Annual Report 2004

Canada - France - Hawaii Telescope Corporation

The Canada-France-Hawaii Telescope Corporation

operates the CFHT 3.6 m telescope near the summit of the 4200 m dormant volcano Mauna Kea on the Big Island of Hawaii, USA. Support is provided by the National Research Council Canada, the Centre National de la Recherche Scientifique of France, and the University of Hawaii according to the agreement signed June 1974. CFHT is dedicated to the exploration of the Universe through observation.

NATIONAL RESEARCH COUNCIL CANADA

CONSEIL NATIONAL DE RECHERCHES CANADA

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

UNIVERSITY OF HAWAII

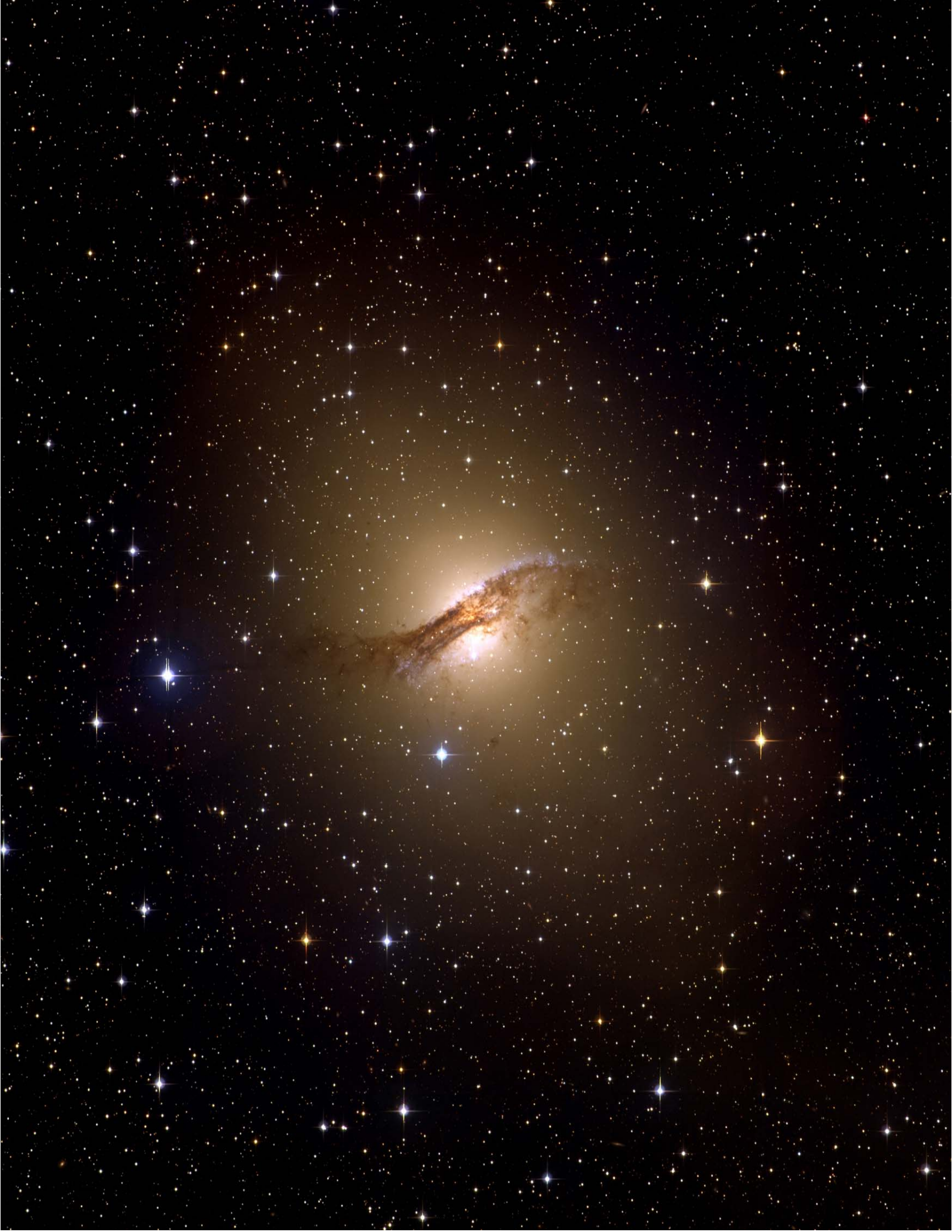
Editors:
David Valls-Gabaud & Christian Veillet

http://www.cfht.hawaii.edu

Picture Credits

All images © CFHT except:
Cover: © CFHT and Terapix
p. iii, NGC 6726 : © CFHT/MegaCam and Coelum.
p. v, Centaurus A : © CFHT/MegaCam and Coelum.
p. 3, CFHT/SNLS: © R. Pain, C. Pritchet.
p. 7, Seeing : © Terapix.

Table of contents



Introduction

Celebrating 25 years of excellence and looking ahead to a bright future

Executive Director Christian Veillet

On September 28, 1979 in the CFHT dome on Mauna Kea took place the dedication ceremony of the telescope, marking the official beginning of its scientific operation. First light had taken place earlier that year with a 35-mm camera at the prime focus as its first instrument (!). CFHT was at that time the 6th largest telescope in the world and photographic emulsion was still a detector of choice. CFHT was designed to be a versatile telescope, providing the best instruments you can imagine to astronomers eager to get a few nights of observing time with excellent image quality, one of the trademarks of the observatory very early on. Over all the years since that day, CFHT has generated hundreds of publications, quite a few very exciting scientific achievements and excellent instruments bringing new technologies at the fingertips of thrilled astronomers. Twenty-five years later, CFHT is not a "big telescope" anymore: the sixth largest one is nowadays 8 meters in diameter! Are we therefore looking back to a fading glory, longing for the good old days? Fool! the one who would answer yes to such a question. Thanks to the wise men and women who took care of CFHT over these twenty-five years in the three communities it serves, the observatory remains a first-class facility playing a major role in today's astronomy. This celebration was indeed an important milestone of the year, acknowledging an exemplary collaboration between the three founding partners spread over three continental plates, collaboration very well alive today in spite of the distance and the sometimes different routes they took on other projects.

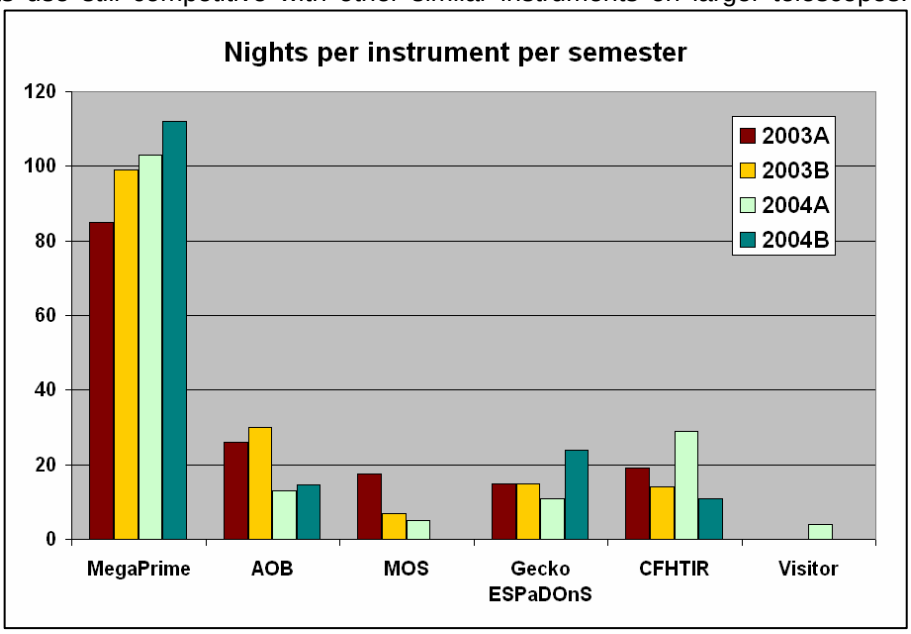
CFHT Dedication Ceremony – Mauna Kea – 28 September 1979

This Annual Report will detail some of the important developments that happened at CFHT in 2004. Among them, the commissioning of the spectro-polarimeter ESPaDOnS takes a large place: The arrival of a new instrument is always a very important event on any telescope, especially when it offers new capabilities hardly available anywhere else and provides its users the opportunity of a new type of observations. The development of WIRCam, the wide-field near-infrared camera which will complement MegaPrime, has been the focus of many on staff as well as in the laboratories in France and Canada collaborating to the project. With more that 210 nights on the sky in 2004, MegaPrime looked like an instrument continuously in operation and gobbled much resources for its maintenance and operation as well as on the Queued Service Observing side. The terabytes of data it generated made the pre-processing and data distribution a challenge at times. The impact of MegaPrime failures decreased steadily with time, as did the load of the operation on the staff, a more than welcome relief, and the image quality of the focal plane improved dramatically in the fall. All in all, some very challenging times in an extremely busy year that was very successful, thanks to a highly dedicated staff.

If 2004 was an opportunity to reflect on the past, it marked also an important step in the preparation of the future of the observatory. With MegaPrime now in full operation, WIRCam likely to be in operation by the fall of 2005, and ESPaDOnS offering capabilities not found anywhere else, CFHT is going to be under high pressure for the coming years (the pressure on observing time for the second semester of 2005 is more than 3 in Canada and more than 5 in France) and there will be high expectations from the CFHT communities and beyond. As data processing is now an essential component of these instruments and with the adoption of the Queued Service Observing (QSO) mode for both MegaPrime and WIRCam, CFHT's duty is not only to maintain the facility and the instruments in pristine condition, a challenging task by itself with the increasing complexity of this new instrumentation; its duty is also to observe over an estimated 85% to 90% of the time, to prepare and acquire the necessary calibration, to pre-process and calibrate the images, to assess the final quality of the data and to distribute them. Assuming that WIRCam will be used for at least 5 years and that follow-up and complementary observations of the CFHTLS with MegaPrime will be highly desirable, CFHT needs to operate at its best at least until the end of 2010, with a skilled staff in an increasingly complex environment, to be ready to meet expectations from the community that were never as high as they are now. This is, in the current context of the large projects undertaken by the CFHT communities, a real challenge. Getting more funding from the current members, attracting potential partners, keeping the dynamics of the Corporation and maintaining its staff, none of that can be achieved without a clear plan covering the 2005-2010 period: a plan exciting enough that the staff, the agencies, potential other funding partners or new customers will be ready to devote time, energy or funds to keep CFHT at the forefront of astronomy up to the early years of the next decade. Such a plan, "2005-2010: CFHT's Golden Age", was presented to the CFHT Board of Directors in December 2004 and endorsed as a good basis for the development of the observatory for the coming years. Focusing on the excellence of the services rendered to the community, on the efficiency of the Observatory and on leading-edge technical developments, this plan will allow the CFHT Corporation to work at its best for the last six years of the decade and be ready for the beyond-2010 era. The next Annual Report will present the plan in more detail, with its goals and associated metrics and an account of the first year of its implementation… Stay tuned!

Instrument statistics

2004 observing time was largely dominated by long MegaPrime runs. The use of Pueo, CFHT's Adaptive Optics bonnette, decreased significantly and the instrument was allocated essentially to French observers. MOS, CFHT's multi-object spectrograph, is still requested for programs where the spatial density of sources makes its use still competitive with other similar instruments on larger telescopes. ESPaDOnS, the new spectro-polarimeter, had its first scientific nights at the end of the year, marking the beginning of what should be long years of exciting observations, with Gecko's use likely to fade rapidly. With WIR-Cam on the sky before the end of 2005, CFHTIR should not be requested anymore. The only visitor instrument in 2004 was Lapoune, the Montréal 3-channel photometer.

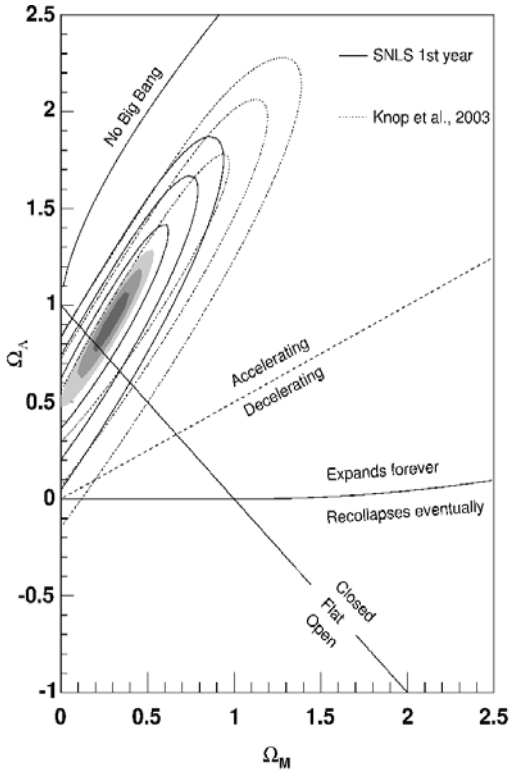


Science highlights of 2004

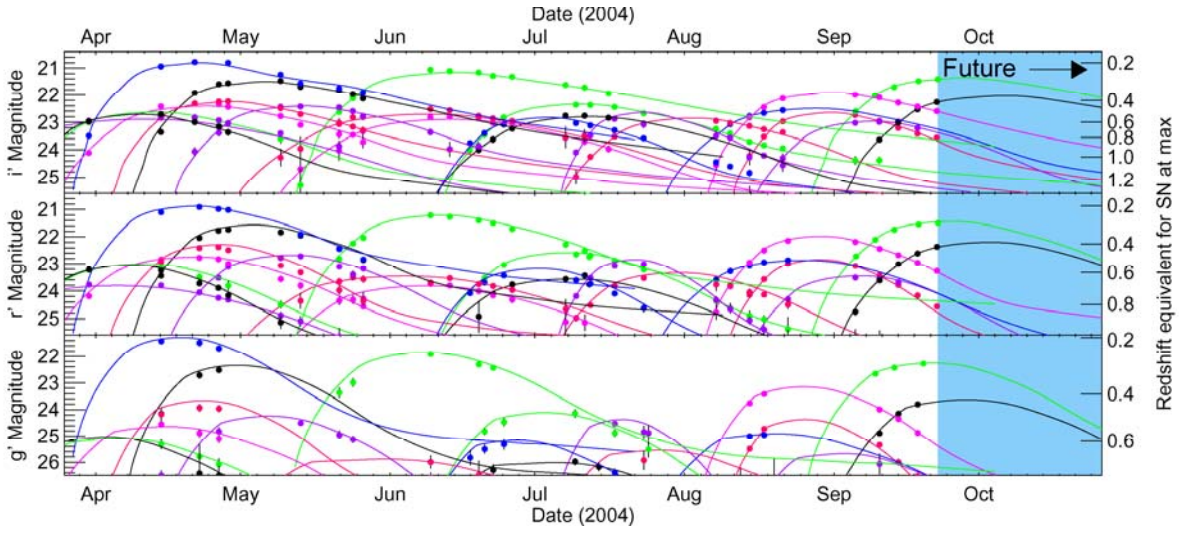
SNLS : The first year

After only 18 months of operation, the SuperNova Legacy Survey (SNLS, one component of the CFHTLS, the Canada-France-Hawaii Telescope Legacy Survey) is the most successful high-redshift supernova study in history, with more confirmed type Ia supernovae (SNe Ia) and better light-curve cadence and filter coverage than ever previously achieved. SNLS is on track to (i) spectroscopically confirm 700 Sne Ia by 2008, and (ii) use these SNe to determine the nature of the Dark Energy driving the accelerating expansion of the Universe, via a measurement of the equation of state parameter w. Such a legacy-quality dataset will also provide the control over the systematics which will form the cornerstone of third generation studies to determine changes of w with redshift.

Operationally, the SNLS is an extraordinary success. The survey is finding supernovae in the expected numbers, and CFHT queue scheduled observing is functioning well in providing the required time sampling. The SNLS teams have created new, more efficient pipelines for real-time and final data reduction, SN discovery, follow-up spectroscopy, SN typing, light-curve fitting, and database manipulation. A large allocation of VLT/Gemini/Keck spectroscopic time (averaging 140 hours per semester) continues for SN Ia identification. SNLS exploits new techniques to pre-select likely SNe Ia ensuring the most efficient use of this time. SNLS preliminary cosmology results can be seen in the figure on the left. SNLS is poised to achieve all of its stated goals and provide perhaps the most compelling measurement of dark energy achievable over the next decade, as well as a SN dataset of true legacy value



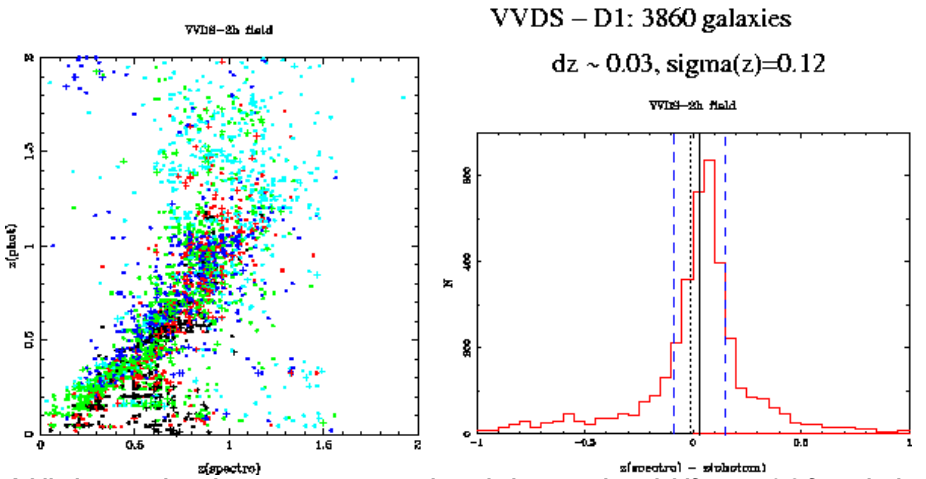
A preliminary analysis of the first year of data. The solid contours (statistical only, at 68%, 95% and 99%) give $\Omega_\Lambda \sim 0.79$. Already SNLS is doing better than recent ground-based results, with just one year of data (when the survey was running at only about 50% efficiency). For reference, the shaded area shows the expected results at the end of the survey in 2008. Note the dramatic improvement that can be expected with 700 SNe Ia.



A sample of 2004 SNLS real-time supernovae light curves.

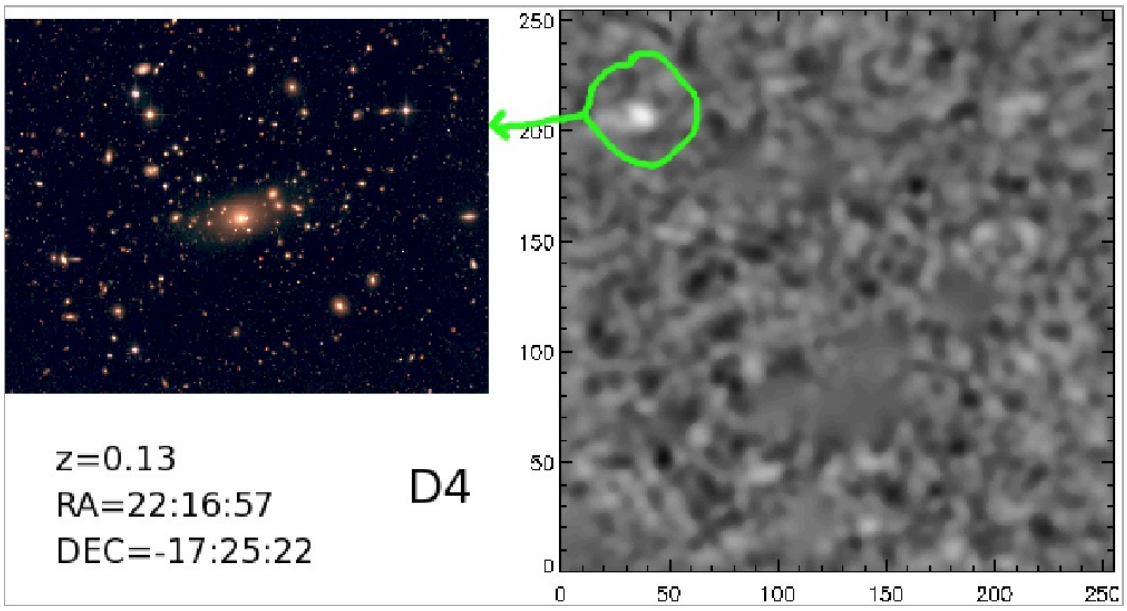
CFHTLS-Deep

The CFHTLS Deep component is strongly linked to the SNLS program, shares the same data and corresponds to the stacks of all the acquired data. In order to highlight its scientific rewards, the wavelength coverage was extended to the u* band at similar depth than in the other bands. These observations correspond to the only part of the Deep survey observed independently from the SNLS (therefore with no time constraints).



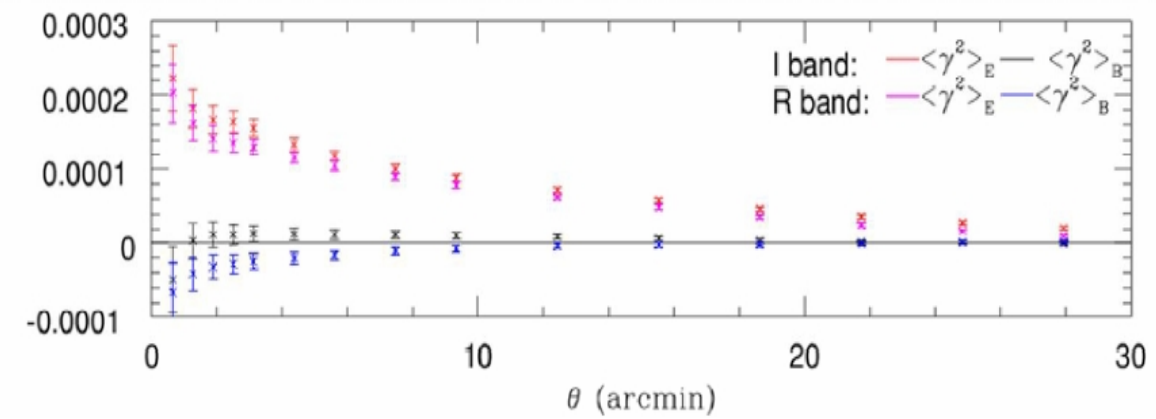
A blind comparison between spectroscopic and photometric redshifts at z=0-2 for galaxies in D1 and within the WDS samples. Different galaxy types, based on a purely photometric SED fitting classification are identified in black (E/S0), red (Sbc), green (Scd), blue (Im) and cyan (young starbursts).

Obviously the scientific outputs of such a Deep survey will start to be more and more competitive while the survey goes on. Presently, with 1.5 year of observations, 2 fields (D1 and D4) were observed for 2 seasons while the two others (D2 and D3) were observed only for one period and the first official stacks were recently released in November 2004. However the detailed performances achieved and measured in these stacks are within the expected ones. The choice of the 4 Deep fields has been instrumental for a firs-class scientific outcome, thanks to many follow-ups in progress. A preliminary comparison of photometric redshift performances with HyperZ (R. Pello and F. Ienna, OMP) shows that there is only a small systematic shift between 0.03 and 0.07, and a typical dispersion $\sigma(z) \sim 0.14\text{-}0.16$ over the entire redshift range. A joint weak-lensing and multi-color analysis of the Deep fields (T001 release) has started, with the reconstruction of the projected mass using the systematic polarisation of the background sources. The figure below shows the projected density contrast (kappa, the convergence) in D4. The zoomed-in highest peak turns out to correspond to a RASS bright cluster located at z=0.13.



CFHTLS Cosmic Shear Legacy Survey (CCLS)

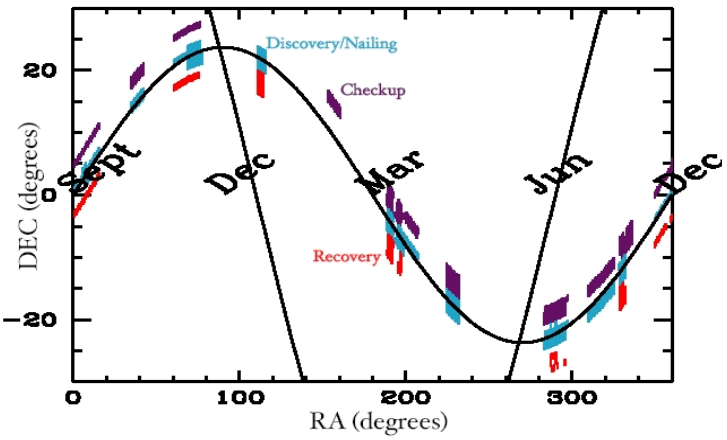
The CCLS uses both the Deep and Wide data to derive properties of the dark matter power spectrum and the biasing as function of angular scale and redshift. The wide survey is the most important part of CCLS: with a total sky coverage of 170 square degrees in five filters and spread over 3 uncorrelated patches, it constrains the dark energy (w_0 and w_1), Ω_m, σ_8 as well as the spectral index and the running spectral index. Hence, constraints on inflation models are also expected. The first investigations of the T0001 release and (un-released) wide data covering about 25 deg^2 show a strong cosmic shear signal. Using photometric redshifts with deep data, the weak lensing signal increases as function of source redshift, demonstrating the cosmological nature of the measured distortion field. Remarkably, both deep and wide data have zero B-mode signals. Moreover, the cosmic shear signal has been detected on angular scales up to 2 degrees, so that the CCLS will measure cosmic shear up to the quasi-linear and linear scales.



The two-point shear correlation functions of the Deep data derived independently from the r'-band and from the i'-band in D1 and D3. Both E and B modes have similar shape and amplitude, demonstrating that the signal is robust and reliable.

CFHTLS-Very Wide (LS-VW)

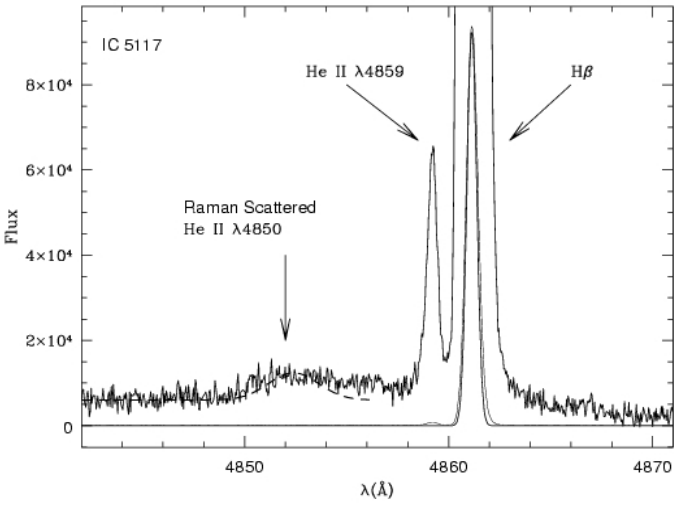
The LS-VW has been acquiring new fields at the rate of about 100 square degrees per semester. While still below the planned rate for the project, the LS-VW Kuiper Belt (Canada-France-Ecliptic Plane Survey) project has already discovered and tracked about 125 distant solar system objects (about 15% of all KBOs currently known). At this time 250 square degrees have been observed in three pass bands (g', r', i') and a follow-up is acquiring z' imaging of many of the LS-VW fields to search for quasars and brown dwarfs. During the coming months the LS-VW KBOs will have their second and third years of measures, making the orbits more secure and enabling the database as a constraint on planet formation. Meanwhile, all LS-VW fields are now being searched in real time for possible orphan GRBs and for asteroids.



The distribution of observed LS-VW fields. Blue (Discovery/Nailing) patches have been observed in g', red (Recovery) patches in r' and purple (Checkup) patches in i'. The r' and i' fields are offset -4/+4 degrees in declination from the actual field locations (for clarity). The dates indicate when particular areas of the sky come to opposition (making them good fields for KBO searching).

Galactic Astronomy

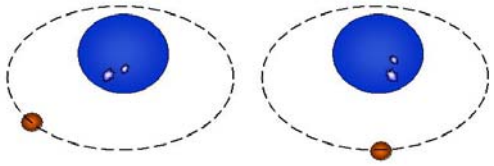
Very young planetary nebulae with ESPaDOnS. Hee-Won Lee, Yang-Chan Jung and Sang-Hyeon Ahn (Sejong Univ., S. Korea) observed the very compact and young planetary nebula IC 5117 with the newly installed spectropolarimeter ESPaDOnS in the spectroscopic mode on the night of December 25 to find Raman scattered He II λ4850 by atomic hydrogen. This feature is formed when a He II 972 line photon is incident upon a hydrogen atom in the ground state and is subsequently re-emitted as a result of de-excitation into the excited 2s state. The operation condition for Raman scattering by atomic hydrogen is the co-existence of strong UV emission sources and very thick neutral regions, which may be readily met in wide binary systems of a mass losing giant and a hot white dwarf, namely symbiotic stars. Therefore, Raman scattered He II lines have been often found in many symbiotic stars but only very rarely in planetary nebulae. Thus far, the planetary nebulae NGC 7027 and NGC 6302 are known to exhibit Raman scattered He II λ4850. They tentatively find that the Raman conversion efficiency in IC 5117 is much higher than those in other symbiotic stars including V 1016 Cyg and HM Sge, and also that the H I column density of the neutral region in IC 5117 is much larger than the value proposed from 21 cm observations.



The young planetary nebula IC 5117 observed with ESPaDOnS showing the Raman scattered HeII line.

Planetary Astronomy

An extra-solar planet with a magnetic field. Observations with Gecko -the CFHT high-resolution spectrograph- carried out by E. Shkolnik, G. Walker and D. Bohlender appear to show a persistent hot spot in the chromosphere of HD 179949 with a rotation period of about 3 days, exactly the same as the orbital period of its planet, a "hot Jupiter" 270 times more massive than the Earth. This fast traveling spot is slightly ahead of, but keeps pace with, the planet and could be the first glimpse ever of a magnetic field in an extra-solar planet: it could well be that the entanglement of the stellar magnetic field with that of the planet gives rise to this coupling, as sketched in the figure.



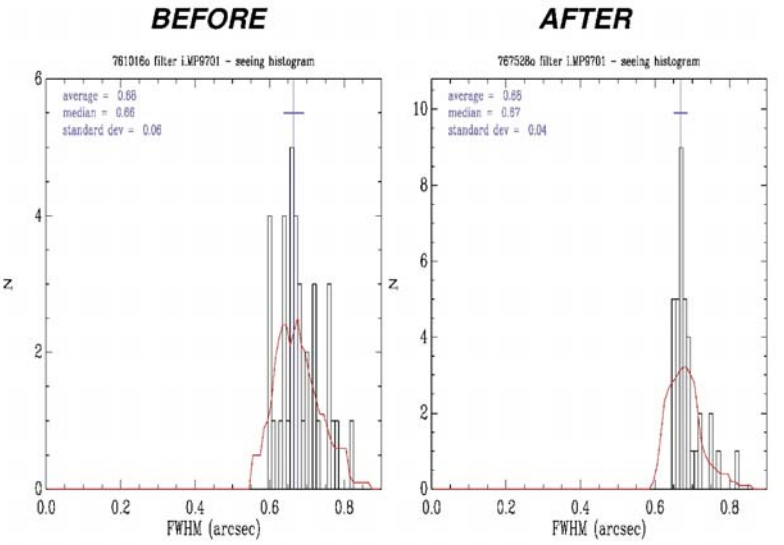
A persistent hot spot has been observed in HD 179949 for over a year, or 100 orbital periods, moving across the stellar surface slightly ahead of the magnetized planetary companion.

Evidence for methane on Mars. Methane is often proposed as a biomarker because, on Earth, it is generated primarily by living bacteria. V. Krasnopolsky and collaborators used CFHT's Fourier Transform Spectrometer to measure the average methane abundance in the Martian atmosphere. This detection is consistent with the one obtained by M. Mumma et al. who used Gemini, Keck and IRTF, and received a spectacular confirmation from the Planetary Fourier Spectrometer onboard the European Space Agency's Mars Express mission. While on Earth the photolysis of methane molecules implies a lifetime of about 10 years, on Mars methane can survive no more than some 300 years, and it is tempting to infer that the source of methane on Mars is some very recent event, such as the impact of a small comet or bacterial activity. Whether alternative purely inorganical processes, such as the combination of water with carbon dioxide altering basalts to serpentine, which frees methane, can also account for the measured abundance and its correlation with water remains to be seen.

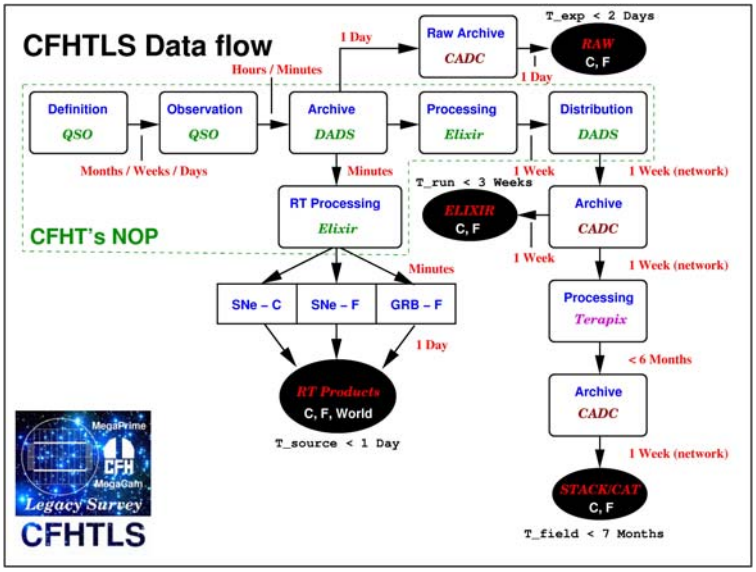
Operations Report

MegaPrime/MegaCam

The second year of operation yielded a higher rate of failures than expected and the continued technical work on several issues (guiding/autofocus) generated more engineering sky time. Overall, the nights lost to technical problems and engineering rose to 33. With the really poor weather Mauna Kea suffered during this year (almost 60 MegaPrime nights lost), along with the technical problems and the still high observing overheads, the average QSO data validation rate for 2004 reached only 3.3 hours per night, 50% of the predicted rate as established in 2001 based on CFH12K statistics (technical and weather). The most serious failure in 2004 came from leaks and shorts in the CCD hermetic pass through connectors. In collaboration with CEA, the camera builder, the pool of available spares has been increased. Early in the year, a light baffle was installed on MegaPrime and it significantly reduced the contamination from stray light, like the moonlight reflecting off the telescope's caisson central structures.



2004 saw a major effort to gain a better understanding of the image quality problem MegaPrime has exhibited since its first light. The wide field corrector (4 lenses) has been dismantled several times for individual components analysis and tests, without a clear result pointing to the culprit. The accidental flipping of lens L3 brought a spectacular improvement of the image quality though the design calls for the lens to be mounted as it initially was. The performance of the corrector is now within specification over 93% of the MegaCam field of view. This configuration now allows for the science to be properly conducted and investigations will proceed at a slower pace in order to get a good understanding of the MegaPrime optical behavior.



CFHTLS operations

The first release of CFHTLS/Elixir products was made at CADC (January), followed 9 months later by the first Terapix release. The entire data flow has been smoothed out throughout the year. The CFHTLS scientific requirements call for frequent e-mail interactions between the four survey coordinators and the QSO team to define the observing strategy based on acquired data and the status of the instrument: on a run basis for the Wide survey, and every other day for the SNLS/Deep and the Very Wide surveys. The CFHTLS having the status of an agency on its own, it gets equally affected by the bad

weather: the QSO validation rate in 2004 is 50% of what was expected to be achieved and this had a dramatic impact on the data rate, forcing new observing strategies and prioritization to be adopted. The two SNLS teams' Real-Time Analysis Systems in operation at the CFHT headquarters need a timely delivery of Elixir processed data. New schemes have been implemented by the Data Archiving and Distribution Service and Elixir to provide the fully processed data on the RTAS within 10 minutes of having been taken at the telescope. Elixir can now process an entire run (master detrend frames, photometric and astrometric calibration, quality control) within 7 days after the end of the observing run and then transferred over the network to CADC. A maximum of three weeks has been adopted to make the Elixir data available, but delivery at CADC now happens regularly within two weeks. The network transfer also benefits to the raw data which reach CADC within 24 hours. This is very practical for the Very Wide survey as it needs the raw data only within days after the acquisition. The Terapix data center retrieves automatically through the network all the Elixir data reaching CADC, and months later when a new release is ready, transfers its data products to CADC where they are made available to the CFHTLS community. The major bulk of the data download from CADC in 2004 (a total of 20 Tb) comes from the Elixir data since they were available well before the Terapix release. In the future, lower numbers are expected as CFHTLS users will use the regular 6-months Terapix releases.

Queued Service Observing in 2004

Since its commissioning in early 2003, all of the observations with the MegaCam mosaic camera were performed through the New Observing Process (NOP). The main objectives of this ambitious operational mode are to improve observing efficiency, increase science productivity and add value to the data. The NOP is composed of an ensemble of software designed to plan and perform the observations (Queued Service Observing), acquire the data (New Environment for Observing), analyze and process the data (Elixir), and, finally, distribute and archive the data (DADS). The front-end of the NOP scheme is the Queued Service Observing (QSO) project, which seeks to obtain astronomical data under the optimum sky conditions for each science program. Other goals include a fair balancing of the different Agency time, obtaining data for programs with time-critical constraints (e.g. monitoring supernovae), and improvement of the observing efficiency. In 2004, observations for MegaCam in the QSO mode were scheduled for about 235 nights, that is, 65% of the total telescope time available at CFHT! During each semester, about 45 different programs were available.

Among the QSO programs, of course, is the CFHTLS program, which covers about 50% of the total observing time available in the queue mode. Two components of the CFHTLS have also time critical observations, that is, the data have to be taken within a certain opportunity window or within a given periodicity. Although these constraints can be handled well on a technical side, general observation planning for the queue mode has thus become very complex and requires a lot of attention from the QSO Team. Unfortunately, the year 2004, and in particular its first semester, was a difficult one because the weather has been much worse than usual and time was lost to several technical issues with the camera. The operational overheads are also larger with MegaCam although clear improvements have been made to minimize them during 2004; even more efforts will be dedicated to this important issue in 2005. Despite all of this, the amount of data taken for highly ranked programs was quite good in 2004 (especially during the second semester with a completion rate for A programs of about 97 %!). When weather was really good, exceptional amounts of high quality data were gathered (for instance, close to 2000 science images were taken during the 19-night run in September). The time used between the different Agencies was also fairly balanced, not a small feat considering the global scheduling constraints on the programs.

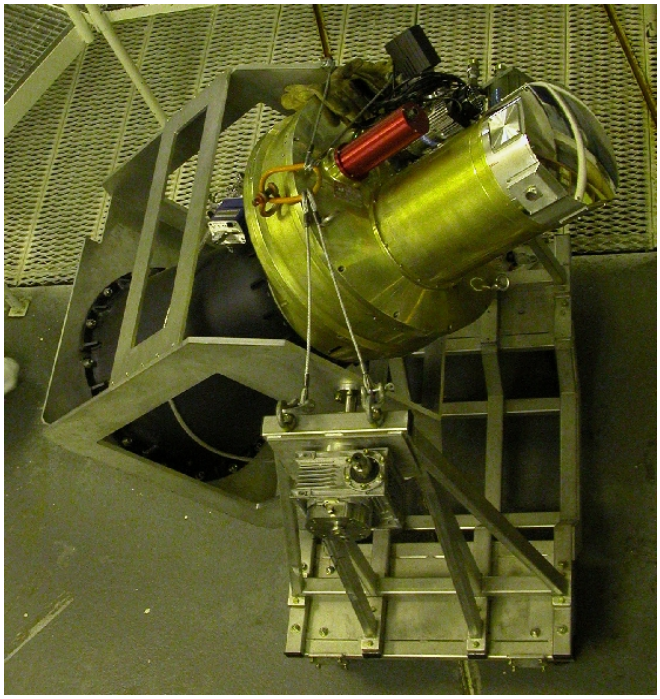
It is our hope that with MegaCam becoming more robust and with the operational efficiency on the sky getting even higher, much more data of great quality will be gathered in the years to come. With the arrival of WIRCam which will be exclusively operated in a queue mode, the coming year will also be extremely challenging. Development of additional tools has already been started, a third Service Observer will soon join the team, and a revision of the operational model of QSO in the era MegaCam + WIRCam is underway.

WIRCam: putting the pieces of the 20' x 20' puzzle together

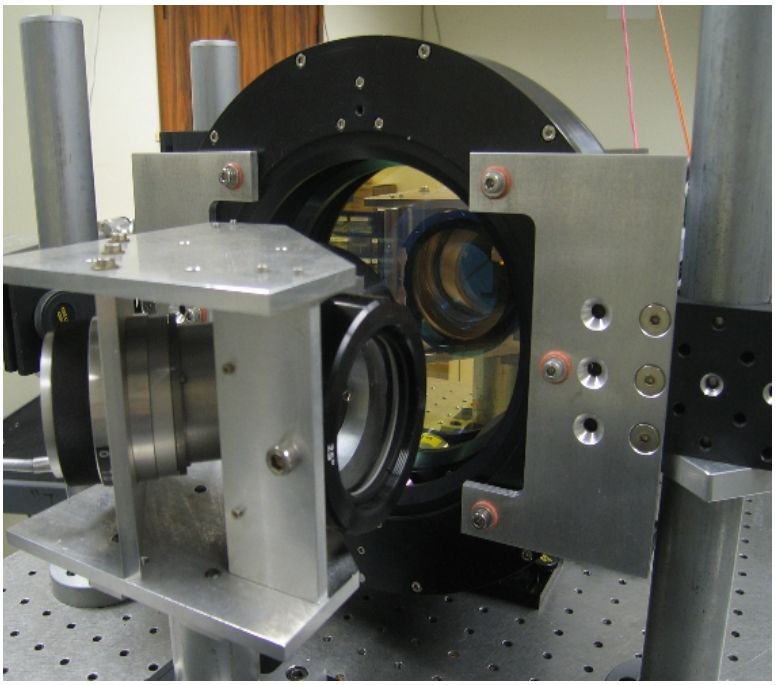
The Wide InfraRed Camera has started to take shape. With the delivery of the cryovessel and the Image Stabilizer Unit (ISU), the purchase of two of the four HAWAII-2RG science chips and the delivery of the last detector mosaic mount, WIRCam is coming to life!

The first part to arrive in Waimea was the ISU, in May, from the *Laboratoire d'études spatiales et d'instrumentation en astrophysique*. It will allow telescope vibrations compensation (<5 Hz), fulfilling the same role as that of the MegaCam ISU. Then, in December, a full delegation of engineers from the *Laboratoire d'astrophysique de Grenoble* came to the summit for the final acceptance of the cryostat. The cooling cycling, temperature regulation and filter wheels operation proved to work flawlessly with an excellent (<10^{-8} mTorr) vacuum.

The upper end of the telescope and the prime focus cage were upgraded to allow the WIRCam cryovessel to fit in the former CFHT12K cage. A new platform that allows lifting and accessing the upper end was delivered from the mainland.



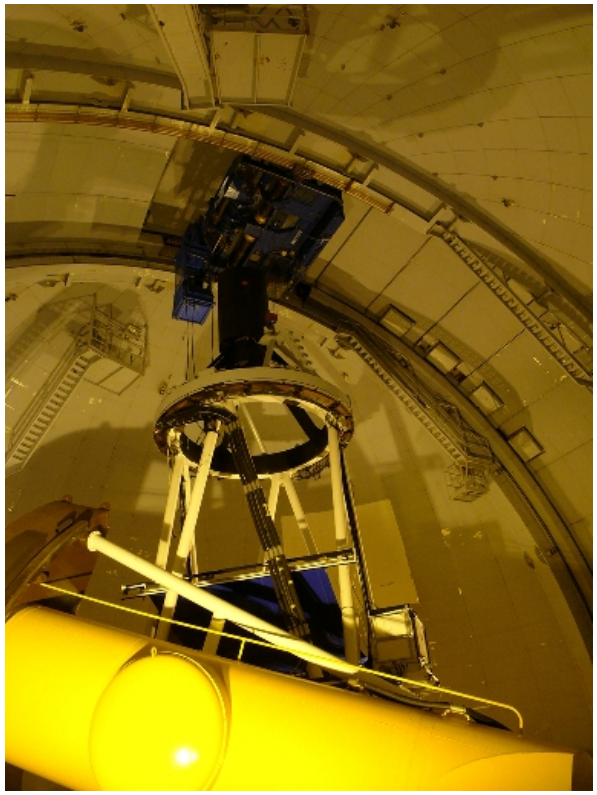
The WIRCam cryovessel devivered by the Laboratoire d'Astrophysique de Grenoble in December 2004.



The Image Stabilizer Unit delivered by the Laboratoire d'études spatiales et d'instrumentation en astrophysique in May 2004 on the test bench with a simulated laser star at the CFHT.

Scientists will be delighted to learn that two science grade HAWAII-2RG detectors have been accepted by CFHT and delivered by Rockwell Scientific. Their quantum efficiencies outperform the requirements with QEs of 75% and 80% in J and K, respectively. A third, even better chip, was offered before the end of the year. Two of the engineering chips were mounted in diagonal by GL Scientific on the second detector mosaic mount then shipped to Montreal for the optical tests.

The delicate task of reading the detectors was to be fulfilled by the ASIC controller in development at IfA but the schedule was slipping past WIRCam's first light. Fortunately, an interim solution has been put in place at CFHT. It is a more conventional approach with 2 SDSU controllers that will use 32-outputs read slowly to achieve both low overheads (< 2 sec) and low readout noise (< 30 e-).



WIRCam being mounted at the telescope with the upgraded upper end and prime focus cage.

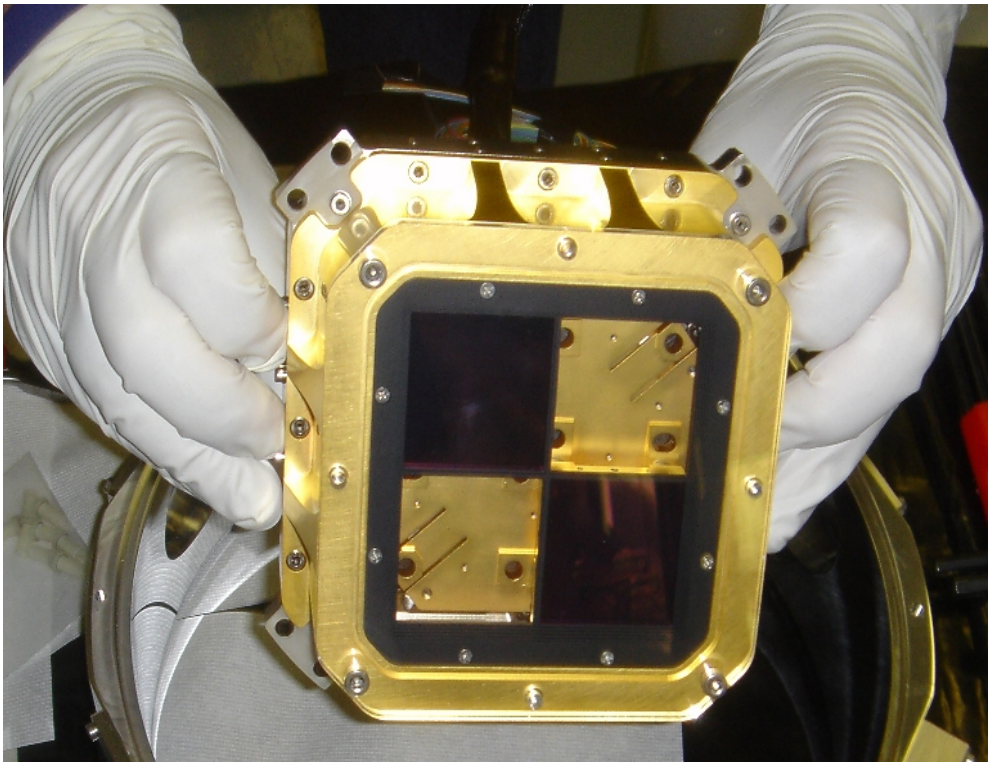
At the CFHT, the software development has started. One of the unique features of WIRCam is the on-chip guiding which allows continuously reading a small window at 50 Hz while integrating for science on the rest of the chip.

This was successfully implemented in the lab by using an artificial star and an engineering grade chip. Work had started on tweaking the parameters for closing the loop with the ISU.

The optics was due to arrive early in 2005 with first light at the end of March 2005. 15 nights of engineering and commissioning are planned between March and July. Science should start on a shared-risk basis in the semester 2005B.

With the success of the Queue Service Observing and New Observing Procedure (QSO/NOP) obtained with MegaCam, a similar model will be adapted for WIRCam.

This means observations exclusively conducted in queue, data reduction in house, archiving and data distribution.



The detector mosaic with two of the engineering-grade HAWAII-2RG detectors .

ESPaDOnS, from final acceptance tests to first scientific observations

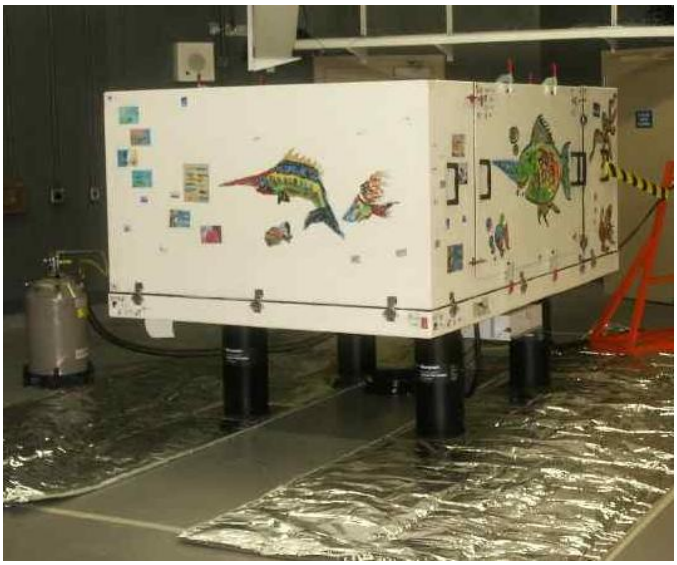
Calibration and polarimeter module at the Cassegrain focus.

ESPaDOnS is a bench-mounted high-resolution échelle spectrograph fiber-fed from a Cassegrain module. The spectrograph is located in the Coudé room and housed in a thermal enclosure to minimize temperature and pressure fluctuations, which affect the spectrograph's stability. The Cassegrain module contains all the necessary calibration facilities and the optics needed to perform polarimetry. The instrument was designed and constructed at *Observatoire Midi-Pyrénées* in France, by a team of 15 scientists, engineers, technicians, and administrators. J.-F. Donati is the principal investigator (PI) and system scientist while other scientists from Canada, France, and the Netherlands were involved in finding the funds (755k euros) provided by France, CFHT, Canada, and ESA/ESTEC/RSSD. CFHT scientists, engineers and technicians were also involved in the Final Design Reviews, integration of the instrument, tests, and in implementing the Graphical User Interface.

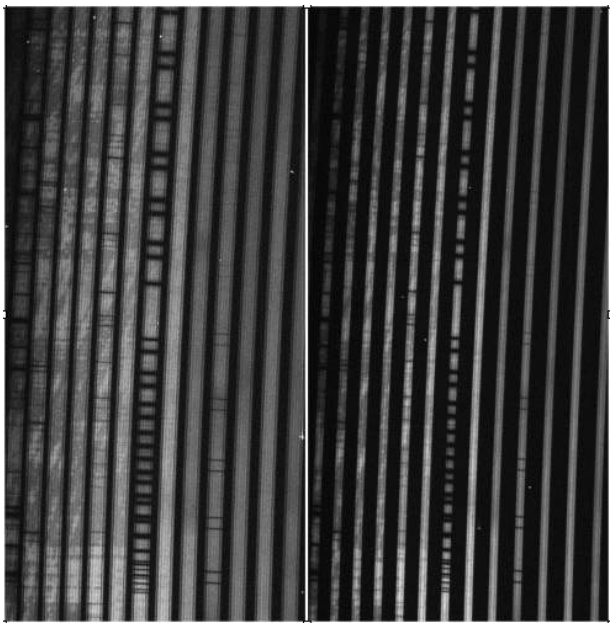
The year 2004 was a very busy one for ESPaDOnS, which went through intense (and successful) acceptance tests in Toulouse in May and June, followed by a complete disassembly, a trip around half the world, re-assembly on the summit of Mauna Kea in August, more testing, 6 engineering nights on the sky, 5 nights of commissioning science, and the first observers on Christmas!

First light occurred very quickly at 10pm on the very first night on the sky! During a total of 6 engineering nights, acquisition and guiding were tested: the ESPaDOnS guider works in both modes, on axis and off axis, and down to a magnitude 14 or 15. The Atmospheric Dispersion Corrector, which compensates for the wavelength dependence of the refractive index of air, creates rounder images of stars, gathers more flux at red wavelengths, does not introduce spurious polarization and does not reduce the flux very significantly.

ESPaDOnS comes with an Exposure Meter, temperature, pressure and humidity sensors, and a Graphical User Interface that automates much of the observations, including calibrations, acquisition of targets, guiding, and scientific observations in spectroscopic or polarimetric mode. A data reduction package is also provided by the instrument's PI. It takes care of all the necessary steps to get the geometric and wavelength calibrations, extract star and sky spectra when appropriate, and calculate polarization. There are also 4 CCD readout modes with different gains, readout noises, and readout times. Data was successfully obtained in the 3 instrument's modes, all of which offer 40 orders covering from 370 nm to 1050 nm.



The spectrograph in its thermal enclosure.



Observations obtained in two of the spectroscopic modes : 'star only' (left) and 'star+sky' (right). Red orders are at the left of the frames, blue orders at the right.

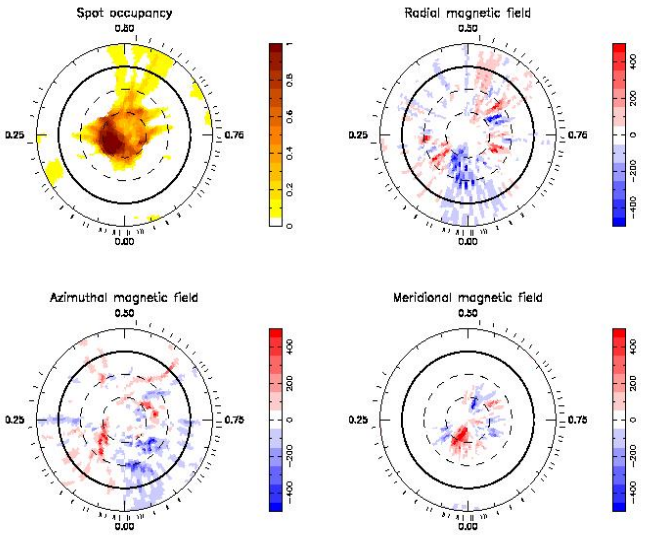
In the spectroscopic mode 'star only', only the light from the object goes through the instrument. The light is gathered at the f/8 Cassegrain focus of the telescope by a 1.6 arcsec aperture hole and brought to the spectrograph through 30m of optical fibers. At the entrance of the spectrograph, the image is sliced into 6 slices, which are then dispersed by the grating and the prism cross disperser, and recorded on the detector. With 6 slices, the spectral resolution is about 80,000.

In the spectroscopic mode 'star + sky', in addition to the light from the star, that from the sky located about 7.9 arcsec South is gathered through a 2.2 arcsec aperture hole. Both spectra are fed to the spectrograph and are recorded simultaneously on the detector. Since 2 spectra are now recorded, the images are sliced into 3 slices only so they fit on the detector without overlapping. This means the resolution is lower than in the 'star only' spectroscopic mode, and is around 68,000.

In the polarimetric mode, the light from the star is analyzed by the optical components in the polarimeter, where 2 beams of opposite polarizations are produced and fed to the spectrograph. Once again, 2 interleaved spectra are recorded on the detector, with images sliced in 3, which gives a spectral resolution of about 68,000.

The scientific drivers for ESPaDOnS cover a broad range of research subjects in stellar and interstellar physics, such as stellar magnetic fields and surface inhomogeneities, differential rotation, stellar activity, diffusion and turbulence, convection, abundances, pulsations, winds and disks, extrasolar planets, and interstellar bands, to name just a few.

Commissioning observations for two separate projects were carried on hot stars and convective stars. Despite marginal weather, a few results were obtained. V471 Tau, a 12.5 hr eclipsing binary composed of a dwarf convective star and a hot white dwarf, was followed over most of its rotation period to produce a map of the spots and magnetic field strength and geometry. The first observer, using the spectroscopic mode, used ESPaDOnS on Christmas night, with clear skies and exciting results. The overwhelming number of proposals for 2005A resulted in 11 programmed runs with a total of 30.5 nights.



Commissioning data obtained on V471 Tau. Following the circular polarisation for this star over most of its period allows one to map star spots and the geometry of the magnetic field. In each panel the pole is at the centre, and the equator is the thick circle. The numbers are the rotation phase and tick marks indicate at which phase observations were taken.

The personal touch

Sidik Isani left CFHT in February 2004 after 9 years with the software group. He has joined the PanSTARRS project at the Institute for Astronomy. While at CFHT Sidik was in charge of the "New Environment for Observing" project which provided the software infrastructure for observing with CFH12K and MegaPrime, including his writing of the Director program and agents, the DetCom detector interface control program, new FITS libraries, and the RPM web server. We wish him well working with a new, even larger camera.

L. William Rambold left CFHT in August 2004 after 5 years, not counting several previous visits. He was the project engineer for MegaPrime, seeing it developing through to commissioning and becoming a highly successful and productive instrument. He was also instrumental in the design reviews and acceptance testing for OASIS and ESPaDOnS, and the design of WIRCam. In addition he became group manager for the instrumentation group when it was formed in 2003. He has retired again to Denman Island and his cabin in the wild, at least for a moment. We thank him for all his efforts here and know he will succeed in the future.

Eugene Magnier left his position of UH Resident Astronomer at CFHT at the beginning of 2004 to join the Pan-STARRS project at IfA. Eugene spent 4 years at CFHT and was instrumental in the development of the New Observing Process. In particular, his work to define and implement the data reduction and analysis system (Elixir) for CFH12K and MegaCam was nothing short of spectacular! Eugene was also involved in several other areas at CFHT, from MOS support to the outreach program. Mahalo Nui Eugene and all the best!

Malia Mallchok left CFHT in January 2004 after 2.5 years with the software group. She wrote and distributed multitudes of CFH12K and MegaPrime data tapes for observers during that time. She also performed many Windows installations and virus disinfestations for our PC users. May her future endeavors be as successful as was her time here.

Bobby Song left CFHT in April 2004 after almost 22 years at the summit. He kept up with the telescope electronics as they went through various birthing pains and mid-life crises, keeping things running, adding new bit and pieces as the state of the art advanced, and making many cables for those of us less patient. We hope he will be able to acclimatize well to the denser atmosphere at sea level.

Outreach

2004 has been a very interesting year for the outreach group. We have welcomed a new active member; the outreach team is now made of Moani Akana, Liz Bryson, Rémi Cabanac, Mary-Beth Laychak, Billy Mahoney, Grant Matsushige. Thanks to the enthusiasm of the CFHT staff, we have been able to organize or participate in a remarkable number of activities. A quick look at the calendar will give the reader a good idea of the dynamisn of our team and the broad range of our interest!

CFHT Christmas star party of December 4, 2004.

Onizuka Day: Mary-Beth teaches how CFHT works.

2004 Calendar

Stargazing parties:

- June 8, 2004 (Venus Transit)
- Dec 4, 2004 (Christmas)

Fairs and festivals:

- Jan 24, 2004: Onizuka Day
- Feb 3, 2004: Waimea HPA school Science fair
- Feb 16, 2004: Hilo Science Fair (judging)
- Mar 10, 2004: Women in Science Hilo (talks to school students)
- Apr 24, 2004: Astro Day
- May 15, 2004: Keiki Fest
- June 30, 2004: MKAEC blessing and dedication ceremony
- Sept 16-19, 2004: Hilo County Fair
- Aug 29, 2004: Waimea Aloha festival
- Oct 1st, 2004: Waimea middle school Career Day (talks)

Summit and HQ visits:

- Feb 29, 2004: Parker school science students HQ visit (talk)
- Mar 5, 2004: HPA VIP summit visit
- Mar 15, 2004: Summit Visit Community College Hilo
- Spring 2004: Visit of Flat Stanley from Surrey, B.C. (Canada)
- May 25, 2004: Mauna Kea Guiding for Lonely Planet editor
- Nov 15, 2004: Visit from science students of Surrey, B.C.

Miscellaneous outreach activities

In addition to scheduled activities, CFHT also participates in numerous outreach activities rooted in the local and state education system. Among these are an ongoing project to donate posters to all Big Island public schools, public lectures at workshops for science teachers of the state and lectures in schools.

CFHT participates also as sponsor or tutor in educational projects such as Kohala Electric Car Project or the Parker School students community work. A growing aspect of our activity is directed towards supporting the future Mauna Kea Astronomy and Education Center in Hilo, by the creation of the exhibits.

Finally, Liz Bryson represents CFHT at the monthly meetings of the Mauna Kea Observatories Outreach Committee. The MKOOC oversees common outreach activities of Mauna Kea Observatories.

Astronomy with Aloha

During the year 2004, the outreach group designed a T-shirt for its volunteers in order to give CFHT more visibility in outreach events. The outreach group launched a contest for CFHT staff and their families. The goal was to invent a slogan to be printed on the outreach T-shirts. The winner's name, Lisa Wells, was announced at the Board meeting in December. She won a brunch for two at a West Hawaii coastal resort for the slogan **"Astronomy with Aloha".**

Finally, the outreach group wishes to extend its mahalo to the families of the CFHT staff. Many outreach activities are necessarily organized during the week-ends or late at night, and the families are often solicited to share their spouse, father or mother, or simply to participate in the outreach effort themselves. Without the efforts and dedication of the families of the CFHT staff, the outreach group would certainly not be able to bring astronomy to Hawaii!

Last but not least, the Oral History project is finally underway, and, thus far, every interview has been different. The stories, humorous, nostalgic, and sad, capture a sense of astronomical history that can never be duplicated. Our librarian hopes that Big Island residents will enjoy the legacy of CFHT and the people who made it all happen.

Safe sunspotting at the Waimea Festival with Loïc.

VIPs enjoying a summit visit after winning CFHT's silent auction gift to a local school.

New Faces

Loïc Albert – Resident Astronomer

Loïc came to CFHT in July 2004 from *Université de Montréal* where he participated in building a Near-Infrared Camera/Spectrograph for his PhD project. As WIRCam Instrument Scientist, he is responsible for adapting the Elixir Reduction Pipeline for WIRCam and managing the Queued Service Observing once the instrument is commissioned. Loïc is actively searching for brown dwarfs, both around nearby stars and elsewhere in the Galaxy. He dreams of starting an all-Hawaiian hockey cossom team.

Tomo Matsumoto – Assistant System Administrator

Tomo joined CFHT in February 2004 after working in the San Francisco Bay area as a software engineer and a project manager for 12 years. Besides her work in system administration, Tomo enjoys playing piano and violin, tutoring math and hiking with her family.

Doug Teeple – System Programmer

Doug arrived at CFHT in June 2004. He has over 25 years of experience in commercial and scientific software development. Doug has a BSc in Systems Engineering and a MSc in Computer Science/EE. Besides enjoying his work on real-time closed-loop guiding software, Doug enjoys working on his Karmann Ghias.

Billy Mahoney – Data Base Specialist

Billy came to the CFHT in January 2004 as a member of the software group to help with database and software development. He spent the previous 14 years working for high-tech companies in the San Francisco and Lake Tahoe areas. He enjoys raising his two girls and long distance running.

Current Staff at CFHT

Akana, Moani	Administrative Specialist	Manset, Nadine	Resident Astronomer
Albert, Loïc	Resident Astronomer	Martin, Pierre	Director of Science Operations
Alles, Rosemary	Systems Programmer	Matsushige, Grant	Sr. Instrumentation Specialist
Atapattu, Rohendra	Operations Manager	Mizuba, Les	Detector Specialist
Barrick, Gregory	Optical Engineer	Potter, Sharon	Safety Specialist
Beck, Thomas	Electrician	Puget, Pascal	WIRCam Project Manager
Benedict, Tom	Instrumentation Specialist	Rodgers, Jane	Finance Manager
Brotman, Susan	Instrumentation Specialist	Sabin, Daniel	Mech. Designer / Instrument Maker
Bryson, Elizabeth	Librarian	Salmon, Derrick	Director of Engineering
Burdullis, Todd	Service Observer	Savalle, Renaud	Data Base Engineer
Cabanac, Rémi	Resident Astronomer	Stevens, Mercédes	Administrative Assistant
Cruise, William	Telescope Control Systems Engineer	Szarlan, Todd	Instrumentation Specialist
Cuillandre, Jean-Charles	Staff Astronomer	Taroma, Ralph	Observatory Facility Manager
Dale, Laurie	Administrative Specialist	Teeple, Doug	System Programmer
Fischer, Linda	Resource Specialist	Thomas, James	Software Manager
Forveille, Thierry	Resident Astronomer	Uchima, Roger	Mechanical Technician
George, Teddy	Observing Assistant	Valls-Gabaud, David	Visiting Astronomer
Hickman, Coleen	Accounting / Administrative Specialist	Veillet, Christian	Executive Director
Ho, Kevin	Instrumentation Manager	Vermeulen, Tom	Systems Programmer
Lai, Olivier	Resident Astronomer	Ward, Jeff	Detector Engineer
Laychak, Mary Beth	Service Observer	Warren, DeeDee	Director of Finance & Administration
Look, Ivan	Mechanical Design Engineer	Wells, Lisa	Observing Assistant
Luthe, John	Observing Assistant	Withington, Kanoa	System Administrator
Mahoney, Billy	Data Base Specialist	Wood, Roger	Automotive Mechanic
Matsumoto, Tomoko	Assistant Systems Administrator	Woodworth, David	Observing Assistant

Comings and Goings

Delorme, Phillipe	Visitor	Apr-Aug	Quinn, Mathews	Visitor	Jan-Apr
DeMotta, Ryan	Staff	Feb-Dec	Rambold, William	Left	Aug
Isani, Sidik	Left	Feb	Riopel, Martin	Visitor	Jul-Aug
Kim, Sam	Visitor	Jun arrival	Song, Robert	Left	May
Lin, Ethan	Visitor	May departure	Stanley, Paul	Left	Jul
Magnier, Eugene	Left	Jan	Wang, Shiang-Yu	Visitor	Nov-Dec
Malan, Van	Staff	Aug-Sep	Yan, Chi-Hung	Visitor	Sep arrival
Mallchock, Malia	Left	Jan			

Financial Resources

The three member agencies supported the shares of CFHT's annual budget in 2004 as shown in the table at right, in US funds.

Agency Contributions

NRC	$2,770,801
CNRS	2,770,801
UH	642,504
Total	$6,184,106

These contributions reflect a fourth-year extension of the financial framework originally established by the Board for the five years 1996-2000, which freezes the operating budget at its 1995 amount without adjustment for inflation.

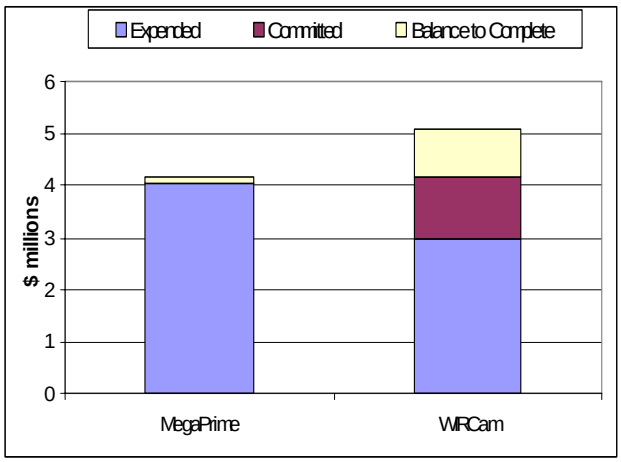
Under collaborative agreements with CFHT, Korea Astronomy Observatory and National Taiwan University remitted $400,000 and $908,259 respectively, as reimbursement for costs associated with their use of the Corporation's facilities. Other sources of funds included $15,087 from the daily surcharge credits at the mid-level facility and $109,281 in earned interest allocated to the contingency reserve fund.

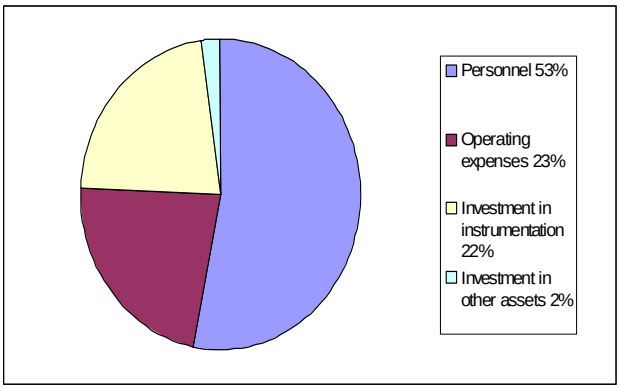
Expenditures for 2004

Observatory facilities and operations	$662,027
Base facilities and operations	653,583
Instrumentation	115,371
Science	66,989
Personnel	4,247,045
General expenses	445,591
Reserve	(6,500)
Total Operating Fund Expenditures	$6,184,106

From the operating fund, expenditures were allocated to the areas listed in the table at right.

During the year $1,789,433 were disbursed from the instrumentation fund for the current projects of the Wide-field Imaging plan, which brings the total investment under this multi-year program to $8,570,412. The current appropriation and the portion committed to date are shown in the graph below for MegaPrime and for WIRCam, the two ongoing major instrument projects. At the end of 2004, 90% of total appropriations under the Wide-field Imaging plan were spent or committed. Overall in 2004, resources from all CFHT funds were allocated to the categories of expenditures shown in the pie chart below.





CFHT Committees

Board of Directors

Executive Secretary to the Board of Directors: Mercédes Stevens

Claude Carignan [C] - Secretary	Université de Montréal
Jean-Gabriel Cuby [F] - Vice-Chair	Laboratoire d'Astrophysique de Marseille
James Gaines [H]	University of Hawaii
William Harris[C] - Chair	McMaster University
James Hesser[C]	Herzberg Institute of Astrophysics
Anne-Marie Lagrange[F]	Institut National des Sciences de l'Univers
Robert A. McLaren[H] - Treasurer	University of Hawaii
Jean-Pierre Picat[F]	Observatoire Midi-Pyrénées
Daniel Rouan[F]	Observatoire de Paris-Meudon
Richard Normandin[C]	National Research Council Canada

Scientific Advisory Council & Time Allocation Committee Members

Jean-Luc Beuzit[F] - TAC	Observatoire de Grenoble
David Bohlender[C] - TAC	Herzberg Institute of Astrophysics
David Elbaz[F] - TAC	Commissariat à l'Energie Atomique
Eric Emsellem[F]	Centre de Recherches Astronomiques de Lyon
Chris Ftaclas [H] - TAC	University of Hawaii
George Mitchell[C] - TAC	Saint Mary's University
Patrick Petitjean[F] - Chair	Institut d'Astrophysique de Paris
Christopher Pritchet[C]	University of Victoria
Nicole St.-Louis[C] - Vice Chair	Université de Montréal
Brent Tully[H]	University of Hawaii

CFHT Executive

Christian Veillet - Executive Director	DeeDee Warren - Director of Finance and Administration
Derrick Salmon - Director of Engineering	Pierre Martin – Director of Science Operations

Audit Committee

Bernard Adans[F]	Centre National de la Recherche Scientifique
Daniel Gosselin[C]	National Research Council Canada
Russell Miyake[H] - Chair	University of Hawaii
Peter Peacock[C]	National Research Council Canada
Hubert Rédon[F]	Centre National de la Recherche Scientifique

Contracts Review Committee

Catherine Brophy[C]	Public Works & Government Services Canada
Robert McEwen[C] - Chair	National Research Council Canada
Michel Ravaut[F]	Institut National des Sciences de l'Univers
Gérard Vivier[F]	Institut National des Sciences de l'Univers
Edward Yuen[H]	University of Hawaii

[C]Nominated by the National Research Council Canada
[F]Nominated by the *Centre National de la Recherche Scientifique*, France
[H]Nominated by the University of Hawaii

Approved Programs 2004A

Allen	MegaPrime	Enhancing SIRTF's Ecliptic Plane Survey
Aussel	MegaPrime	Resolving the Cosmic Infrared Background
Barkhouse	MegaPrime	Environmental Effects on the Cluster Dwarf Galaxy Population
Bohlender	Gecko	A large-scale investigation of the small-scale structure of the interstellar medium
Bohlender	Gecko	The isotopic helium abundances of the hot field horizontal branch star Feige 86
Bouvier	CFHTIR	Near-infrared imaging of optically selected brown dwarf candidates in pre-main sequence clusters
Capak	MegaPrime	Understanding the Star Formation History of the Universe
Capak	MegaPrime	Determining the Evolution of Starburst Galaxies
Charpinet	Lapoune	Asteroseismology of pulsating subdwarf B stars: A CFHT/WHT campaign with multicolor photometry
Clénet	AOB GRiF	Spectro-imagerie de la région du centre galactique : recherche d'images dédoublées par lentille gravitationnelle et analyse spectrale de la population stellaire d'étoiles massives
Clem	MegaPrime	The CFHT MegaPrime Globular Cluster Survey
Connors	MegaPrime	An Earth Trojan Search in the MegaCam era
Cowie	MegaPrime	An Intensive Survey of the Hubble Deep field North
Cuillandre	MegaPrime	Dust-to-gas ratio and stellar content of the intergalactic medium in the tidally-interacting Messier 81 group
Dawson	CFHTIR	Empirical Temperature-Scale Calibration for Low-Mass Stars
Demers	MegaPrime	Tracing the halo of dwarf irregular galaxies: Sextans A and Sextans B
Demers	MegaPrime	The riddle of the star formation history of the halo of NGC 6822
Donovan	MegaPrime	A weak-Lensing Study of Massive MACS Clusters
Doressoundiram	CFHTIR	Visible-infrared colors of the outer solar system objects
Forveille	AOB GRiF	The small scale structure of the Helix nebula (NGC 7293)
Ftaclas	AOB IR	Adaptive Optics Search for Extrasolar Planet Companions Around White Dwarfs
Gerbaldi	Gecko	Probing time dependant diffusion in A-type stars members of open clusters
Gladders	MegaPrime	Galaxy clusters as dark energy probes
Hanes	MOS	Globular Clusters as Dynamical Probes of the Dark Halos of Early-Type Galaxies: Omnipresent or Not?
Harris	MegaPrime	Global Structure of the M87 Globular Cluster System
Henry	MegaPrime	Comparison of Cluster Samples Selected at X-ray and Optical Wavelengths
Im	MegaPrime	Rest-frame UV Imaging of the SIRTF First Look Survey: Rare IR Sources and Star Formation Rate of the Universe at $1 < z < 3$
Kawasaki	MegaPrime	Dwarf galaxies in the Hercules cluster
Kim	CFHTIR	CFHT-IR K-band Imaging Observations of Ultraluminous Infrared Galaxies and Field QSOs
Kuan	AOB GRiF	Direct imaging of Water Jets from Cometary Nucleus of C/2001 Q4 (NEAT)
Kwok	CFHTIR	Imaging of Molecular Hydrogen Emission in Planetary Nebulae
Kwon	MegaPrime	Cometary Dust Trail Survey
Lagrange	AOB IR	Investigating low-mass companions around early type stars
Lin	MegaPrime	MegaCam I and z survey of DEEP2 fields
Manset	Gecko	Spectroscopy of hot star candidates with recently formed circumstellar dust
Park	MegaPrime	Search for tidal structures of halo globular clusters
Petit	MegaPrime	A search for small distant satellites of Neptune
Petitjean	MegaPrime	Corrélations spatiales dans le milieu intergalactique
Reipurth	MegaPrime	Ultra-Deep Hα Imaging of Herbig-Haro Flows
Rizzi	MegaPrime	Multiband Imaging of Nearby Galaxies
Robin	MegaPrime	Cinématique du bulbe galactique : vers une meilleure compréhension de la formation des bulbes
Sanders	MegaPrime	Hawaii Imaging of the HST-ACS COSMOS 2-Degree TreasuryField
Segall	MegaPrime	A la recherche de la queue du Dragon: la matiere noire dans les galaxies naines
Seymour	MegaPrime	The origin of the microJansky radio source population and its link to the X-ray and Far Infrared background.
Sheppard	MegaPrime	Faint satellites of the gas giants
Sohn	CFHTIR	Near-Infrared census of metal poor globular clusters in the Galactic Bulge
Stalder	AOB IR	AO Studies of High *z* Radio Source Hosts Near Bright Natural Guide Stars
Stratta	MegaPrime	GRB physics, progenitors and cosmological environment
Wang	MegaPrime	High-Redshift Star Forming Galaxies in Lensing Cluster Fields
Webb	MegaPrime	Optical identification of newly discovered X-ray sources in two galactic globular clusters
Willott	CFHTIR	The quasar luminosity and black hole mass functions at z=6 from the CFHTLS
Yee	CFHTIR	Deep Imaging of High-z Galaxy Clusters with Submm Sources

Approved Programs 2004B

Akiyama	MegaPrime	Search for Obscured QSOs in the High-z Universe
Allen	MegaPrime	Determining the Kuiper belt Size Distribution
Allen	MegaPrime	The Sub-Kilometer Main Belt Asteroid Population
Beaulieu	MegaPrime	A wide-field survey for variable stars in M 33
Bohlender	Gecko	A large-scale investigation of the small-scale structure of the interstellar medium
Bouvier	CFHTIR	Proper motion of brown dwarf candidates in the Hyades cluster : a near-IR follow-up
Carney	Gecko	Line broadening in luminous metal-poor stars: Turbulence or Absorption of Planets?
Catala	AOB IR	Imagerie AOB des champs des cibles de la mission spatiale COROT
Chene	OSIS V	In Pursuit of the Rotation Rates of Wolf-Rayet Stars
Chiueh	MegaPrime	Galaxy Clusters as a Dark Energy Probe
Courteau	MegaPrime	The Halo Shape, Metallicity, and Substructure of Three Nearby, Massive Galaxies
Cowie	MegaPrime	The Large Scale Structure and Evolution of AGN at z < 1
Crotts	MegaPrime	Microlensing in M31 at Large Distances and for Large Masses
Dennis	MegaPrime	Images for Canadian Amateur Astronomer Contest
Dougados	MegaPrime	The substellar IMF in Taurus: completion of the CFHT deep photometric survey.
Durret	MegaPrime	Deep multi-band imaging of the merging cluster Abell 85 and its X-ray filament
Fernandez	MegaPrime	Survey of Catastrophic Mass Loss in Comets
Forveille	AOB IR	Stellar multiplicity and extra-solar planet formation
Ftaclas	AOB IR	Adaptive Optics Search for Substellar Companions Around White Dwarfs
Galazutdinov	Gecko	Linear, carbon-bearing, interstellar molecules.
Galland	AOB IR	Investigating low-mass companions around early type stars
Gilbank	MegaPrime	Tracing Galaxy Transformation around a pair of z=0.4 Clusters with MegaCam
Hodapp	MegaPrime	The Frequency of FU Orionis Events in M33
Hoekstra	MegaPrime	Comparison of the weak lensing mass to the baryonic constituents in X-ray luminous clusters of galaxies
Ibata	MegaPrime	Quantifying the structure and substructure of the outer halo of the Andromeda galaxy
Ip	MegaPrime	CFHT Survey of KBO Targets for the New Horizon Mission
Ishiguro	MegaPrime	Contemporaneous Survey of Dust Trails by CFHT/MegaCam and Spitzer/MIPS
Israelian	Gecko	Have the parent stars of extra-solar planetary systems engulfed planets?
Kalirai	MegaPrime	The White Dwarf Initial-Final Mass Relationship
Kavelaars	MegaPrime	The irregular satellites of Uranus: the era of impact
Kim	CFHTIR	CFHT-IR K'-band Imaging Observations of Ultraluminous Infrared Galaxies and Field QSOs
Kwon	MegaPrime	Contemporaneous Observations of Cometary Dust Trails by CFHT/MegaCam and Spitzer
Landstreet	Gecko	Magnetic measurements of very slowly rotating magnetic Ap stars
Lee	Gecko	Deep Raman Spectroscopy of Symbiotic Stars
Lee	MegaPrime	Search for high redshift clusters of galaxies around the North Ecliptic Pole
Lemaire	AOB GRiF	The spatially resolved dynamics of star-forming regions, using Pueo+GriF
Lim	CFHTIR	Optical/Near-IR and HI Imaging of QSO Host Galaxies
Lin	MegaPrime	MegaCam i' and z' survey of DEEP2 fields
Magnier	MegaPrime	POMME: Pixel Observations of M31 With MegaCam
Manset	Gecko	Spectroscopy of hot star candidates with recently formed circumstellar dust
Moraux	CFHTIR	Near-infrared follow-up of Pleiades and Blanco 1 brown dwarf candidates
Park	MegaPrime	Search for tidal structures of halo globular clusters II
Petit	MegaPrime	Recovery of small distant satellites of Neptune
Petitjean	MegaPrime	Corrélations spatiales dans le milieu intergalactique
Reipurth	MegaCam	Ultra-Deep Hα Imaging of Herbig Haro Flows
Rice	Gecko	Doppler Imaging of the Young Active SLowly Rotating Star PW And
Roueff	Gecko	The ionization rate of hydrogen in the neutral interstellar medium
Sung	OSIS V	The Kinematics and Star Formation Histories of Super Star Clusters (SSCs) of blue Compact Dwarf Galaxy (BCDG) NGC 1569
Tholen	MegaPrime	The Population of Asteroids Interior to Earth's Orbit
Tholen	MegaPrime	Recovery of Virtual Impactor 1994 WR12
Tully	MegaPrime	Multiband Imaging of Nearby Galaxies
Veillet	AOB IR	Binarity in the Solar System
Vidal-Madjar	Gecko	The evaporating planet HD 209458b : Search for additional escape signatures
West	MegaPrime	Dwarf Galaxies in the NGC 1023 Group
Willott	CFHTIR	The quasar luminosity function at z=6 from the CFHTLS

2004 CFHT Refereed Publications

All CFHT refereed publications are now located in a dataset on ADS at: http://adsabs.harvard.edu/abstract_service.html

The following criteria are used to judge whether a paper is considered a CFHT publication: "A paper must report new results based on significant observational data obtained at CFHT or be based on archival data retrieved from the CFHT archive. If data from multiple telescopes are included, the CFHT data should represent a significant fraction of the total data."

Abbott, J.B. et al. 2004, Wolf-Rayet stars in M33 - I. Optical spectroscopy using CFHT-MOS, MNRAS, 350, 522-564.
Andrievsky, S.M. et al. 2004, The galactic abundance gradient from Cepheids. V. Transition zone between 10 and 11 kpc, A&A, 413, 159-172.
Barrado y Navascués, D. et al. 2004, The substellar population of the young cluster λ Orionis, ApJ,610, 1064-1078.
Barris, B.J. et al. 2004, Twenty-three high-redshift supernovae from the Institute for Astronomy deep survey: Doubling the supernova sample at z > 0.7, ApJ,602, 571-594.
Battinelli, P. et al. 2004, Carbon star survey of Local Group galaxies. X. Wolf-Lundmark-Melotte a galaxy with an extreme C/M ratio, A&A, 416, 111-118.
Battinelli, P. et al. 2004, Carbon star survey in the Local Group. VIII. Probing the stellar halo of NGC 147, A&A, 418, 33-40.
Battinelli, P. et al. 2004, Carbon star survey of Local Group galaxies. IX. The spheroidal galaxy NGC 185, A&A, 417, 479-486.
Beuzit, J.-L. et al. 2004, New neighbours. III. 21 new companions to nearby dwarfs, discovered with adaptive optics, A&A, 425, 997-1008.
Blais-Ouellette, S. et al. 2004, Accurate determination of the mass distribution in spiral galaxies III. Fabry-Perot imaging spectroscopy of 6 spiral galaxies, A&A, 420, 147-161.
Boesgaard, A. M. et al. 2004, Boron benchmarks for the galactic disk, ApJ, 606, 306-318.
Borys, C. et al. 2004, The nature of a gravitationally lensed submillimetre arc in MS0451.6-0305: two interacting galaxies at z~ 2.9?, MNRAS, 203, 124.
Boschin, W. et al. 2004, Internal dynamics of the radio-halo cluster A2219: A multi-wavelength analysis, A&A, 416, 839-851.
Bournaud, F. et al. 2004, Kinematics of tidal tails in interacting galaxies: Tidal dwarf galaxies and projection effects, A&A, 425, 813-823.
Chorney, N. et al. 2004, A rotational light curve for the Kuiper belt object 1997 CV29, Icarus, 167, 220-224.
Crézé, M. et al. 2004, Dark baryons not in ancient halo white dwarfs, A&A, 426, 65-73.
Davidge, T.J. 2004, Stars, star clusters, and dust in NGC 3077, AJ, 127, 1460-1471.
Demers, S. et al. 2004, Carbon star approach to IC 10: Distance and correct size, A&A, 424, 125-132.
Duchêne, G. et al. 2004, Multiple protostellar systems. I. A deep near infrared survey of Taurus and Ophiuchus protostellar objects, A&A, 427, 651-665.
Ferruit, P. et al. 2004, Ionized gas and stars in the central kiloparsec of the type 2 Seyfert galaxy NGC 2110 - I. The data, MNRAS, 215, 1365-2966.
Flores, H. et al. 2004, Star formation rates of distant luminous infrared galaxies derived from Hα and IR luminosities, A&A, 415, 885-888.
Forveille, T. et al. 2004, An L0 dwarf companion in the brown dwarf desert, at 30 AU, A&A, 427, L1-L4.
Gavazzi, R. et al. 2004, Mass and light in the supercluster of galaxies MS0302+17, A&A, 422, 407-422.
Gioia, I.M. et al. 2004, RX J1821.6+6827: A cool cluster at z = 0.81 from the ROSAT NEP survey, A&A, 428, 867-875.
Haines, C.P. et al. 2004, Galaxy evolution in the environment of ABCG 209, A&A, 425, 783-796.
Heymans, C. et al. 2004, Weak lensing with COMBO-17: estimation and removal of intrinsic alignments, MNRAS, 347, 895-908.
Hoekstra, H. et al. 2004, Properties of galaxy dark matter halos from weak lensing, ApJ, 606, 67-77.
Hoekstra, H. 2004, The effect of imperfect models of point spread function anisotropy on cosmic shear measurements, MNRAS, 347, 1337-1344.
Hu, E.M. et al. 2004, The luminosity fuction of Lyα emitters at redshift z~5.7, ApJ, 127, 563-575.
Krasnopolsky, V.A. et al. 2004, Detection of methane in the martian atmosphere: evidence for life ?, Icarus, 172, 537-547.
Lee, K.H. et al. 2004, Mass segregation and tidal tails of the globular cluster NGC 7492, AJ,128, 2838-2846.
Liang, Y.C. et al. 2004, Misleading results from low-resolution spectroscopy: From galaxy interstellar medium chemistry to cosmic star formation density, A&A, 417, 905-918.
Maier, J.P. et al. 2004, On the possible role of carbon chains as carriers of diffuse interstellar bands, ApJ, 602, 286-290.
Maillard, J.-P. et al. 2004, The nature of the Galactic Center source IRS 13 revealed by high spatial resolution in the infrared, A&A, 423, 155-167.
Mékarnia, D. et al. 2004, Analysis of spectro-imaging data using the Karhunen-Loéve expansion: Application to NGC 7027 in the infrared, A&A, 418, 771-780.
Miroshnichenko, A.S. et al. 2004, Properties of galactic B[e] supergiants. III. MWC 300, A&A, 417, 731-743.
Pagani, L. et al. 2004, L183(L134N) Revisited. II. The dust content, A&A, 417, 605-613.
Paumard, T. et al. 2004, Kinematic and structural analysis of the Minispiral in the Galactic Center from BEAR spectro-imagery, A&A, 426, 81-96.
Pelló, R. et al. 2004, ISAAC/VLT observations of a lensed galaxy at z = 10.0, A&A, 416, L45-L40.
Pen, U.-L. 2004, Beating lensing cosmic variance with galaxy tomography, MNRAS, 350, 1445-1448.
Petit, J.-M. et al. 2004, A highly automated moving object detection package, MNRAS, 347, 471-480.
Petit, P. et al. 2004, Differential rotation of cool active stars, AN, 325, 221-224.
Pogodin, M.A. et al. 2004, A new phase of activity of the Herbig Be star HD 200775 in 2001 : evidence for binarity, A&A, 417, 715-723.

Raynaud, E. et al. 2004, Spectro-imaging observations of Jupiter's 2-μm auroral emission. I. H3+ distribution and temperature, Icarus, 171, 133-152.
Ridgway, S.E. et al. 2004, The aligned z ~ 1 radio galaxy 3C 280, ApJ, 600, 70-87.
Rucinski, S.M. et al. 2004, Differential rotation of the active G5 V star κ^1 Ceti : Photometry from the MOST satellite, PASP, 116, 1093-1104.
Ryabchikova, T. et al. 2004, The spectroscopic signature of roAp stars, A&A, 423, 705-715.
Schahmaneche, K. 2004, Intensive supernovae searches, Ap&SS, 290, 61-68.
Sharp, R.G. et al. 2004, A survey for low-luminosity quasars at redshift z~5, MNRAS, 350, 449-455.
Sheppard, S.S. et al. 2004, A survey for outer satellites of Mars: Limits to completeness, AJ, 128, 2542-2546.
Sung, H. et al. 2004, The initial mass function and young brown dwarf candidates in NGC 2264 I. The initial mass function around S Monocerotis, AJ, 128, 1684-1693.
Tovmassian G.H. et al. 2004, A close binary nucleus in the most oxygen-poor planetary nebula PN G135.9+55.9, ApJ, 616, 485-497.
Vaduvescu, O. 2004, Strategies for imaging faint extended sources in the near-infrared, PASP, 116, 640-651.
Valtchanov, I. et al. 2004, The XMM-LSS survey. First high redshift galaxy clusters: Relaxed and collapsing system, A&A, 423, 75-85.
Wang, H. et al. 2004, FU Orionis: A binary star?, ApJ, 601, L83-L86.
Webb, T.M.A. et al. 2004, The submillimeter properties of extremely red objects in the Canada-UK deep submillimeter survey fields, ApJ,605, 645-655.

Glossary

CEA: Commissariat à l'Energie Atomique, the French Agency responsible for the construction of MegaCam, under contract to CFHT.

CFHTLS: The CFHT Legacy Survey takes advantage of MegaCam's large field of view to conduct 3 different surveys totaling over 5000 square degrees in 5 years. The survey will play a crucial role in studies ranging from the nearby KBOs, to brown dwarfs in our Galaxy, to the distribution of matter in the Universe.

MegaCam: A large mosaic of 40 charge-coupled device (CCD) imaging chips that provides a field of view on the sky of one square degree, about five times the area covered by the full moon. It is on the sky since 2003.

MegaPrime: In order to make the best use of MegaCam, a completely new prime-focus environment is needed. The many separate activities involved in this work are grouped under the MegaPrime project. Apart from the original construction, this is the largest development project ever undertaken at CFHT and is the principal activity for much of our technical staff.

WIRCam: Wide-field Infrared Camera. This 16-million pixel camera provides a field of view on the sky somewhat greater than 40% of the area covered by the full moon. It was a major instrumentation project at CFHT and was constructed in collaboration with external partners for deployment on the sky in 2005.

ESPaDOnS: The échelle spectro-polarimeter which gives a complete optical spectrum in a single exposure with a spectral resolution of about 70,000. ESPaDOnS arrived at CFHT in 2004.

HIA: The Herzberg Institute of Astrophysics manages Canada's involvement in major astronomical observatories in Chile and Hawaii, and participated in the MegaPrime project.

Contact Information

Canada-France-Hawaii Telescope Corporation

65-1238 Mamalahoa Hwy
Kamuela, Hawaii 96743
U.S.A

Phone: +1.808.885.7944
FAX: +1.808.885.7288
http://www.cfht.hawaii.edu

National Research Council Canada

Herzberg Institute of Astrophysics
5071 West Saanich Road
Victoria, B.C. V9E 2E7
Canada

Centre National de la Recherche Scientifique

Institut National des Sciences de l'Univers
3 rue Michel Ange
75766 Paris Cedex 16
France

University of Hawaii

Institute for Astronomy
2680 Woodlawn Drive
Honolulu, Hawaii 96822
U.S.A