matter with zero pressure, (c) zero cosmological constant and (d) no shell crossing. We considered a simple point-mass model with a total mass of 8.0 x 10^{14} solar masses, the virial mass of the Virgo Cluster given by Tully and Shaya (1984), placed at a distance of 16.8 Mpc. Figure 5 shows our two galaxies and the results from our simple point-mass model of the Virgocentric infall for three lines of sight 13°, 14° and 15° offset from the center of the Virgo Cluster assumed to be coincident with NGC 4486 (M87). The line of sight to our two galaxies is 14° offset from M87. Figure 5 also shows spirals taken from Teerikorpi *et al.* 's sample with angular distance from Virgo between 13° and 15°. All velocities have been corrected to the centroid of the Local Group. Our results are consistent with a Hubble constant of 90 km s^{-1} Mpc^{-1}. However, our value for the Hubble constant should be taken as a first estimate at best since many studies have shown that the Virgo Cluster is far from being a nice spherical system. One of the most recent studies by Fukugita *et al.* (1992) has found that spiral galaxies in the Virgo Cluster are distributed in an elongated region, like a filament, which extends from 13 to 30 Mpc almost along the line of sight with the maximum of the density distribution at around 15 Mpc.

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LATEST NEWS ON INSTRUMENTATION

Progress with 'Bear:' The Imaging Fourier Transform Spectrometer

In the 1991 CFHT Annual Report, we reported on what we believed to be the first successful attempt at Fourier imaging spectroscopy at a ground based astronomical observatory. This "feat" was accomplished with the CFHT facility Fourier Transform Spectrometer (FTS) coupled to the University of Hawaii's 1 – 2.5 μ infrared camera. The instrument works by reimaging the telescope's focal plane through the FTS and onto an infrared array. As the interferometer is stepped, images are sequentially recorded, effectively yielding an interferogram at each point in the imaged field of view.

Performing a Fourier inversion on the raw data cube yields a cube consisting of monochromatic images in the free spectral range sampled during the observations. The October 1991 run demonstrated the viability of this unique instrument but we felt that the logical next step for the program was to wait until the CFHT facility infrared camera was available before developing the instrument further. More specifically, the wide field Redeye infrared camera offered several advantages over the UH camera, including:

- The system overhead was reduced to 2.2 seconds with the Pegasus/Gen III combination. This is nearly an order of magnitude faster than what was possible with the UH camera's PC based control system. The reduced overhead makes it practical to extend the spectral resolution of scans, as well as quickly record scans in time-critical applications, e.g., with rapidly rotating planets.
- The wide field camera had a custom cold field mask installed in it that significantly reduced the background flux coming from the interface optics for filters passing >2.0 micron radiation.
- The higher throughput of the Redeye camera improved the overall system throughput.
- Greater system stability with a single computer handling all instrument control functions was achieved.
- Susceptibility to internal reflections was reduced, particularly with narrow band filters.

Two science programs were incorporated into our March 1993 run, which was the first time one of the Redeye cameras was coupled to the FTS, forming Bear *. One program included scans of the dark side of Venus in an attempt to map out the Venusian disk through several of its atmospheric infrared windows. The other program was designed to image H_2 and H_3^+ emission from the polar regions of Jupiter (north and south). The Jupiter program was particularly demanding since Jupiter's fast rotation rate (~10 hr period) made it imperative that scans be completed in less than 10 min, i.e., before Jupiter rotates more than 1 arcsec at a latitude of ~60°.

All of the data are currently being reduced. Preliminary results indicate that Bear worked quite well. By far the largest bug in the system discovered was (as usual) an unanticipated problem. The Redeye shutter, which had to fire repeatedly during scans, failed intermittently throughout much of the run. Needless to say an improved shutter will be incorporated into Bear when it is used during 1993 semester II to image planetary nebulae. Final results from the scans of Jupiter and Venus will be derived later this summer as the data are fully reduced.

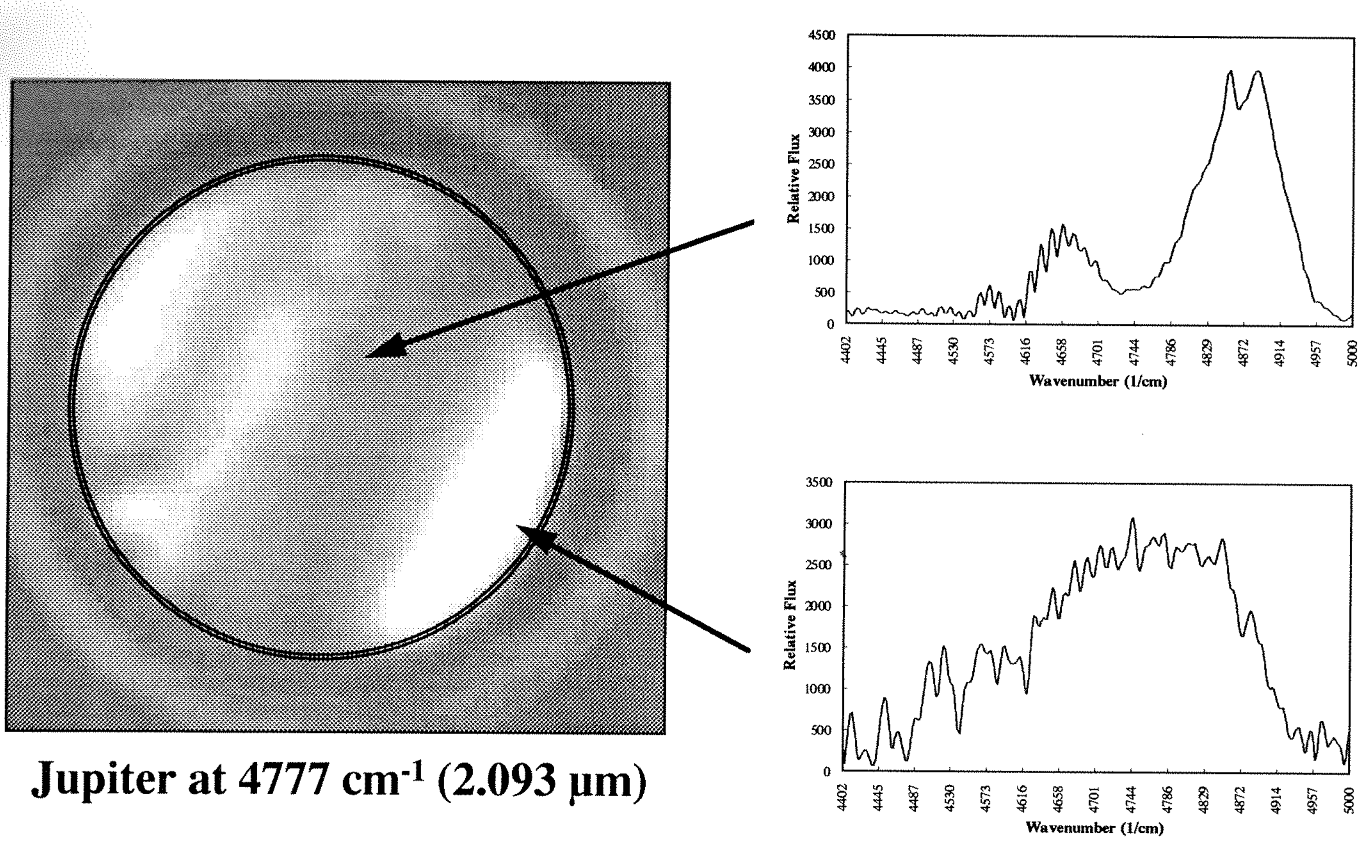

Figure 6: A monochromatic image and representative spectra of Jupiter are shown. The double circle depicts the ~20" circular field of view of the instrument. The bright spot in the lower right of the field is reflected light from Jupiter's polar region.

In the mean time, as an example of the type of data acquired during this first test of the instrument, we present spectra and images of Jupiter made through a filter centered at 2.15 µ. The bright zone in the monochromatic image of Jupiter at 4777 cm $^{-1}$ (2.09 µ) is due to a high altitude haze located at the pole, which efficiently diffuses incident solar light while the rest of the planet is almost dark.

Representative spectra from two places in the field indicated by arrows are also shown. These spectra have resolutions of ~2 cm $^{-1}$. From these spectra the compositional difference between the polar haze and the atmosphere closer to the equator is obvious. The minimum at 4740 cm $^{-1}$ (2.11 µ) in the top spectrum is due dipole pressure-induced absorption of H_2.

This run posed unique challenges for the Bear team, since we were not only using a new camera system but were attempting to couple that system to the FTS to effectively create a new instrument. The fact that Bear was used successfully for the March 1993 run is a testament to the skill of the CFHT technical staff.

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C. Clark, S. Smith, S. Massey

* *In case you were wondering, the name "Bear" stems from the collective imagination of the CFHT software group and dates back to the days when "Lions (a.k.a. Pumas), and Tigers" were abundant on the summit. They felt a Bear was needed at the zoo. We are still trying to retrofit an acronym onto Bear. Some possibilities include "Bidimensional Experience Adapting Redeye" or "Best Experimental Astronomical Research"!*

PUEO Progress Report

PUEO, if not yet arrived at CFHT, even not being built yet, nevertheless manages to take a lot of time from CFHT staff. We estimate that the CFHT adaptive optics bonnette project monopolizes 4 employees full time.

Many developments have taken place since the last issue of the CFH Information Bulletin. First, two contracts have been finalized, including detailed technical specifications of the instrument, and have been approbated by the CFHT Contract Review Committee. They cover the fabrication of the opto-mechanical assembly (Dominion Astrophysical Observatory) on the one hand, and of the real time control software, tip-tilt and deformable mirror on the other hand (Laserdot). A third contract is being prepared for the integration of the instrument. The Observatoire de Paris-Meudon will be responsible for this latter task.

F. Rigaut has studied the behavior of our adaptive optics system using numerical simulations. His model shows that wavefront correction can be done on guide stars of 15th magnitude. A strehl ratio of 0.4 is reached at a wavelength of 1 µm. At the end of 1992, CFHT made an important decision, namely to change the deformable mirror type from piezo-stack to the bimorph technology. The reasons are numerous:

- the bimorph technology has made encouraging progress recently.
- it offers a better match to the curvature wavefront sensor.
- the bimorph mirror shows similar quality of image improvement than the piezo-stack, despite the fact it has 23 less electrodes (result of simulations).
- the cost is substantially lower than for a piezo-stack.
- F. Roddier's AO group at the University of Hawaii has strongly encouraged CFHT to adopt this technology, and