

**National Research Council of Canada**  
**Herzberg Institute of Astrophysics**  
**Office of the Director General**  
5071 West Saanich Road, Victoria, BC, Canada V8X 4M6

This report covers the period from 1 April 1995 through 31 March 1996.

### 1. MANDATE

The National Research Council (NRC) has the Parliamentary mandate to operate and administer any astronomical observatories established by the Government of Canada. NRC exercises this mandate through its Herzberg Institute of Astrophysics, which provides astronomical facilities, research, and infrastructure to university scientists and their students.

### 2. HIGHLIGHTS

HIA has seen several major changes over the past two years, including the transfer of the Molecular Spectroscopy Group within NRC to the Steacie Institute of Molecular Sciences, the phasing out of the Solar Terrestrial Physics Group and all activity in space physics, and the move of the Director General from Ottawa to the Dominion Astrophysical Observatory (DAO) in Victoria. We also initiated the relocation of the central administration and the group supporting our participation in the James Clerk Maxwell Telescope (JCMT) to DAO in order to economize by consolidating all HIA activities in British Columbia. The year of this report began with a significant reduction in government funds to NRC and hence to HIA.

Nevertheless we still see a promising future for astronomy in Canada. The Canada-France-Hawaii Telescope (CFHT) and the JCMT are performing exceptionally well, the Dominion Radio Astrophysical Observatory (DRAO) has begun a survey of the Galactic Plane, we are actively involved in the Gemini 8-m telescopes, and we are investigating options for participation in a future international radio facility in case capital funds become available in the future.

### 3. STAFF CHANGES

During the reporting year our Manager of Operations, Michael Storr, and one technical officer, Jerry Sebesta, moved to Victoria from Ottawa. In addition, Christine Cunningham, Michael Albert and Susan Firestone joined the administrative staff of HIA from other parts of NRC, while Tamara Starheim resigned. In Ottawa, Mary Saver, the long-serving Secretary to the Director General, retired, while Donnia Grundy and Carolyn Tidd of the administrative staff found other positions in NRC.

### 4. RESEARCH

Morton has continued his investigations of interstellar absorption lines with colleagues from the University of Chicago. Using the HST they reported the second detection of interstellar Pb II towards 1 Sco. The abundance is similar to that derived by Cardelli and colleagues in 1993 for  $\zeta$  Oph. In both cases the depletion is greater than expected for the con-

densation temperature. Welty, Morton and Hobbs studied Ca II absorption in 417 components towards 44 stars at resolutions of 0.3 and 1.2 km/s with the Ultra High Resolution Facility on the AAT and the coudé feed at KPNO. They found that on average the Ca II lines were wider than the corresponding Na I lines, implying that Ca II occupies a larger volume characterized by a higher temperature or turbulent velocity or both.

### 5. CANADIAN GEMINI PROJECT OFFICE

The Canadian Gemini Project Office, led by Andrew W. Woodsworth, is a joint activity of NRC's Herzberg Institute of Astrophysics and the University of British Columbia. Staff members include G.A.H. Walker and T.J. Davidge of UBC as long-term Guest Workers, and G.A. Herriot of HIA.

The CGPO maintains a liaison between the Gemini 8-m Telescopes Project and the Canadian scientific and industrial communities. It also has overall management responsibilities for Gemini work being done within HIA labs. This work includes the Multi-Object Spectrographs (jointly with the United Kingdom), the Data Handling System, the Enclosure Control System, and the Adaptive Optics System. These are reported on in the DAO section of this report.

The Canadian Gemini Science Steering Committee met on 30 May 1995 to discuss the plans for Gemini operations, and how the CGPO would evolve during the transition from construction to operations.

Davidge and collaborators continued to pursue their long term program of deep near-infrared photometric measurements of globular clusters. The goal of this program is to gain insight into the early star-forming history of the inner Galaxy. During this period data were reduced for the clusters M22, M28, and NGC288. M28 is of particular interest because it is moderately metal-poor and is located at small Galactic radii. Based on the K, J-K colour-magnitude diagram it appears that M28 is at least as old as NGC288, which is one of the oldest halo clusters.

Working in collaboration with Sohn (Yonsei University and DAO), Davidge investigated the luminous stellar content of the nearby spiral galaxy NGC628. Based on the brightnesses of red supergiants, they derived a distance modulus of 29.3 for this galaxy.

Working in collaboration with Hutchings, Davidge investigated the nature of the compact faint galaxies detected by Dressler *et al.* (1993, ApJ, 405, L45) near the  $z=2$  QSO in the field of the  $z=0.4$  cluster Abell 851. The data used in this analysis include deep J and K images obtained with the CFHT, and archival HST WFPC2 images. Comparisons with GISSEL models indicate that these objects must be dominated by young populations, a result that is very insensitive to their redshifts.

Woodsworth completed his study of the H-alpha emission

line profiles of S-type Mira stars. In contrast to the more common M-type Miras, the S-types show highly repeatable variability which can be modelled as the sum of three components. The velocity of one of these components matches that of the H-beta and H-gamma emission.

## 6. FUTURE RADIO TELESCOPES

Peter E. Dewdney is the Coordinator of Future Radio Telescope Initiatives for the Herzberg Institute of Astrophysics. He is assisted by B.G. Veidt who arrived in March 1996. Both are based at the Dominion Radio Astrophysical Observatory (DRAO).

Dewdney is a member of the NRC Planning Committee for a New National Radio Astronomy Facility, of which E.R. Seaquist (University of Toronto) is the chairperson. This committee has completed a draft of a major report: "Canadian Radio Astronomy in the 21st Century – The Challenge" which was circulated to the Canadian Astronomical Society (CASCA). As part of the preparation of the draft report, Veidt carried out an evaluation of the capabilities of Canadian industry and universities which could be relevant to either a future mm and submm telescope or to a very large dm and cm telescope.

As its highest long-term priority, the draft report recommends adopting the Square Kilometer Array (SKA) as the next generation radio telescope for which Canada would provide national facility support within an international collaboration. An international technical collaboration is developing which will carry out feasibility studies for various methods of implementation for the SKA.

As its highest near-term priority, the draft report recommends that NRC take a leading technical role in linking the James Clerk Maxwell Telescope to the forthcoming Submillimeter Array, a project of the Smithsonian Astrophysical Observatory.

A practical implementation of the SKA will require considerable technical research, because sufficiently inexpensive collecting area cannot be constructed using standard techniques. A potential solution to this problem, proposed by

T.H. Legg of the Herzberg Institute, has been called the Large Adaptive Reflector (LAR). The LAR is a long focal-length parabolic reflector which requires an air-borne platform, the key technology required to implement this idea, to support the focal receiver. The promise of this technique is to allow the construction of very large antennas at a relatively low cost per unit of collecting area. An array of LAR's might be used to build the SKA.

## PUBLICATIONS

- Davidge, T. J. 1995, Near-Infrared Photometry of the Core-Collapsed Metal-Poor Globular Clusters NGC 5946 and NGC 7099, *AJ*, 110, 1177-1185.
- Davidge, T. J., and Grindler, M. 1995, Stellar Population Gradients in Bright Cluster Galaxies at  $z=0.2$ , *AJ*, 109, 1433-1450.
- Davidge, T.J. and Harris, W.E. 1995, Deep Infrared Array Photometry of Globular Clusters. III. M13, *ApJ*, 445, 211-220, Erratum *ApJ*, 454, 545.
- Davidge, T.J. and Harris, W.E. 1996, Deep Infrared Array Imaging of Globular Clusters. IV. M22 (NGC 6656), *ApJ*, 462, 255-265.
- Welty, D.E., Hobbs, L.M., Lauroesch, J.T., Morton, D.C. and York, D.G. 1995, Interstellar Lead, *ApJ*, 449, L135-L138.
- Woodsworth, A.W. 1995, Evolution of  $H\alpha$  Emission Profiles in S-Type Mira Stars, *ApJ*, 444, 396-404.

## SPECIAL REPORTS

- Carignan, C., Dewdney, P. E., Taylor, A. R., Seaquist, E., and Wilson, C. 1995, A New National facility for Radio Astronomy: A preliminary Report of the NRC Planning Committee.
- Carignan, C., Dewdney, P. E., Taylor, A. R., Seaquist, E., and Wilson, C. 1996, Canadian Radio Astronomy in the 21st Century – The Challenge: The Second Report of the NRC Planning Committee for a New National Facility for Radio Astronomy.

Donald C. Morton, Director General