obstruction from reaching the detector. The combined effect of the cone and the undersizing of the secondary is that the detector can "see" only the sky (as reflected by the two mirrors and the cone) - it cannot see any part of the dome or any non-reflective part of the telescope.

3) The secondary mirror is coated with silver (protected by SiO₂), for which ε = 1-2% for aluminum ε = 3-4%.

4) The instruments are all "up-looking"; i.e. there is no folding optics (e.g. dichroic beamsplitter) between the instrument and the secondary mirror. In fact for the photometers, there are only three warm optical elements - the cryostat window and the two telescope mirrors.

Recently we measured ε for the CFHT at λ = 3.8 μm using the InSb photometer and the following procedure. We first measured the background flux from the sky, F₁, by allowing the photometer to look directly out through the slit of the dome. We then attached the photometer to the telescope and measured the flux with the mirror covers open, F₂, and then with them closed, F₃. The emissivity of the telescope is obtained from the expression

\[ \varepsilon = \frac{F₂ - F₁}{F₃}. \]

The result was 11%, which is very good. In fact it is not significantly greater than the values obtained for dedicated infrared telescopes such as the UKIRT and NASA IRTF. The lowest reported value of which the writer is aware is 8%. This means that for observations in the thermal infrared, CFHT is competitive in sensitivity with any other ground-based telescope of similar size. Coupled with its excellent image quality, this makes CFHT an extremely powerful instrument for infrared astronomy.

R. McLaren

---

**SCIENTIFIC NEWS**

**FOURIER SPECTROSCOPY OF HOT STARS**

The Fourier Transform Spectrometer is now in a fully operational mode. During the run in January 1984, A. Chalabaev (Meudon, now at ESO - La Silla) and J.P. Maililard (CFHT, now at Montreal) have successfully carried out observations on a program of spectroscopy of hot stars (main sequence and envelope stars). In total, spectra of about 20 objects in λλ 0.9-2.5 μm were taken at a medium resolution (0.5-1.0 cm⁻¹, i.e. 20-40 km s⁻¹ at the Pβ λ 1.28 μm line).

Here some preliminary results are briefly reported. The profile of the hydrogen Pβ λ 1.28 μm line of a main sequence star (γ Gem, AOIV) is presented in Figure 1. The wings of the line are in good agreement with a theoretical profile computed for a model atmosphere in LTE. Note the deep and fine absorption core in the center of the line. This feature can be explained only if one assumes the non-LTE effects in the stellar photosphere. This is the first IR observation showing the importance of the non-LTE effects in spectra of hot stars.

A number of young stellar objects (LKH₄101, Herbig stars) were observed as well. The Pβ line of LKH₄101 is plotted in Figure 2, showing extremely strong emission. The line is resolved with FWHM = 60 km s⁻¹ and wings with the full width more than 120 km s⁻¹.

The complete reduction of this huge amount of data is still in progress. The first result of this work will be an atlas of spectra of main sequence B stars and that of Be stars in the λλ 0.9-2.5 μm region.

A. Chalabaev
LITHIUM IN THE HYADES CLUSTER

In December 1984 Ann M. Boesgaard (University of Hawaii) and U.H. graduate student M.J. Tripicco used the Reticon with the coude spectrograph to determine the Li abundance in fifteen F dwarfs in the Hyades cluster. The Reticon observations have a signal-to-noise of 400–500 and a spectral resolution of 0.11 µm. They added these observations to a sample of eight Hyades F stars which they had obtained with a CCD at the U.H. 2.2m telescope and coude spectrograph at somewhat lower resolution and signal-to-noise. (Three stars were observed with both systems.)

A preview of the astonishing results can be seen in Figure 1 which shows the flat-fielded spectra of five of the stars through the temperature range observed. The hottest and the coolest stars in this group show strong Li I lines and the resultant Li/H abundances are close to the “cosmic” abundance for Population I objects, i.e., 10^-9. Three stars of intermediate temperature show barely detectable Li I features even at this high S/N and spectral resolution.

The preliminary abundance results for the full sample are shown in Figure 2 along with earlier results of Cayrel et al. (1984, Ap.J. 283, 205) on the Li abundances in the Hyades G dwarfs, which were also obtained with the CFHT Reticon and coude spectrograph. The deep dip in Li abundance in the F dwarfs between Teff = 6400–6800 K (or B-V = 0.40–0.47) is remarkable both in its regularity with temperature and in the magnitude of the depletion of Li: a factor of >100 relative to neighbors with Teff of 300 K hotter or cooler. Earlier results of Wallerstein, Herbig, and Conti (1965, Ap.J. 141, 610), which were done photographically, hinted at such a dip but they could determine upper limits which were only three times less than the neighboring maxima in Li. Higher signal-to-noise observations with modern linear detectors at high spectral resolution were needed to define this remarkable dip.

Fig. 1 - Samples of the CFHT flat-fielded Reticon spectra of Hyades F stars. They are arranged in order of decreasing temperature. (The relative intensity scale is slightly different for each spectrum because it is set by the depth of the Ca I \( \lambda 6717 \) feature (about two-thirds of the way toward the right) and the highest continuum point, which is a cosmic ray spike in VB 128.) The Li I \( \lambda 6707 \) feature, indicated by an arrow in each panel, is clearly present and strong in the hottest and in the coolest stars, VB 14 and VB 121, but much weaker in the three stars of intermediate temperature. The individual star names, temperatures, equivalent widths for Li I \( \lambda 6707 \) and values for \( \log N(\text{Li}) \) (on the scale of \( \log N(\text{Li}) = 12.00 \)) are given to the right of each spectrum.

Fig. 2 - Preliminary lithium abundances (on the scale of \( \log N(\text{Li}) = 12.00 \)) for Hyades dwarfs as a function of effective temperature. The open circles and open triangles are the observations of Boesgaard and Tripicco, where the circles are detections and the triangles are upper limits. The two small H symbols are stars in the Hyades moving group. The crosses are the G dwarf data of Cayrel et al. The small open squares are abundances from the equivalent widths of Duncan and Jones (1983, Ap.J., 271, 663) from spectra taken at Lick Observatory.
Possible explanations include gravitational settling of Li atoms, convective overshoot which carries Li to deeper layers, mass loss of the surface layers containing the Li, etc. All theoretical explanations will have to account for the narrowness of the temperature range where the extreme depletion occurs.

The depletion which occurs in the cooler stars has been known for about twenty years, but was very clearly defined by the high quality observations of Cayrel et al. (1984). Various sources of "extra mixing", including turbulent diffusion, have been advanced to account for the increasing Li depletion with decreasing stellar mass. A different phenomenon must be operating in the middle F dwarfs.

Other observations of Boesgaard and Tripicco in seventy-five F dwarfs in the field show that only about half of the field stars in the temperature range (6400-6800 K) of the Hyades dip are afflicted by this same depletion.

A.M. Boesgaard

CCD IMAGING OF HALLEY AND OTHER COMETS

There currently exists a unique opportunity for advancing our knowledge of comets because of the intense worldwide interest focussed on the return of Comet Halley. A consequence of this interest is an extensive coordinated program of groundbased observations called the International Halley Watch plus a number of deep space and earth orbital missions. The CFHT is particularly well-positioned to conduct cometary observation during this period because of its geographic location, the outstanding observing conditions on Mauna Kea, and the available compliment of instrumentation.

In late December 1984, B.A. Goldberg (JPL), I. Halliday (HIA), and G.C.L. Aikman (DAO) obtained the first images of Halley through some of the interference filters designated by the International Halley Watch, using the RCA CCD at the f/8 Cassegrain focus of the CFHT. This initiated a program to study the nuclear regions of Halley and other comets of interest during this period. When these observations were made, Halley was just beyond the orbit of Jupiter at 5.3 AU and essentially inactive. Its bare nucleus was imaged with a good signal-to-noise ratio, and there was some evidence for a weak coma in the H_2O^+ filter bandpass, centered at 7025 Å. In addition to Halley, images of comets Neujmin 1, Arend-Rigaux, Shoemaker 1984S, and Schaumasse, as well as asteroid 1983TB were obtained. These comets shared a wide range of activity.

This observing program has two basic components. The first is the direct study of the comet nucleus by imaging of faint, inactive comets through interference filters. Specific observational objectives are to monitor light variations, determine magnitudes and colors, and search for incipient activity. The second is to obtain observations with both high time and spatial resolution, also through interference filters, of the nuclear region of bright, active comets to monitor both systematic and temporal structures (for example, gas jets moving as the nucleus rotates) and to determine the distribution and production rates of dust and molecular species. The International Halley Watch filter set contains filters centered on the following cometary features: continuum 3650, CN 3871, C_3 4060, CO 4260, continuum 4845, C_2 5139, continuum 6840, H_2O^+ 7025.

Observing on the CFHT scheduled for September-November will emphasize both Comet Halley during the best period for its observation from the northern hemisphere and Comet Giacobini - Zinner during the International Cometary Explorer (ICE) encounter on September 11, 1985 UT.

The capabilities of the JPL Multimission Image Processing Laboratory (MIPPL) have been particularly valuable during the initial phases of the data processing. Other collaborators in this program are B. McIntosh and A. Cook of HIA.

B. Goldberg
CARBON AND M STARS IN A FIELD IN M 31

A study of the late-type stellar content of nearby galaxies can provide a wide range of information important in understanding fundamental galactic properties. Among these are the following: (a) The mean metal abundance of the system from the ratio of carbon to M stars. This ratio correlates with metal abundance because it is easier to turn a metal-poor star into a carbon star (defined as an object with C/O > 1 in its atmosphere) as the oxygen abundance is already low and the carbon is produced by nuclear reactions (triple alpha) not dependent on the metallicity of the star. (b) The star formation history of the galaxy. (c) The distance to the galaxy by using these late-type stars as standard candles. With only broadband photometry it is not possible to distinguish spectral types among late-type stars, while grism work is usually impossible in the crowded fields of late-type spirals. The solution is to use appropriately chosen filters which isolate desired spectral features and to do imaging. H. Richer, D. Crabtree, and C. Pritchett have been working on just such a program at both CTIO and CFHT. Only two narrowband and two broadband filters are sufficient to unambiguously identify and distinguish carbon and M stars. The narrowband filters are centered at 7800 Å (TIO band) and 8100 Å (CN band) and the color formed from these filters together with a broadband (V-I) color nicely separates C and M stars. The figure shown below illustrates the operation of this method with standard stars of known spectral type.

The most recent work on this project was carried out in early November at CFHT with the CCD at the Cassegrain focus. A full night of imaging was required to cover the small field in Band's Field III of M 31 as the narrowband exposures were 90 minutes each and the broadband ones a total of 60 minutes each. This data was secured on the best night that any of the observers have ever had at any telescope. The I frame images have a FWHM of about 0.5", while those for V are only slightly worse at 0.7". This data has been fully analyzed and the color-color diagram for the field is shown below. Through a comparison with the standards, it is clear that 5 carbon stars are present together with 41 M stars of spectral type M5 or later. This gives a carbon to M star ratio of 0.12 and implies (as expected) that the metal abundance in the field is significantly higher than that in either the LMC or NGC 300, but lower than that in the Galactic Center. Using only the 5 carbon stars discovered in this field, a true distance modulus to M 31 of 24.39 can be derived. The full AGB (asymptotic giant branch) luminosity function for the field was also obtained and was shown to be similar to that in the LMC, meaning that the deficiency of luminous AGB stars known to exist in the LMC also exists in this field of M 31.

H. Richer

Figure 1: A plot of the narrowband index (8100 Å - 7800 Å) versus broadband color (V-I) for standards of known spectral type. Stars with strong TIO bands (M stars) will have negative (81-78) indices, while those possessing prominent CN bands (carbon stars) will exhibit positive indices.

Figure 2: The (81-78) versus (V-I) color-color diagram for the M 31 field. Note the 5 obvious carbon stars and numerous M stars present in the data. The stars plotted with filled triangles were too faint to be measured on the V frames; their color was derived assuming V = 24.0.
VELOCITY DISPERSION IN GIANT EXTRAGALACTIC H II REGIONS

Jean-René Roy and Robin Arsenault of Laval University have conducted a study of velocity dispersion in large extragalactic H II complexes. Using their Fabry-Pérot spectrometer (Arsenault and Roy, 1984, PASP 93, 247), they obtained high-resolution H-alpha line profiles of 48 giant H II regions belonging to late-type spirals and Magellanic irregulars, and of three galaxy nuclei and five blue compact galaxies. Forty of these objects were observed at the CFHT during a four night observing run in March 1984. The velocity widths (in excess of thermal broadening and the instrumental profile) of the line profiles were compared with the diameters of the H II regions and with the absolute blue magnitude of the parent galaxies, using the distance moduli and M(B) from Richter and Hutchmeier (1984, Astron. Astrophys. 132, 253). The velocity widths W(km/s) of the 48 H-alpha line profiles are found to relate with the diameters D(pc) of the H II regions with a coefficient of correlation (Pearson) of r = 0.68. The probability is less than 0.001 that an unrelated data set could produce the observed correlation. The relation between velocity width and diameter is

$$\log W = 0.29 \pm 0.04 \log D + 0.65 \pm 0.12.$$  

There is also a relation (r = 0.78) between the H-alpha velocity width for the largest H II regions in a galaxy and the absolute blue magnitude M(B) of the parent galaxies:

$$M(B) = -17.4 \pm 2.2 \log W + 5.5 \pm 3.2.$$  

The large uncertainty in the distances of many of the observed nearby galaxies is responsible for most of the errors. The M(B) vs Log W relationship can be used only as a rough distance indicator.

Although our results are consistent with those of Melnick (1977, Ap.J. 213, 15) and of Terlevich and Melnick (1981, MNRAS 195, 839) which were based on a much smaller sample of H II regions, the relationships that we find differ enough from theirs to cast severe doubt on the interpretation of large supersonic motions in H II regions as being powered by self-gravitation. Instead we favor an interpretation in terms of a turbulent energy cascade where energy input into the large cells comes from the transverse shear due to the differential rotation of the galaxy.

J.R. Roy

Relationship between the velocity dispersion of the largest H II regions and the absolute blue magnitude of the parent galaxy. The straight line represents the linear regression (eq. 2). The error bar is the typical uncertainty on the velocity width W of the mean H-alpha profile. The mean velocity width was deduced from three H II regions in each galaxy, except for I2574 (12), N4214 (1), No II (1) and N4631 (1). This graph shows that N4258 seems to have an abnormally high luminosity.

Requests for observing time on the Canada-France-Hawaii Telescope are made to the member agencies on a semi-annual basis. For proposals to the French and Hawaiian agencies, the mailing deadlines (postmark date) are September 1 for the first calendar semester (Jan-June) of the following year and March 1 for the second semester (July-Dec.). For proposals to the Canadian agency, the deadlines are August 15 for the first semester and February 15 for the second semester. The mailing addresses are:

For Canadian astronomers:
Canadian Applications Committee
CPHC, c/o Director
Herzberg Inst. of Astrophysics
National Research Council
Ottawa, Ont. – Canada K1A 0R6

For French astronomers:
M. le Directeur de l’Institut
National des Sciences de l’Univers
77, avenue Denfert-Rochereau
75014 Paris – France

For U. of Hawaii astronomers:
Director
Institute for Astronomy
2680 Woodlawn Drive
Honolulu, Hawaii 96822
U.S.A.