here, we give a brief overview of the research activities in 1994.

Research in gravitation theory included work on the back reaction of vacuum polarization on a black hole spacetime, new analytic solutions of Einstein's equations for supermassive disks, and a rigorous analysis of the nonrelativistic limit for the General Relativistic equations for the gravitational instability of collisionless matter. Research in particle theory included an examination of the long-range interactions between heavy neutrinos, which may offer a solution to some current problems in large-scale structure if the new interaction mimics gravity. Further research in particle astrophysics included an analysis of gamma-ray data from the Pioneer Venus Orbiter at the time of Supernova 1987a to limit the parameters of neutrino radiative decay.

Research topics in cosmology ranged from the large scale structure to high redshifts, and gravitational lensing. Examples of studies of large scale structure dealt with the construction of CMB anisotropy maps of the kinetic Sunyaev-Zeldovich effect or moving cluster effect, development of efficient cosmological smooth particle hydrodynamical models, the influence of tidal fields on the evolution of galactic scale density peaks in primordial Gaussian random density fields, and the formation and evolution of large scale voids. Research on cosmology at high redshifts included a major book-length set of lecture notes by Dick Bond for the Les Houches series, entitled *Theory and Observations of the Cosmic Background Radiation*, an analysis of the two-year COBE *dmr* 53, 90, 31 GHz *a* and *b* and the *first* 170 GHz maps, a study of

the size of gravity-wave-induced CMB anisotropies and the use of COBE to normalize the density fluctuation spectrum, and studies of the effects of a dynamical Planck mass in inflationary models of the universe. Research on gravitational lensing included studies of the effects of three-dimensional distributions of point masses, development of techniques for measuring the distortion of background galaxies induced by weak gravitational lensing along with tests using deep multicolour images from the HST Medium Deep Survey, development of estimators for the surface density in clusters based on this background galaxy distortion, a new method for cluster lens reconstruction which is applicable in the strong lensing regime of giant arcs and arclets.

CITA members also worked on galaxies, the intergalactic medium, the interstellar medium, and active galactic nuclei. Examples of work on galaxies include the development of a spectral synthesis/stellar evolution code for the purpose of studying the evolution of an individual low-mass galaxy experiencing a short burst of star formation, two-dimensional hydrodynamical calculations to examine the interaction between the intracluster medium and hot gas of an elliptical galaxy moving in a rich cluster, and a study of surface photometry of dwarf galaxies in the field. Work on interstellar and intergalactic media included a theoretical determination of the cross sections for collisional excitation and dissociation of H_2 colliding with H_2 , use of the Faint Object Spectrograph of the Hubble Space Telescope to observe interstellar linear polarization from 1300 to 3300 Å, a determination of the size distribution of polarizing dust grains based on the wavelength dependence of interstellar linear polarization from the infrared to vacuum ultraviolet, work on a planned survey of the Galactic Plane in HI and radio continuum at 1 arc minute resolution with the DRAO synthesis telescope, and a continuation of research on turbulence in the ionized interstellar medium. Other CITA research in these areas included characterizing the newly discovered class of gamma-ray loud Active Galactic Nuclei observed by the *EGRET* experiment aboard the *Compton Gamma-Ray Observatory*, and extensive modeling of Broad Absorption Line (BAL) QSOs.

Several CITA members worked in the fields of galactic and stellar dynamics. This work included an investigation of the nature and excitation mechanism of warps seen in edge-on disk galaxies, and analysis and modeling of high-resolution images of the centres of elliptical galaxies and spiral bulges by the *Hubble Space Telescope* (HST) to yield insights into galaxy structure and formation and to search for evidence of massive black holes in galactic nuclei.

There has been considerable work at CITA in the study of stellar physics, nucleosynthesis, compact objects, and gamma-ray bursts. In particular, CITA members have

carried out a comparison of theoretical models of stellar evolution, nucleosynthesis, and dredge-up with accurate oxygen-isotope measurements from interstellar grains isolated from meteorites.

They have performed a detailed study of possible sources of error in the absolute ages of globular clusters constructed from light element (6Li , 7Li and 9Be) depleted isochrones for halo stars with standard stellar evolution models, completed a detailed study of the effects of rotation, diffusion and overshoot on solar and stellar models, derived the local mixing length theory of convection in a fluid with a composition gradient, and investigated the recent observations of the $^7Li/^6Li$ ratio in the ISM.

Work on compact objects included a study of accretion dynamics and emergent spectra of X-ray pulsars accreting at low luminosity, examination of the role of hydrodynamic turbulence in generating the observed X-ray variability in the so-called "high states" of black hole candidates, and development of models of high energy emission from rotation-powered pulsars. In the field of gamma-ray bursts, CITA researchers have predicted a new class of very-strongly magnetized neutron stars with $B_{dipole} > 10^{14}$ G which are born with spin periods in the millisecond range.

CITA researchers have also been active in studies of solar system formation, evolution, and dynamics. Work in this field has included an examination of the long-term dynamics of the orbit and rotation of the Moon. Other work has focused on the modeling of the growth of dust grains, and planetesimals with the coagulation equation and with an N-body model extended to include multiple collisions for examining the fractal aggregation of dust particles. Finally, the dynamics of cometary objects in the solar system has received much attention. A collaboration has been started to trace the clumping of fragments of comet Shoemaker-Levy 9's final orbit. Scott Tremaine with M. Irwin, A. Zytzkow (Cambridge) and R. Webster (Melbourne) discovered two Kuiper belt objects, 1994 JQ and 1994 JR1, at the Isaac Newton Telescope in La Palma. Analysis of the brightness and distance distribution of slow-moving objects, including both Kuiper belt objects and Centaurs (objects orbiting between Jupiter and Neptune) has been completed. Also, an investigation of the evolution of long-period comets, using a program that follows the evolution of comet orbits in the combined gravitational field of the Sun, the giant planets, and the Galactic tide is underway.

Robert Malaney

Matthew Holman



This issue we publish abstracts from the theses of all nominees for this year's Plaskett Medal. They are led by the winner, *Michael Richer*. The remainder follow in alphabetical order.

Planetary Nebulae: Their Use as a Tool to Probe the Evolution of Galaxies

Michael Gerard Richer

Centre for Research in Earth and Space Science

York University

Ph. D., 1994

Abstract

The properties of bright planetary nebulae in the Magellanic Clouds and the Milky Way were investigated to determine whether bright planetary nebulae are suitable as oxygen abundance probes for chemical evolution studies, particularly in galaxies without current star formation. It was found that bright planetary nebulae do not modify their initial oxygen abundance, that the central star's ultraviolet luminosity is the most important factor affecting the nebular [O III] $\lambda 5007$ luminosity, and that the maximum [O III] $\lambda 5007$ luminosity attained increases with increasing oxygen abundance. Consequently, a luminosity-based selection will preferentially select oxygen-rich planetary nebulae, a bias that makes bright planetary nebulae particularly suitable probes for

chemical evolution studies in star-forming galaxies. Theoretical models were used to investigate whether this circumstance persists in galaxies where star formation stopped long ago. These models predict luminosity functions for all galaxies and abundance distributions for the Magellanic Clouds that are similar to those observed. In all galaxies, these models predict that a gap develops between the abundances observed in bright planetary nebulae and those that persisted in the interstellar medium when star formation stopped. This abundance gap is a function of the oxygen abundance achieved in the interstellar medium when star formation stopped, rather than of the model details, and is always less than 0.5 dex. For the Milky Way, the predicted abundance gap, 0.14 dex, is identical to that observed.

Oxygen abundances for planetary nebulae were used to investigate whether diffuse elliptical and dwarf irregular galaxies are related by evolution. Diffuse ellipticals are found to have larger oxygen abundances than similarly luminous dwarf irregulars, and to have larger [O/Fe] ratios than dwarf irregulars with the same oxygen abundance. The simplest explanation for both of these observations is that diffuse ellipticals formed on shorter time scales than dwarf irregulars. Given their different star formation histories, diffuse ellipticals cannot be the faded remnants of dwarf irregulars.

Since extragalactic planetary nebulae are faint, two methods were developed to determine empirical oxygen abundances. These methods are based upon the observations that the maximum [O III] λ 5007 luminosity and the maximum [O III] λ 5007/H β ratio both increase with increasing oxygen abundance.

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Recherche et analyse de galaxies brillantes en excès en ultraviolet

Roger Coziol

Département de physique, Université de Montréal

Ph.D. 1994

Sommaire

Dans ce travail, nous décrivons et présentons les résultats du sondage *Montreal Blue Galaxy* (MBG) visant la recherche de galaxies émettant en excès en ultraviolet. Cette recherche utilise le matériel photographique du sondage MCT (Montreal-Cambridge-Tololo) qui par son étendue correspond à un des plus importants sondages de l'hémisphère austral. Le sondage MBG est présentement le seul dans cet hémisphère à employer la technique de poses multiples pour la sélection de ses candidats. Grâce à cette technique, nous avons l'occasion d'étudier un échantillon de galaxies ayant des caractéristiques quelque peu différentes de celles des échantillons analysés auparavant.

Deux phénomènes peuvent expliquer l'excès d'ultraviolet observé dans ces galaxies. Le premier suppose la présence dans leur noyau d'un trou noir massif. Toutes les galaxies sujettes à ce type d'activité sont regroupées sous le nom de galaxies avec noyau actif (AGN). Le deuxième phénomène est relié à une période de formation intense d'étoiles, ou sursaut de formation d'étoiles ("starburst"). L'excès d'ultraviolet trahit ici la présence d'un grand nombre d'étoiles massives récemment créées au sein de ces galaxies. En plus d'augmenter le nombre d'AGN connues, les sondages de galaxies brillantes en ultraviolet permettent aussi d'approfondir les questions spécifiques suivantes: combien y a-t'il de galaxies starbursts différentes? Quelle est l'origine possible de leur activité? Quel est le rôle des sursauts de formation d'étoiles dans la vie d'une galaxie? Quel est le lien entre les galaxies starbursts et les AGN?

L'analyse de notre échantillon de galaxies se fait par l'entremise de plusieurs méthodes. La première consiste à obtenir des spectres optiques de nos candidats. L'étude de ces spectres nous permet de distinguer entre les AGN et les galaxies starbursts et de déduire plusieurs paramètres

physiques importants. Notre deuxième méthode consiste à obtenir des images. Ceci nous permet d'avoir une idée de la morphologie des galaxies et ainsi de comprendre les phénomènes sous-jacents aux sursauts de formation d'étoiles. En plus de la forme et des dimensions, une analyse des images prises sous différents filtres nous permet d'étudier les différentes populations stellaires présentes et d'en comprendre l'évolution. La troisième méthode employée pour notre étude utilise les informations en infrarouge du satellite américain IRAS. Ces données nous renseignent sur la quantité et l'état de la poussière associée à l'activité de ces galaxies.

Les résultats faisant l'objet de cette thèse portent sur 40% du sondage total. L'échantillon étudié compte 332 galaxies, dont 60 ont été observées en spectroscopie et 15 analysées en imagerie. Les AGN ne constituent que 5% des galaxies de notre échantillon. La majorité de nos candidats sont des galaxies starbursts. Leur caractéristique principale est que le sursaut de formation d'étoiles est principalement localisé dans la région de leur noyau. La majorité des galaxies starbursts de notre échantillon ont une morphologie de type spirale précoce et contiennent des populations stellaires relativement évoluées. Plusieurs indices suggèrent que les sursauts de formation d'étoiles sont reliés à une accréation relativement récente de matière provenant soit de leur environnement soit de l'interaction avec d'autres galaxies. Les sursauts de formation d'étoiles peuvent être de longue durée (de l'ordre de 10^9 années) ou peuvent se produire en cascades. Ces résultats semblent typiques des galaxies avec sursauts de formation d'étoiles dans le noyau. L'importance du phénomène laisse penser qu'il s'agit d'une phase majeure dans l'évolution de ces galaxies.

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The Circumstellar Dust Shells of Proto-Planetary Nebulae

Phillip P. Langill

Department of Physics and Astronomy, University of Calgary

Ph.D. 1994

Abstract

The circumstellar dust shells of Proto-Planetary Nebulae (PPNe) have been investigated both observationally and theoretically. Twenty PPNe candidates were selected based on their *IRAS* colours and lack of variability. They were observed in the optical, near- and mid-infrared wavelengths. These ground-based observations, combined with the *IRAS* data, show the archetypal double-peaked flux distributions. Models of these distributions confirm that large scale AGB mass loss has terminated.

Optical images of these PPNe were obtained with the CFHT/DAO High Resolution Camera. The optical counterpart of four (and possibly six) previously unseen PPNe have been identified. The dust shells of eight PPNe were discovered via a point spread function analysis. Four of these possess spherical symmetry and four possess elliptical (and possibly bipolar) symmetry. The dust shells of two PPNe, IRAS 17150-3224 and IRAS 17441-2411, are bipolar as seen in their direct images. Hence, the majority of PPNe dust shells are nonspherical. Assuming the morphology reflects the mass loss history of the progenitor star, a wide variety of AGB mass loss phenomena were detected including precession, multiple mass loss episodes, and the formation of ansae. No correlation is found between dust shell morphology and chemical composition.

A two-dimensional radiative transfer model has been developed which utilizes the dust temperature radial profiles of two spherically symmetric detached dust shells, as calculated self-consistently with a one-dimensional model. Pertinent dust temperatures and optical depths within the asymmetric dust shell are derived from known values along perpendicular axes. The model is

useful for examining the expected changes in morphology and flux distribution with orientation and in morphology with wavelength.

The flux distributions and the bipolar morphology of 17150-3224 and 17441-2411 have been studied with this 2-D model. Results show their orientations in the plane of the sky are 80° and 60° respectively. The inner radius of their dust shells are both 0.0015 pc which, using their CO expansion velocities, suggests large scale mass loss ended in these objects ~ 100 years ago.

Images of IRAS 09371+1212 show this high galactic latitude bipolar nebula is surrounded by a faint spherical halo $\sim 30''$ in diameter. Multi-wavelength observations indicate a precessing disk has regulated the diametric polar outflow.

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The Structure of the Outer Atmosphere of Cool Stars

Christopher Ian Short

Department of Astronomy, University of Toronto

Ph.D. 1995

Abstract

Models of the K2 III star Arcturus computed with the latest model atmosphere code and line lists, those of ATLAS9, and with the latest values for the stellar parameters predict twice as much flux in the violet and near ultra-violet spectral regions as is observed. The models also predict line profiles in these regions that are much too strong. The addition of an approximately gray continuous absorption opacity in this spectral region that is approximately equal to that which is already included in ATLAS9 and that has the same depth distribution as $n\text{H}$ eliminates both the flux and the line profile discrepancy. A comparison of the violet spectrum of Arcturus with that of other K2 III standard stars indicates that this additional opacity is a general feature of early K giants. Although we have not identified this hitherto undiscovered source of opacity, we present evidence that it is molecular in origin.

The addition of this continuous opacity in the violet spectral region decreases the relative strength of the predicted Ca II K line. We present a chromospheric model of Arcturus based on this line with the additional opacity included. The value of T_{\min} in this model is 300 K lower and lies at a column mass density that is almost an order of magnitude smaller than that of the only other chromospheric model of Arcturus in the literature. As a result, proposed chromospheric heating mechanisms and thermally bifurcated models of Arcturus need to be re-considered.

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Infrared Rydberg Transitions in B Stars

Thomas Allan Aaron Sigut,

Department of Astronomy, University of Toronto

Ph.D. 1995

Abstract

The infrared solar spectrum exhibits emission lines near 12 μm from the high- l Mg I Rydberg transitions $6g - 7h$ and $6h - 7i$. Chang et al. (1991) demonstrated that the emission arises from small deviations in the populations of these Rydberg levels from their thermodynamic equilibrium values. In this thesis, the possible operation of this emission mechanism is investigated in the B stars by performing non-LTE radiative transfer calculations for the high- l Rydberg transitions of Mg II and O I.

Highly realistic atomic models are employed, complete in energy levels and radiative transitions far into the Rydberg regime. For MgII, the electron collisional excitation rates are improved by computing collision strengths in a 10 state close-coupling approximation using the R -matrix method. The collisional excitation rates derived from these collision strengths include the full effects of autoionizing resonances and have an expected accuracy of $\pm 10\%$ for transitions between levels lying low in energy in the close-coupling expansion.

For MgII, wide-ranging infrared emission is found, spanning the entire range of B spectral types. The emission is caused by the same mechanism operative in the Rydberg levels of MgI in the sun. Small divergences between the Rydberg departure coefficients produce rising monochromatic source functions and emission. Flux profiles of the MgII high- l ($\Delta n = +1$) transitions from $n=4$ and 5 show an emission peak superposed on a wider absorption trough, similar in form to the solar Mg I lines, while for higher n , the profiles are in full emission. The strongest emission is predicted for transitions from $n = 5, 6,$ and 7 and strongly increases for lower surface gravities where the rates of thermalizing collisions are lower. The emission strengths reach maxima of $F_\lambda/F_c \sim 1.15$ and $W_\lambda \sim -0.1\text{\AA}$. Transitions from higher n exhibit progressively lower continuum contrasts due to the steep rise with wavelength of the continuous opacity in the infrared and increased Stark broadening. The largest source of potential uncertainty affecting the emission strengths is the uncertain scale of the collisional excitation rates between the Rydberg levels. However, reasonable variation of these rates does not eliminate the emission.

Although small divergences occur between the Rydberg departure coefficients of O I, wide-ranging infrared emission is not predicted. Only small self-reversals in the cores of the high- l transitions from $n = 4$ and 5 are seen and then only at the lowest surface gravities. The failure of O I to produce significant emission, or more precisely, significant Rydberg population divergences, can be attributed to the lack of strong ultraviolet photoionization rates from its lower energy levels, the increased collisional coupling between its more closely spaced Rydberg levels, and the longer wavelengths of its Rydberg transitions. Considerable uncertainty exists in the prediction of the absolute infrared line strengths of O I due to uncertainty in the exact treatment of radiative transfer in the resonance line and in the magnitude of the collisional excitation rates among the Rydberg levels. However, these uncertainties do not alter the basic conclusion of no significant emission from the high- l Rydberg transitions of O I in B stars.

xxxxxxxx5555555xxxxxxxx

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AUDITORS' REPORT

To the Members
of
CANADIAN ASTRONOMICAL SOCIETY

We have audited the balance sheet of the Canadian Astronomical Society as at March 31, 1995, and the statement of income and operating surplus for the year then ended. These financial statements are the responsibility of the management. Our responsibility is to express an opinion on these financial statements.

Except as explained in the following paragraph, we conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatements. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management as well as evaluating the overall financial statement presentation.

In common with many non profit organizations, the organization derives revenue from membership fees, the completeness of which is not susceptible of satisfactory audit verification. Accordingly, our verification of these revenues was limited to the amounts recorded in the records of the organization and we were not able to determine whether any adjustments might be necessary to membership fee revenue, excess of revenues over expense, assets and operating surplus.

In our opinion, except for the effect of adjustments, if any, which we might have determined to be necessary had we been able to satisfy ourselves concerning the completeness of the membership fees referred to in the preceding paragraph, these financial statements present fairly, in all material respects, the financial position of the Canadian Astronomical Society as at March 31, 1995, and the results of its operations for the year then ended in accordance with generally accepted accounting principles.

Tinkham & Associates

TORONTO, Ontario
May 5, 1995

CHARTERED ACCOUNTANTS

**CANADIAN ASTRONOMICAL SOCIETY
BALANCE SHEET
AS AT MARCH 31, 1995**

	1995	1994
ASSETS		
CURRENT		
Cash	\$ 3,328	\$ 20,504
Investments	47,200	27,200
Interest receivable	1,712	679
Prepaid expenses	<u>600</u>	<u>-</u>
	<u>52,840</u>	<u>48,383</u>
CAPITAL	<u>2,470</u>	<u>-</u>
	<u>\$ 55,310</u>	<u>\$ 48,383</u>

LIABILITIES and OPERATING SURPLUS

CURRENT		
Accounts payable	\$ <u>460</u>	\$ <u>451</u>
OPERATING SURPLUS	<u>54,850</u>	<u>47,932</u>
	<u>\$ 55,310</u>	<u>\$ 48,383</u>

On behalf of the Board:

Accounting policies - Note 1

W. E. H. H. H. Board Member

Christine Clemat Board Member

Tinkham & Associates

**CANADIAN ASTRONOMICAL SOCIETY
STATEMENT OF INCOME AND OPERATING SURPLUS
FOR THE YEAR ENDED MARCH 31, 1995**

	1995	1994
REVENUE		
Membership fees	\$ 17,510	\$ 12,127
Interest income	2,344	1,643
Miscellaneous revenue	<u>207</u>	<u>-</u>
	<u>20,061</u>	<u>13,770</u>
EXPENSE		
Lecture and awards		
Petrie lecture	-	1,733
Beals award	<u>1,000</u>	<u>-</u>
	<u>1,000</u>	<u>1,733</u>
Office and General		
Astronomical Society of the Pacific	-	928
Amortization	436	-
Donations	2,874	4,665
Newsletter	5,972	6,163
Office expense	75	-
Office-treasurer	604	490
Office-secretary	1,454	2,124
Office-salary	300	-
Publication costs	-	861
Professional	<u>428</u>	<u>526</u>
	<u>12,143</u>	<u>15,757</u>
	<u>13,143</u>	<u>17,490</u>
EXCESS OF REVENUE OVER EXPENSE (EXPENSE OVER REVENUE) FOR THE YEAR	6,918	(3,720)
OPERATING SURPLUS, April 1	<u>47,932</u>	<u>51,652</u>
OPERATING SURPLUS, March 31	<u>\$ 54,850</u>	<u>\$ 47,932</u>

Tinkham & Associates

**CANADIAN ASTRONOMICAL SOCIETY
NOTES TO FINANCIAL STATEMENTS
MARCH 31, 1995**

NOTE 1 SIGNIFICANT ACCOUNTING POLICIES

(a) Revenue and expense recognition

Membership fees and contributions are recorded when received.

(b) Capital assets

Capital assets are recorded at cost and amortized on a declining balance basis at 30%.

NOTE 2 ORGANIZATION

The Canadian Astronomical Society is a non-profit organization incorporated without share capital for the purpose of promoting public awareness of science in Canada.

NOTE 3 CAPITAL ASSETS

Capital assets comprise:

	1995		
	Cost	Accumulated Amortization	Net Book Value
Computer equipment	\$ <u>2,906</u>	\$ <u>436</u>	\$ <u>2,470</u>

NOTE 4 STATEMENT OF CHANGE IN FINANCIAL POSITION

A statement of changes in financial position has not been provided because all the information is available to management and the statement will not add meaningful information to these financial statements.

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CHARTERED ACCOUNTANTS

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AUDITORS' REPORT

To the Trustees
of
CASCATRUST

We have audited the balance sheet of the Cascatrust as at March 31, 1995, and the statement of income and operating surplus for the year then ended. These financial statements are the responsibility of the management. Our responsibility is to express an opinion on these financial statements.

Except as explained in the following paragraph, we have conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

In common with many charitable organizations, the organization derives revenue from donations the completeness of which is not susceptible of satisfactory audit verification. Accordingly, our verification of these revenues was limited to the amounts recorded in the records of the organization and we were not able to determine whether any adjustments might be necessary to donation revenues, excess of expense over revenue, assets and operating surplus.

In our opinion, these financial statements present fairly, in all material respects, the financial position of the Cascatrust as at March 31, 1995, and the results of its operations for the year then ended in accordance with generally accepted accounting principles.

TORONTO, Ontario
April 20, 1995

Tinkham & Associates

CHARTERED ACCOUNTANTS

**CASCATRUST
BALANCE SHEET
AS AT MARCH 31, 1995**

	1995	1994
ASSETS		
CURRENT		
Cash	\$ 572	\$ 2,514
Investments	6,000	1,000
Interest receivable	<u>204</u>	<u>34</u>
	<u>6,776</u>	<u>3,548</u>
LONG TERM		
Restricted funds (Note 1)	<u>2,100</u>	<u>100</u>
	<u>\$ 8,876</u>	<u>\$ 3,648</u>

LIABILITIES and OPERATING SURPLUS

CURRENT		
Accounts payable	\$ <u>300</u>	\$ <u>200</u>
OPERATING SURPLUS	<u>8,576</u>	<u>3,448</u>
	<u>\$ 8,876</u>	<u>\$ 3,648</u>

On behalf of the Trustees:

Christie Clement Trustee
Mike Dawson INCOMING Trustee

Tinkham & Associates

**CASCATRUST
STATEMENT OF INCOME AND OPERATING SURPLUS
FOR THE YEAR ENDED MARCH 31, 1995**

	1995	1994
REVENUE		
Donations	\$ 10,879	\$ 5,713
Interest income	<u>239</u>	<u>65</u>
	<u>11,118</u>	<u>5,778</u>
EXPENSE		
Lectures, awards and grants		
Plaskett medal	760	761
Hogg lecture	1,621	1,323
Educational materials	720	-
FSU Small travel grants program	1,528	-
Universe in the classroom	<u>945</u>	<u>-</u>
	<u>5,574</u>	<u>2,084</u>
Operating expense		
Bank charges	24	1
Courier charges	24	-
Printing costs	-	127
Professional	<u>368</u>	<u>214</u>
	<u>416</u>	<u>342</u>
	<u>5,990</u>	<u>2,426</u>
EXCESS OF REVENUE OVER EXPENSE FOR THE YEAR	5,128	3,352
OPERATING SURPLUS, April 1	<u>3,448</u>	<u>96</u>
OPERATING SURPLUS, March 31	<u>\$ 8,576</u>	<u>\$ 3,448</u>

Tinkham & Associates

**CASCATRUST
NOTES TO FINANCIAL STATEMENTS
MARCH 31, 1995**

NOTE 1 RESTRICTED FUNDS

Restricted funds comprise:

	1995	1994
Cash	\$ 100	\$ 100
GIC	<u>2,000</u>	<u>-</u>
	<u>\$ 2,100</u>	<u>\$ 100</u>

The gifts of cash and GIC's are restricted for a period of ten years commencing in 1993 and 1994 respectively.

NOTE 2 ORGANIZATION

The Cascatruster is a charitable trust without share capital constituted for the purpose of advancement of education in astronomy and is a registered charity for income tax purposes.

NOTE 3 STATEMENT OF CHANGES IN FINANCIAL POSITION

A statement of changes in financial position has not been provided because all the information is available to management and the statement will not add meaningful information to these financial statements.

Tinkham & Associates

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- Baan, W.A., Irwin, J.A. *The nuclear structure of NGC 3079*. Queen's. 11-Apr-1995
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- Woods, D., Fahlman, G.G., Richer, H.B. *Counting pairs of faint galaxies.* UBC. 31-Mar-1995

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