Annual Report 2005

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.

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UNIVERSITY OF HAWAII

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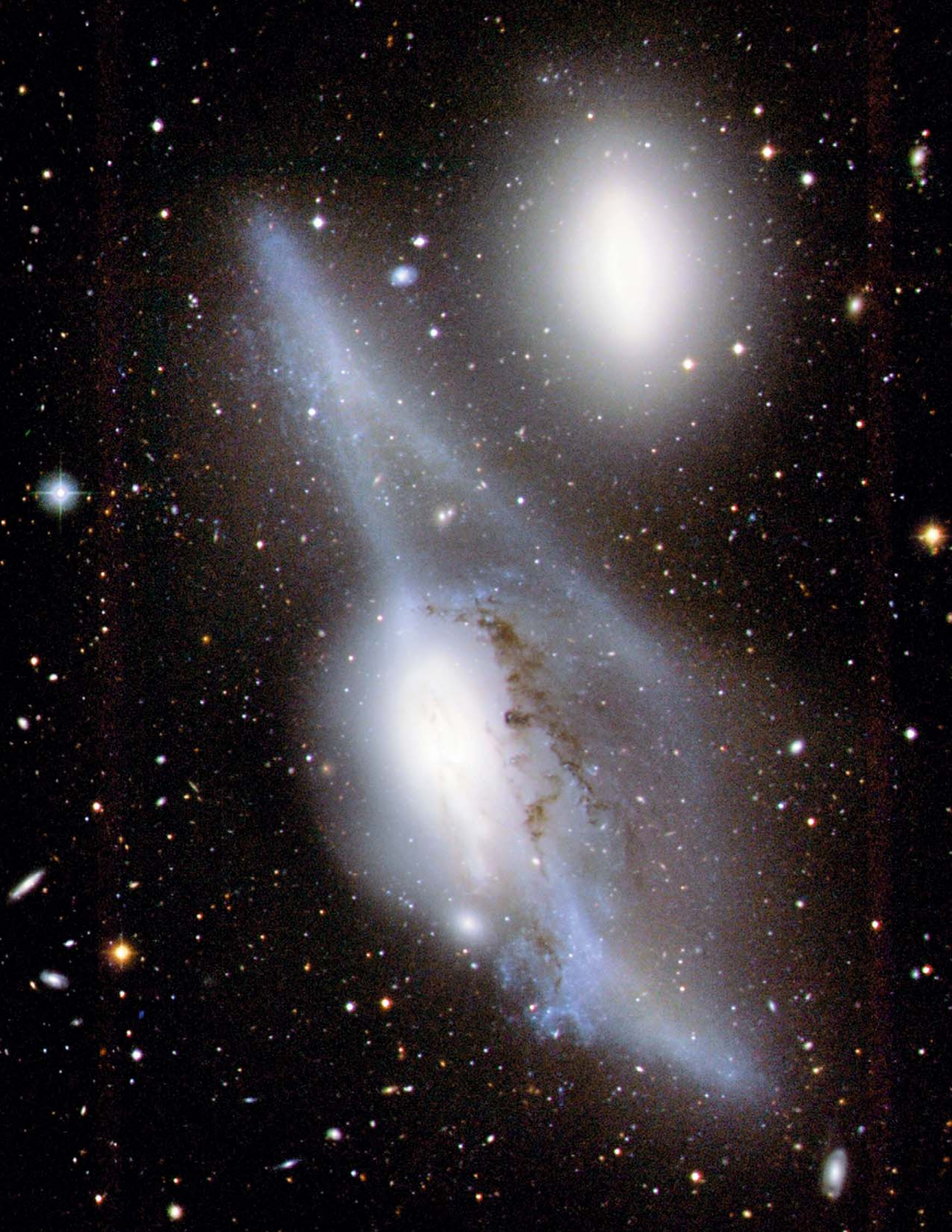

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Introduction

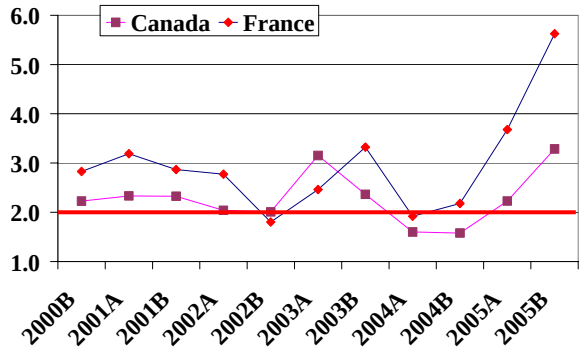
2005-2010: CFHT's Golden Age… Year 1!

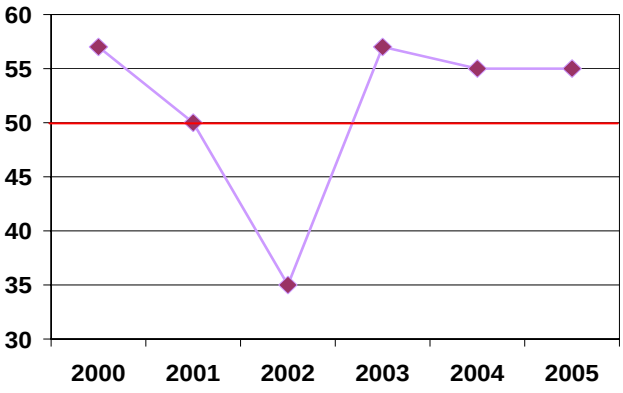
Executive Director Christian Veillet

At the end of my Introduction to the 2004 Annual Report, I briefly introduced "2005-2010: CFHT's Golden Age", a plan submitted to, and endorsed by, the CFHT Board of Directors in December 2004: a plan exciting enough that the staff, the Agencies, potential other funding partners or new customers would be ready to devote time, energy or funds to maintain CFHT at the forefront of astronomy up to the early years of the next decade. Focusing on the excellence of the services rendered to the community, on the efficiency of the Observatory and on leading-edge instrumental developments, this plan is intended to allow the CFHT Corporation to work at its best for the last six years of the decade and be ready for the era beyond 2010. 2005, the first year of this plan, gave the Observatory the opportunity to better define its goals for up to the end of 2010 and to develop the metrics it would use to measure the quality of its work and assess its success.

The first and likely most challenging goal is to gradually decrease the amount of **observing time lost** to technical problems, which range from a simple glitch to a major failure of the telescope or the instrumentation. The ultimate long-term goal is to lose less than 2% of the clear weather observing time to problems by 2010. With only 4.88% of clear observing time lost to problems, CFHT reached its 2005 goal of less than 5% (see p.7 for more details).

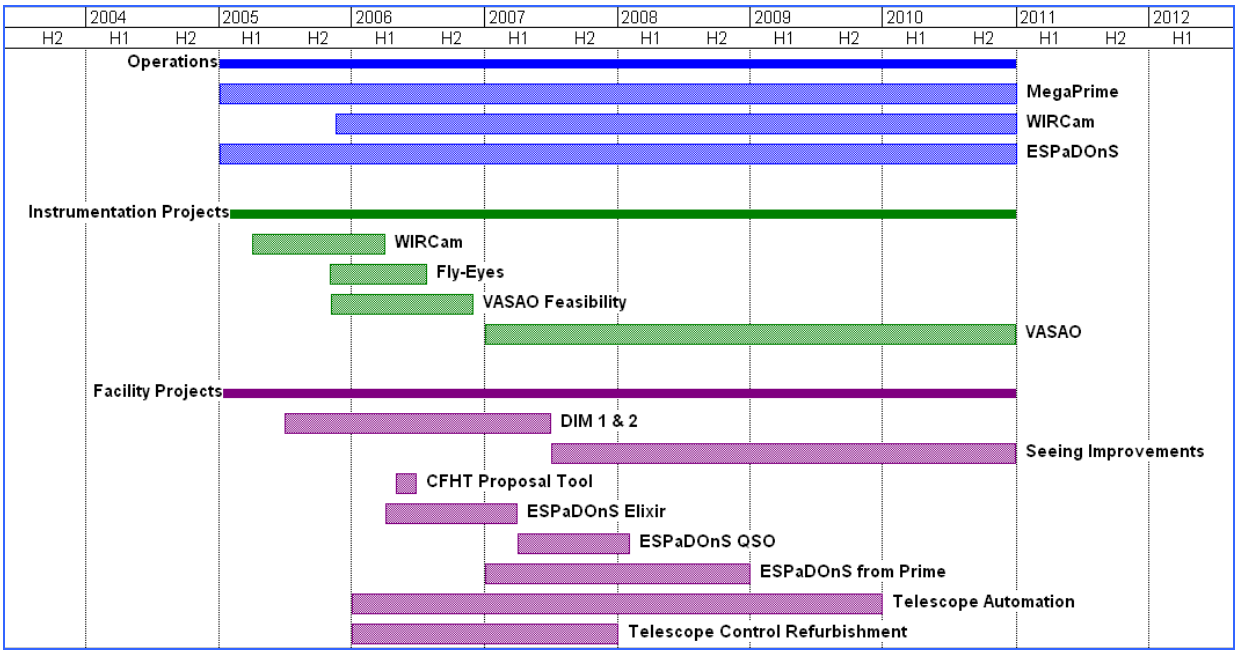
The **oversubscription on the observing time** offered to CFHT's main communities, often called "pressure", is a good indicator of the relevance of the Observatory and of its instrumentation. The goal of the Golden Age plan is to have this pressure stay above 2, a value considered as a healthy minimum by most observatories around the world. For the two semesters of 2005, a Canadian and French averaged pressure larger than 3 clearly demonstrated the importance of the Observatory for these two communities, as seen on the graph on the right.





The **number of refereed publications** is also a good indicator of the relevance of the data gathered by the telescope. Here again, a goal has been set for the duration of the plan: at least 50 publications per year in refereed journals significantly based on CFHT data. The graph on the left shows this number fluctuating over the past years. With the CFHT Legacy Survey and PI programs now ramping up on MegaCam, and new exciting programs being undertaken on ESPaDOnS, the observatory should be able to maintain a scientific yield considered as high for a relatively modest aperture telescope.

The Golden Age plan calls for various current projects to be completed and new ones to be undertaken. The graph below highlights the main objectives of this plan. On the operation side, three instruments will have to be maintained and hopefully upgraded to increase the overall observing efficiency of the observatory. **WIRCam** is indeed operational at the end of 2005, though still to be fine-tuned and its on-sky efficiency to be improved. The reliability of **MegaPrime** has significantly improved, with more still to be done. **ESPaDOnS**'s first year of operation was very productive, to the delights of many eager PIs. On the instrumentation side, **Fly-Eyes**, an on-sky test of novel detectors for wave-front sensing on PUEO, CFHT's adaptive optics, was resurrected at the end of 2005, once the workload of the WIRCam project lessened. The completion of these tests should happen in 2006. The Golden Age plan also calls for a new instrumentation development. By the end of 2005, the feasibility study of **VASAO**, "Visible All-Sky Adaptive Optics", was initiated. If indeed feasible, VASAO could offer CFHT the ability to image a small field at the limit of diffraction in the visible without any natural guide star around, even for the tip-tilt correction. Measuring the seeing inside and outside the dome has been in the books for a long time, and work started in mid-2005 on the "**DIMM**" project, with the installation of a dedicated small telescope in the dome. This project should be completed by mid-2007.



Beyond 2005, two areas will trigger heavy in-house developments:

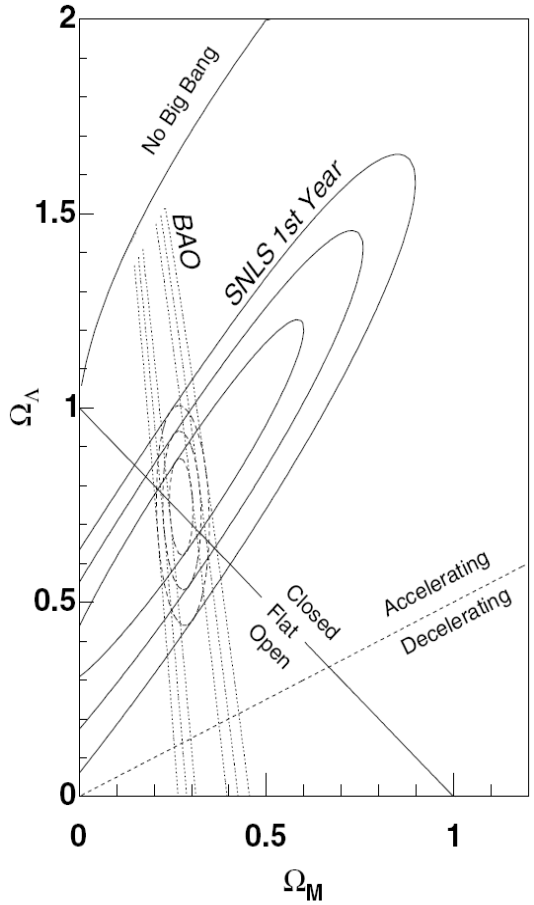
- The first one is related to **ESPaDOnS**, which should be offered **in QSO mode** some time in 2007. Many of the scientific programs are based on the monitoring of single targets over a few nights, something difficult to schedule in normal visitor mode, when the PIs come to the telescope to conduct their observations QSO would allow a more efficient use of the instrument and a better yield of the highest ranked programs. Once ESPaDOnS observations have moved to QSO mode, a fiber feed to ESPaDOnS from one of the prime focus cameras (most likely WIRCam), will allow the use of those many hours in long wide-field QSO runs when seeing is too bad for imaging, but good enough for spectroscopy.

- The second area of development will address the **remote operation** of the summit facility from Waimea, with, as the ultimate goal, the complete automation of the night time operations. Concurrently, this **automation** project will bring to the current operations better remote testing and diagnosis capabilities, therefore leading to a better efficiency of the overall observation process.

At the end of 2005, CFHT has reached what will be its instrument configuration for the coming years: between 250 and 300 nights a year of wide-field observations in QSO mode, and the rest mainly devoted to ESPaDOnS observations and engineering/instrumentation projects. With challenging operations as well as state-of-the-art developments to prepare the Observatory for 2011 and beyond, CFHT is looking ahead to an era of excellent services to the communities it serves, and exciting in-house developments by a highly dedicated staff: the ingredients for a healthy Corporation in the years to come…

Science highlights of 2005

CFHTLS: Let the publications begin!



Contours at 68.3%, 95.5% and 99.7% confidence levels for the fit to an (Ω_M, Ω_Λ) cosmology from the SNLS Hubble diagram (solid contours), the SDSS baryon acoustic oscillations (Eisenstein et al. 2005, dotted lines), and the joint confidence contours (dashed lines).

and is generating a lot of efforts, not only throughout the SNLS collaboration and at CFHT, but also among all the MegaPrime users. These efforts will actually benefit more than just the SNLS program! It should be noted that the uncertainty on the cosmological parameters is not only limited by the photometry of the SNLS high redshift SNe. It is also limited by the low redshift sample currently available.

With the efficiency of MegaPrime operation steadily improving, the SNLS should reach its objective of ~700 SNe Ia after five years of CFHTLS observations, therefore dramatically improving the uncertainties on the cosmological parameters related to the Dark Energy.

The 2004 Annual Report presented spectacular preliminary results on two of the Canada-France-Hawaii Telescope Legacy Survey (CFHTLS) key scientific topics:

(1) Through the study of type Ia supernovae (SNe Ia), determine the nature of the Dark Energy driving the accelerating expansion of the Universe via a measurement of the equation of state parameter w.

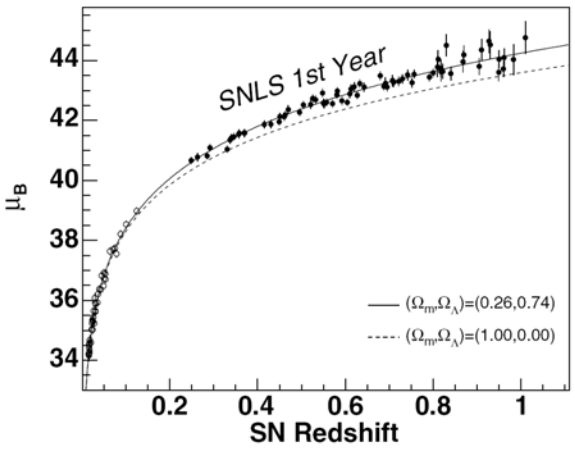
(2) Through the measurement of the cosmic shear, derive properties of the dark matter power spectrum and the biasing as function of angular scale and redshift.

2005 saw the acceptance for publication of two major papers, one on each of these two "hot" topics.

SNLS

The figure on the right illustrates the results from the SNLS (SuperNova Legacy Survey) component of the CFHTLS, released in November 2005 (Astier et al, *A&A* **437**, 31). With just one year of observation and 71 SNe Ia used for the study, the SNLS team was already able to place strong constraints on cosmological models. The results agree well with other measurements, either from similar determinations using SNe or from other sources.

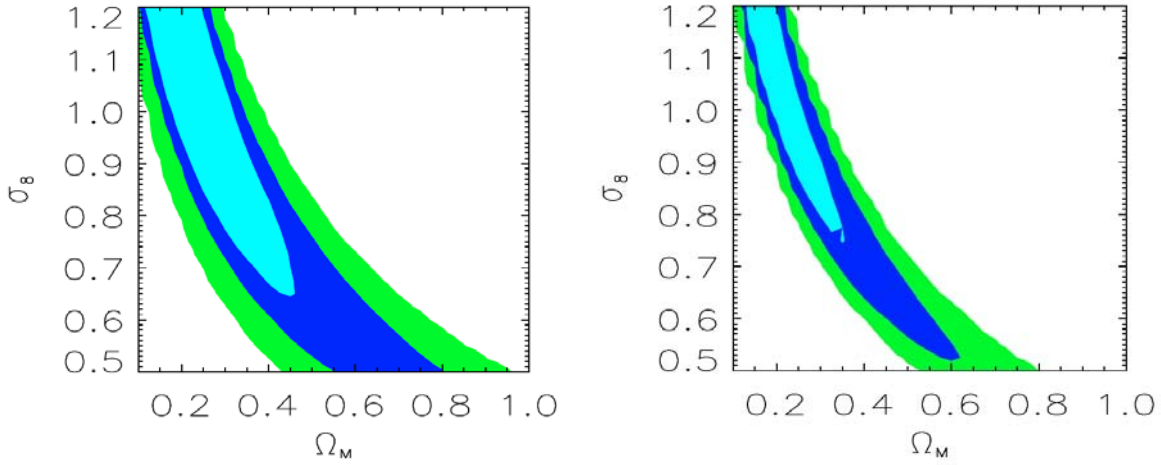
The actual fit to SNe data can be seen on the figure below, where the SNe discovered and followed-up by the SNLS cover the 0.3 to 1 redshift interval. Each of them was observed using with an 8-m class telescope to confirm its type and measure its redshift. Keck, Gemini and the VLT were used for these follow-ups. The higher noise in the photometry at high redshift is clearly seen on this graph. The photometric calibration of the CFHT images is therefore a key to the success of the project



Hubble diagram of SNLS and nearby SNe Ia, with various cosmologies superimposed.

Cosmic Shear

Cosmic shear (cosmological weak lensing) observations provide Dark Matter investigations with an invaluable complement to other methods like the one we just described based on the SNe Ia observations. With its Wide component ultimately covering 170 deg^2, and the four 1 deg^2 fields of its Deep component going to higher redshift, the CFHTLS is currently one of the best surveys tackling this problem. Preliminary results had shown that a clear and reliable cosmic shear signal was indeed measurable in a subset of 25 deg^2 of the Wide. By the end of 2005, the first two papers on Cosmic Shear from the CFHTLS were submitted for publication, one for the Wide (astro-ph 0511089) and the other for the Deep (Sembolini et al., *A&A* **452**, 51). The figure below shows result from the Deep only and combining Deep and Wide data, thus partially breaking the degeneracy on Ω_M–σ_8. This is the consequence of measuring the large and small scales simultaneously.

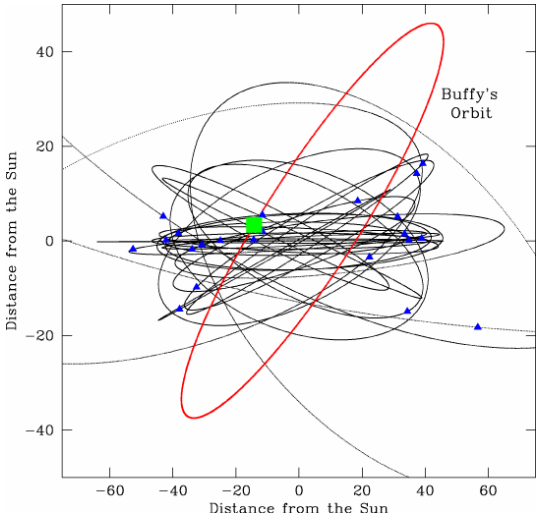


Ω_M and σ_8 constraints with the Deep only on the left, and combining Deep and Wide data on the right. The contours show 0.68, 0.95 and 0.999 confidence regions. Errors include statistical, covariance and residual systematic contributions. The models are pure Cold Dark Matter fit to the data, marginalized over the redshift distribution. With Ω_M = 0.3, the combined analysis gives σ_8 = 0.86 ± 0.05 at 1σ.

Though based on a small fraction of what will ultimately be offered by the CFHTLS, these first Cosmic Shear results augur extremely well for forthcoming studies based on the combination of wider patches of the Wide component and deeper images of the four Deep fields. These studies are likely to bring the best cosmological constraints from weak lensing observations.

From the Very Wide…

While the Very Wide component of the CFHTLS was descoped to allow the cosmology drivers of the survey, considered of higher priority, to proceed at a good pace, the study of the Kuiper Belt remained one of the exciting areas of the CFHTLS. In the course of the Ecliptic Survey (Very-Wide) component of the CFHTLS, tens of KBOs are regularly discovered and their dynamical properties nicely nailed down, thanks to the priority given to the follow-up of the discovered objects. Among them, an exotic object, nicknamed Buffy, was found on a nearly circular orbit which never brings it closer to the Sun than 50 au. A circular orbit of that size is by itself not explained by most of the current models of the Kuiper Belt. In addition, Buffy exhibits a very high inclination of 47degrees, making it an even more puzzling object.

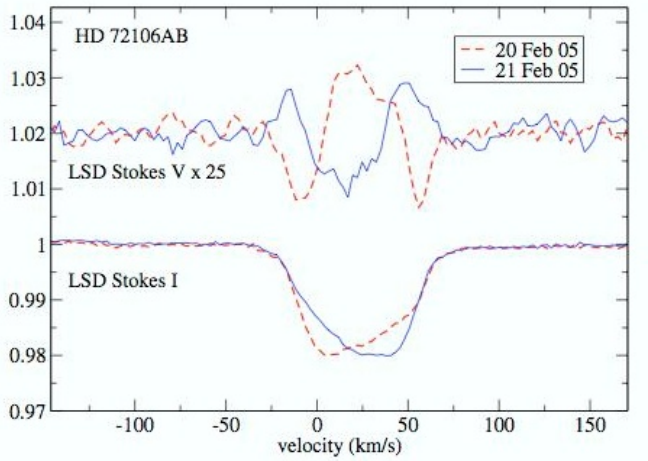


ESPaDOnS' First Year of Exciting Science

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.

Between December 2004, when ESPaDOnS was first offered to the astronomical communities, and December 2005, 18 polarimetry projects and 7 spectroscopy projects were programmed at the telescope, exploring many aspects of astrophysics, from studies of diffuse interstellar bands to magnetic fields in various types of stars.

One of the first projects that produced a refereed publication was led by 2 Canadian astronomers, Gregg Wade and John Landstreet, who looked for the progenitors of Ap/Bp stars. Those hot stars have strong, globally-ordered magnetic fields of strengths of thousands of Gauss, over a thousand times the Earth's own magnetic field. The strong magnetic fields introduce peculiarities in their spectra, hence the name Ap/Bp. Those magnetic stars make up about 5% of all ordinary A and B stars. The ESPaDOnS observations has led to the discovery that about 10% of the Herbig Ae/Be stars (which are thought to be younger versions of the A and B stars) observed for this project, also have magnetic fields of that order, strongly indicating that they are indeed the progenitors of the magnetic Ap/Bp stars.



Average of hundreds of spectral lines for the Herbig Ae/Be star HD 72106AB. The bottom graph shows the average intensity of the star's spectral lines, and the top graph shows the average circular polarization in those lines. The shape of the circular polarization signature yields the strength and configuration of the magnetic field. The fact that the shape of the lines changes between Feb 20 and Feb 21 (blue and red lines) indicates that the star has rotated in a day and therefore presents a slightly different magnetic field configuration.

On the French side, the leader of the team which designed and built the instrument, Jean-François Donati, and his collaborators, have detected a 1 kG magnetic field in the innermost region of the accretion disk around FU Orionis. FU Ori is a young star which suddenly appeared in the middle of a dark cloud in 1936, after its disk started to "drop" matter onto the star. Such magnetic fields have been suspected for a while on stars of that type, but this is the very first time that such a field was directly detected, thanks to spectropolarimetric observations.

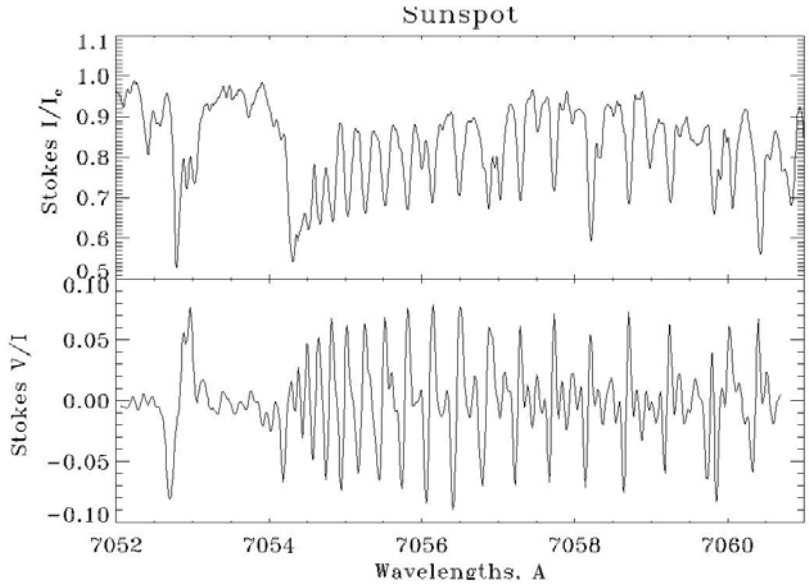
Most of the projects used the Zeeman effect, which affects the circular polarization in atomic lines of a spectra when there is a magnetic field. The Zeeman effect was however detected for the first time in molecular lines forming in magnetic regions (spots) on the surface of active stars. The project, conducted by European astronomers, was led by Svetlana Berdyugina. The molecular Zeeman signature is reminiscent of that observed in sunspots, and will help understand the magnetically active M stars on which is was detected.

Various observers have also contributed the discoveries of 5 new magnetic Ap stars, the second hot O star with a detected magnetic field, linear polarization in an evolved post-AGB star and a supergiant, and circular polarization on a M4.0 dwarf.

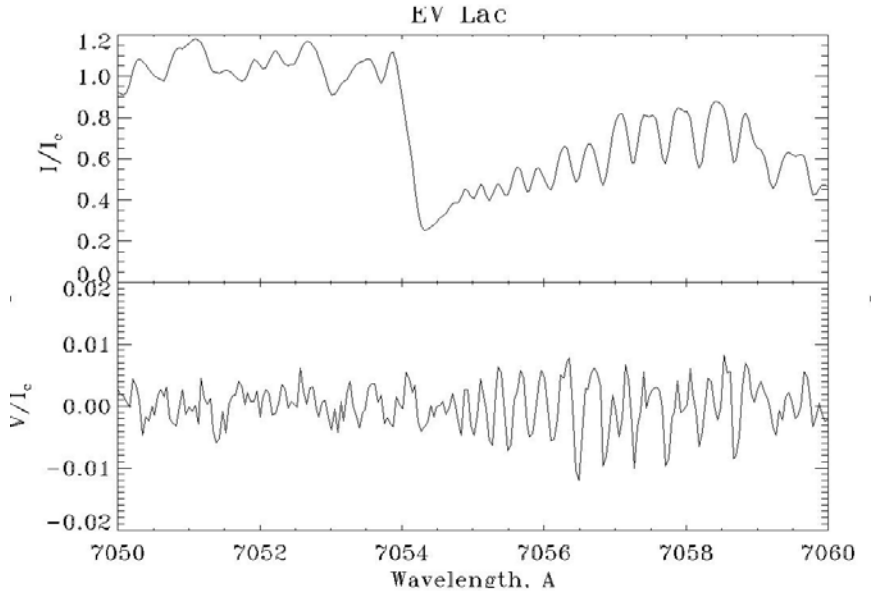
ESPaDOnS was also regularly used by CFHT's astronomers, who have carried out a couple of spectroscopic programs to understand the physics of dust formation around some hot stars, and to independently determine the distance to the Pleiades, a fundamental measurement whose exact value

affects almost all areas of astrophysics. Spectropolarimetric projects were also carried, to study the linear polarization in the emission lines of the Seyfert II galaxy NGC 1068, and the dynamo mechanisms in low-mass fully convective stars.

Thanks to a very reliable and user-friendly instrument, the ESPaDOnS programs carried out in the first year have already led to the publications of 5 papers…



Part of the spectra of a solar sunspot between 705 and 706 nm. The top panel shows the intensity of the light in the molecular TiO line. The bottom panel shows the circular polarization, Stokes V; the pattern is caused by the presence of a magnetic field inside the sunspot.



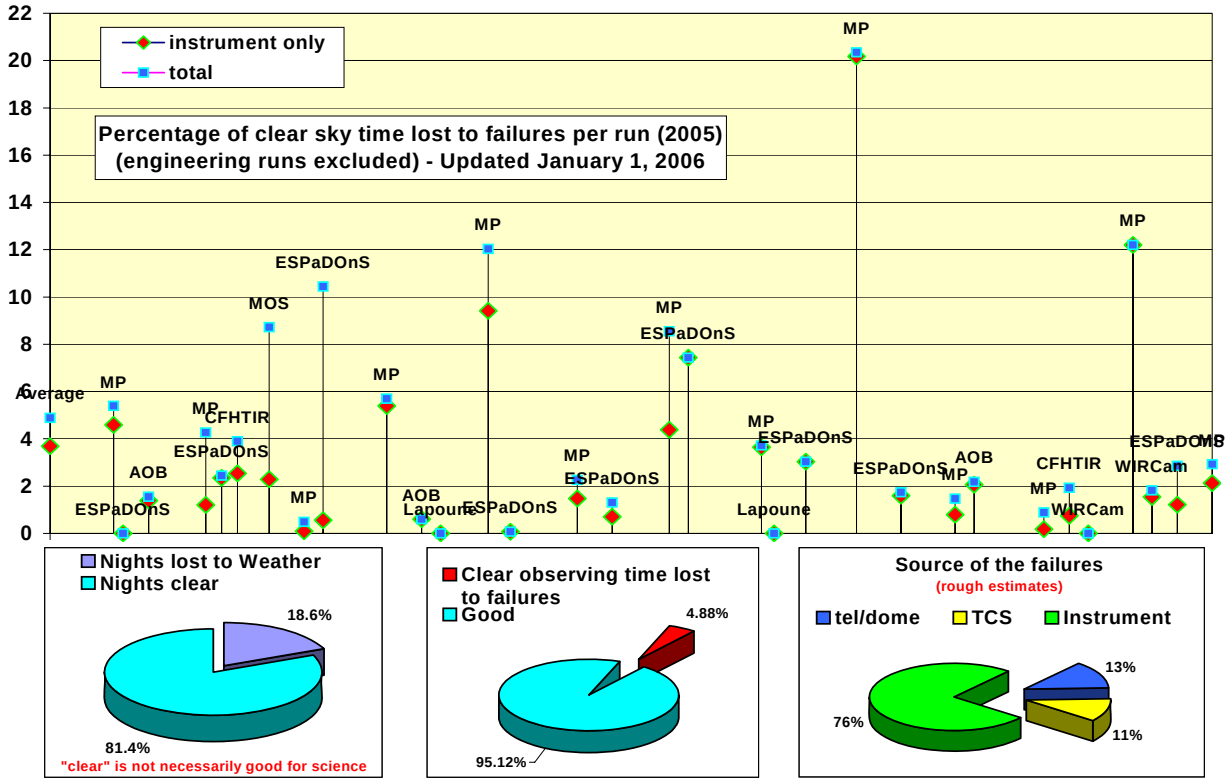
Same plot for the active M star EV Lac. Note how the features are similar to those found in a sunspot.

Operations Report

Observing efficiency

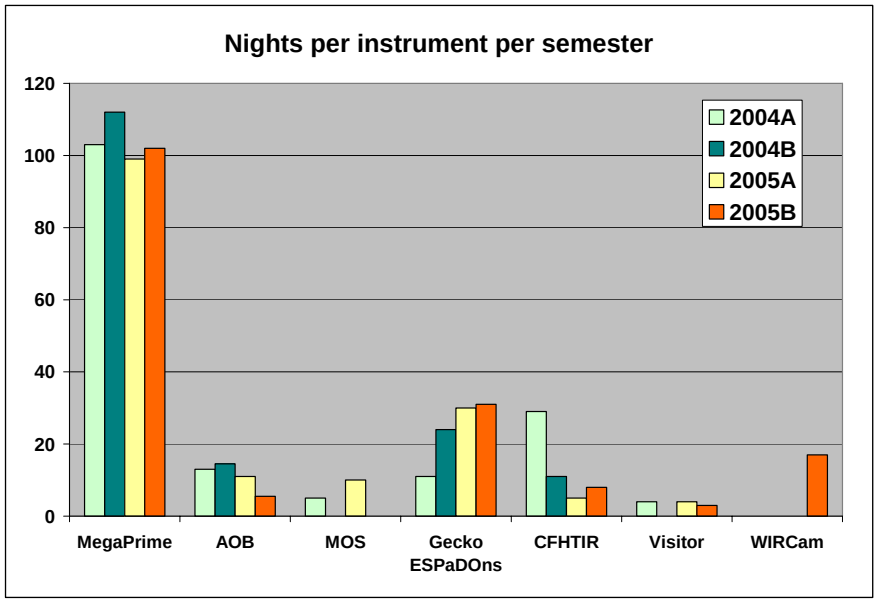
The observing efficiency of **MegaPrime/MegaCam** was a very pressing issue and made CFHT very busy throughout 2005. Plagued by various problems due its complexity as well as its heavy use, the camera and its various components were failing too often, leading to significant losses of observing time and undue pressure on the staff. Thanks to the experience gathered from the first two years of operation of this amazing instrument, it was possible to devise of a careful maintenance plan and to design and implement various upgrades of sub-systems found to be weakness points. As a consequence, MegaPrime behaved much better in average over the year. A couple of major failures still led to a significant loss of observing time, but they were solved through careful analysis and remediation and should therefore not happen again with such catastrophic consequences. Some work remains, especially on the filter changing system, and is planned for 2006.

The graph below summarizes the observing time losses due to instrument and telescope failures. The goal for 2005 was to limit the losses to a maximum of 5% of clear weather. In spite of the MegaPrime failures already mentioned, we were able to meet this goal, losing only 4.88% to problems of any kind. One should realize that a couple of glitches per night, each generating a loss of 10mn of observing time, end up with already 3.5% of the observing time lost!



This graph shows also the percentage of “clear nights” over the year. It is information to use carefully, as clear weather is not necessarily good enough for gathering useful scientific data. Detailed statistics for the QSO nights is available in the QSO pages of CHFT’s web site.

Instrument statistics



2005 observing time was again largely dominated by long MegaPrime runs. ESPaDOnS, the new spectro-polarimeter, was offered over the whole year and highly used, yielding impressive scientific results (see p.12 in this report). The use of Pueo, CFHT's Adaptive Optics bonnette, decreased significantly, a clear sign that Adaptive Optics is now routinely used on 8-m class telescopes. As long as Pueo is limited to natural guide stars and mostly infrared observations, it is of little interest to the communities CFHT is serving. 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. WIRCam was successfully used for its first "shared risk" scientific observations at the end of semester 2005B.

Queued Service Observing in 2005

During 2005, it was the first time that two instruments were offered and used under 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).

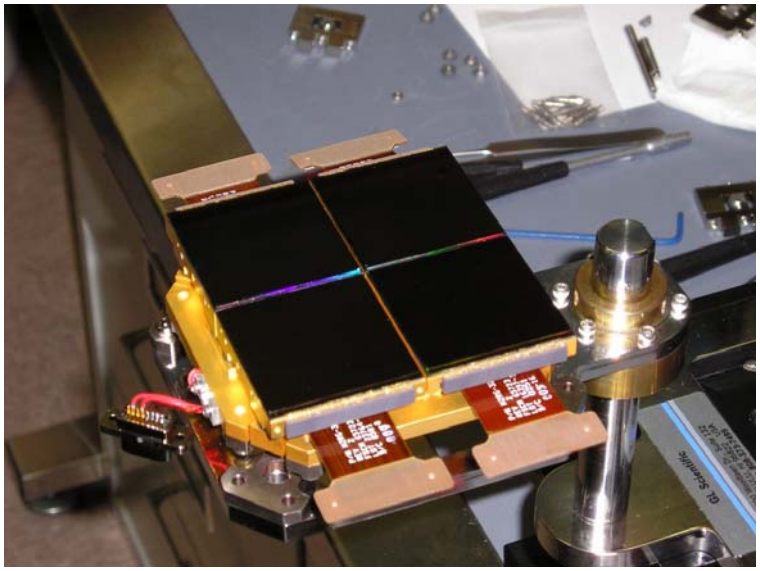
The front-end of the NOP scheme is the Queued Service Observing (QSO) project, which seeks to obtain astronomical data under the optimum sky conditions for each science program. Other goals include a fair balancing of the different Agency time, obtaining data for programs with time critical constraints (e.g. monitoring supernovae), and improvement of the observing efficiency. In 2005, observations for MegaCam in the QSO mode were scheduled for about 210 nights, close to 60% of the total telescope time available at CFHT! During each semester, about 40-45 different programs were available. Among the QSO programs, of course, is the CFHTLS which represents about 55% of the total observing time made available in the queue mode. During the last year, operational overheads have been minimized by making several improvements on the camera (faster guide probes, fully automated focusing model). The first semester of 2005 was a difficult one because the weather was much worse than usual and time was lost to several technical issues with the camera. The second semester was much better, the best so far with Megacam! For the second semester, the amount of data taken for highly ranked programs (A + B grades) was spectacular, with a completion level of 88%. In particular, the December 2005 run was exceptional with 8.2 hours of validated per night of average, with an observing efficiency well exceeding 90% during several nights. The time used between the different Agencies during 2005 was also fairly shared, not a small feat considering the global scheduling constraints on the programs.

During the semester 2005B, we also commissioned WIRCam within the QSO mode. A new Phase 2 Tool version was designed, implemented and used by several PIs with great success. Several new observing modes were made available for WIRCam, for instance micro-dithering and nodding pattern. The entire observing chain QSO->NEO->TCS was implemented and used to gather high quality data for several programs. Everything is ready for 2006 and the subsequent years!

WIRCam: On the Sky for Science

It has been a busy and productive year for the development of the Wide-field InfraRed Camera (WIRCam) at CFHT. All components have been received and integrated, and the instrument is on the sky for science.

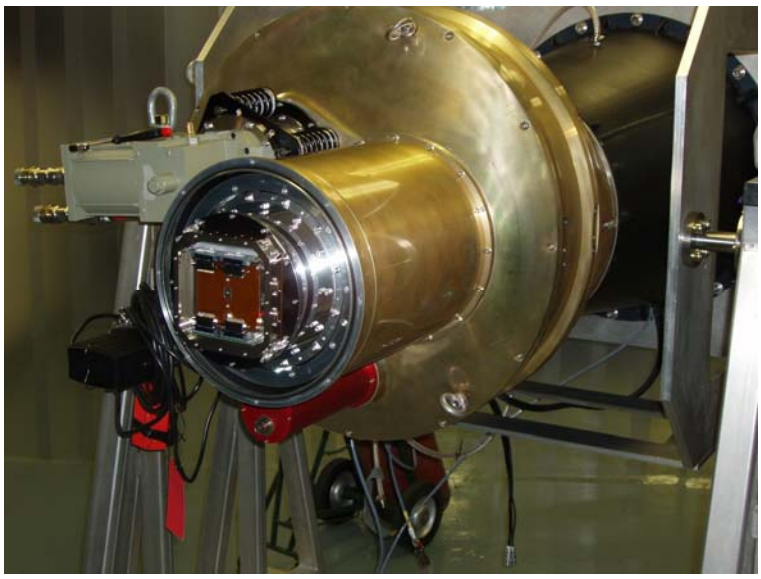
The cryovessel and filter wheel had been received from the *Laboratoire d'astrophysique de Grenoble* (LAOG) and the Image Stabilizing Unit (ISU) had been received from the *Laboratoire d'études spatiales et d'instrumentation en astrophysique* in 2004. The optics were received in early March 2005 from the *Université de Montreal* and were integrated into the cryovessel, along with the two engineering arrays, in time for the first WIRCam engineering run at the end of March.



The four science detectors are integrated at GL Scientific

This run and the subsequent two engineering runs were very successful in finding and correcting some initial bugs in the guiding and some issues with rotations of various parts of the camera with respect to each other. The two arrays were only being readout using four outputs, also.

The time period from the end of March to June was spent accepting the final two science arrays, mounting and measuring the positions of the arrays at GL Scientific, and building an SDSU III system to readout all 32 outputs on all four science arrays. This was all done successfully, however, and by the June run, we were on the sky with all four science arrays. First light!



The mosaic is now in place on the back of the cryostat

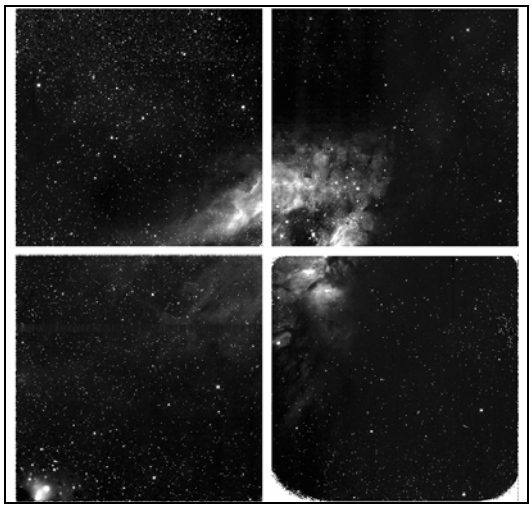
Of course, the work didn't stop there. The hardware was in place for a fast readout of the camera, but the software still needed to catch up. In addition, interlaced, on-chip guiding was turning out to present its own special problems. Queue Service Observing and the New Observing Procedure (QSO/NOP) also needed to be modified to work with WIRCam. Real-time analysis of the images was needed to give the QSO observers information to decide which queues to run when. Also, many modes had to be implemented and tested such as automated pointing correction and guide-star acquisition, micro-dithering, wide dither patterns, and nodding. The focus differentials for the filters needed to be measured, the zero points of the system found,

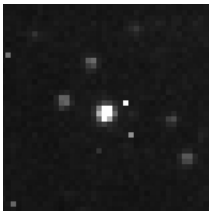
and the image quality verified along with the usual number of testing in preparation to do science with a new instrument.

Much of this has been accomplished and the first science was done, on a shared risk basis, in November, 2005. Science observations and engineering went on together for the rest of the semester so that the camera is now scheduled for normal operations for all of semester 2006A.

The results of these efforts have been very encouraging. The image quality has been measured below 0.5 arc-seconds across the full array, and has been seen as low as 0.4 arc-seconds in Ks band. The noise performance of the arrays is currently at about 30-40 e- with some amplifiers somewhat above this. The cryovessel has been kept cold for as much as six months at a time, though occasional pumping while cold is needed to maintain vacuum during exchanges. The guiding has been shown to work at full speed (50 Hz) on stars as dim as 12th J magnitude with the J filter and as dim as 15th J magnitude with the J filter at reduced guider speeds.

Of course, being operational and on-the-sky for science does not mean the end of work on the camera. The speed-up of the readout is nearing completion and should be ready for the April 2006 run with a single read time of ~1.2 seconds (two reads are needed for correlated, double sampling). The noise on the images is higher in places than expected and work is continuing to bring this noise down, hopefully to under 30 e-. Guiding is being continually improved to take into account all of the various science requirements and to respond to the changes to the science readout. Observing overheads are being studied for way of reducing them to maximize integration time. Also, now that some science images have been obtained, much effort is going into designing and implementing an automated data reduction pipeline, Elixir-IR.





M17

This is one of the first images taken with WIRCam! The whole mosaic is seen on the upper left, while a zoom of the lower left corner of the upper right detector is seen above. On the left, a star from one of the corners is highly magnified, demonstrating the high optical quality of WIRCam. The seeing was good enough to show the under-sampling of the image due to the 0.3" pixels…

The personal touch

Tom Beck

Tom Beck, our summit electrician, retired from the summit daycrew in November after 10 years with CFHT. Prior to coming to CFHT Tom had worked at the Pearl Harbor Public Works and at ALCOA as an industrial high-voltage electrician for a number of years. His quiet but insightful comments and guidance, and his obvious work ethic came to be much appreciated by the staff during his time with us. Tom appears always to be busy - when not working at CFHT he has raised koi, built several homes and run a sizeable ranch which he and wife Luana can now spend at least a little quiet time on.

Renaud Savalle

Renaud Savalle joined CFHT in 1999 as software engineer specialized in data base design and management, hired to work on the development of the Queued Service Observing project. He actually stayed with CFHT for six years and played a paramount role in the practical implementation of QSO. His deep knowledge of astronomy has been a real asset to the project as well as to the outreach activities of the Observatory. Renaud went back to France, bringing his skills to yet another observatory (OAMP).

Todd Szarlan

Todd Szarlan left CFHT in June 2005 to join the Santa Barbara Infrared Corporation, where he is in charge of optical testing. Todd had been with CFHT since March 1999 in the optics group, then later in the instrumentation group. While at CFHT, Todd took care of keeping the primary mirror and most other optics clean, keeping most of the instruments set up and happy, and occasionally doing strategic lens flips. He is sorely missed, but we wish him the best of luck in his new endeavor.

Outreach

2005 has been a rich and full year for the CFHT outreach group. Rémi Cabanac continued to coordinate the outreach activities and to make sure that the information is available to everyone. Most of the activities were still the responsibility of a hard core of volunteers among which Mary-Beth Laychak, Liz Bryson, Moani Akana, Grant Matsushige, and Lisa Wells, but we wish to underline the dedication of the entire staff when time comes to help. We have the feeling that we achieved a good balance between the number and diversity of activities that CFHT staff can face without lowering the required enthusiasm of the volunteers.

The outreach group made full use of the new archiving environment TWIKI, installed by Liz Bryson, Tito Jankowski, and Jeff Mori. This internal site hosts the outreach activity archives and all pictures of outreach activities gathered over the last 2 years. The outreach group wishes to express its gratitude to all the volunteers and their families who participated in these activities which truly makes what CFHT is well known for, an exceptional working environment and an asset to the community, in Waimea and across the Big Island.

Getting ready for the star gazing party December 2005

Star Gazing Parties:

- August 6: Star Gazing at HP
- August 28: CFHT Star Gazing (Back to school)
- December 3: Christmas Star Gazing Party

Fairs and Festivals:

- January 29: Onizuka Day at UHH.
- February 15: Hilo Science fair (judging).
- February 16: Paauilo Science Fair.
- March 9: Women in science in Hilo.
- April 16: Astro day: a lovely day as usual at Prince Kuhio Plaza in Hilo. CFHT small posters were very popular!
- April 16: Waimea Keiki Fest: many visitors and much interest, small posters again very popular.

Waimea festival – August 2005

- April 22: Waimea Country School's Annual Science Fair.
- August 28: Waimea Parker Ranch Fair, with an interview about CFHT on KAPA FM.
- November 4: Science Fair in Kona.

CFHT HQ and Summit Visits:

- Jan 16: CFHT summit visit by K. Meech astrobiology students.
- Feb 3: Waimea Middle school grade 3 class visited HQ.
- Feb 10: Wainakeana Middle School classes visited HQ: a group of 40 people!
- Feb 16: Visit of Kohala school students.
- Feb 17: Summit visit for VIPs.
- Feb 22: Honoka'a Astro class high school visit to the summit (visit of both CFHT and Keck), (teacher Alison

Simmerman) 40 students (80 expected).

- Feb 22: Summit visit for VIPs.

- March: Kindergarten 1st & 2nd visit to CFHT HQ.

- May 4: VIP tour of the summit.

- May 7: CFHT public lecture at the Onizuka Visitor Center: Liz Bryson gave a talk at the visitor center on Mauna Kea Oral History Project

- May 27: CFHT HQ tour for a group of 75 Paauilo kindergarten, first and second graders.

- June 2: CFHT HQ tour+talk for a group of Waimea Ho'okupono special program.

- July 25: VIPs visit HQ.

- October 7: The Supernovae Legacy Survey investigators visit the summit.

- October 14: Make a difference day Parker School students at HQ.

- October 28: Summit visit for the "Make-a-Wish" foundation..

- November 6: World Healing Center visit.

Wainakeana Middle School classes visit the HeadQuarters February 2005

Miscellaneous:

- Since its foundation CFHT co-hosts (with Keck) the West Hawaii Astronomy Club (WHAC) meetings every second months. Rémi and Pierre are active members, giving public talks.

- Participation in Kohala Electric car project.

- Aug 11: Charity event, Calf Dressing Parker Ranch Rodeo.

- September 24: Visitor Information Station support dinner at Hale Pohaku.

- October 3-7: Sponsoring of a Japanese film Crew Zero Corporation at the summit.

- November 17: 'OHANA lecture at the International Lunar Observatory Workshop.

- November 22: MK Natural History Visit with Bill Stormont

- All year long: public lectures to school classes.

New Faces

Sarah Gajadhar - Electronics Engineer

Sarah joined CFHT in August after working in high tech and government environments in Ottawa. She has a degree in Electronic Systems Engineering, and has found her previous experience in systems modeling to be very useful in supporting MegaPrime. She is also interested in learning more about the telescope control system. Sarah enjoys being able to leave the snow at the summit and go to the beach even in January.

Marc Baril – Instrument Engineer

Marc came to CFHT in August from HIA (Victoria, British Columbia), where he worked for a year and a half on instruments for the Thirty-Meter Telescope, Gemini and the Dominion Astrophysical Observatory. Marc holds a PhD in experimental solid-state physics from Simon Fraser University where he undertook spectral studies of mineral luminescence and its application to dating geological deposits. When he isn't tweaking readout code for WIRCam's IR sensors, Marc can be found woodworking, star-gazing and keeping sharp tools away from his toddling son.

Herb Woodruff – System Administrator

Herb Woodruff joined CFHT at the end of September. He came from California where he worked in Lake Tahoe, and the Bay area, in the IT field. He enjoys skateboarding, snowboarding, and is looking forward to surfing. He also likes goats, blind tiger, and cheese.

Glenn Morrison - Resident Astronomer

Glenn Morrison joined the Astronomy Group in July as the University of Hawaii Resident Astronomer, adding his expertise in extragalactic astronomy. He arrived from NOAO where he was a post-doctoral fellow working on the GOODS program and before that as a post-doctoral fellow at Caltech. He specializes in multi-wavelength studies of galaxy clusters. He is investigating galaxy evolution in clusters, using a multi-wavelength approach from visible to IR and radio observations. At CFHT, he will also contribute to the operations of queue observing, MOS/OSIS instrument support scientist, and the development of Elixir for WIRCam. He enjoys downhill skiing and traveling.

Current Staff at CFHT

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

Comings and Goings

Beck, Tom	Departure	Dec	Morrison, Glenn	Arrival	Jul
Barril, Marc	Arrival	Augu	Mugridge, Paul	Visitor	Jan – Apr
Gajadhar, Sarah	Arrival	Aug	Savalle, Renaud	Departure	Mar
Kim, Sam	Visitor	Sep departure	Szarlan, Todd	Departure	Jun
Lawson, Terry	Arrival	Dec	Yan, Chi-Hung	Visitor	Sep departure
Levine, Eric	Staff	Nov - May	Wang, Shiang-Yu	Visitor	Jun
Lin, Ethan	Visitor	Mar-Jul, Nov-Jan	Woodruff, Herb	Arrival	Sep

Financial Resources

The three Member Agencies supported the CFHT annual budget in 2005 as shown in the table at the right, in US funds.

Agency Contributions

NRC	$2,820,801
CNRS	2,820,801
UH	654,098
Total	$6,295,700

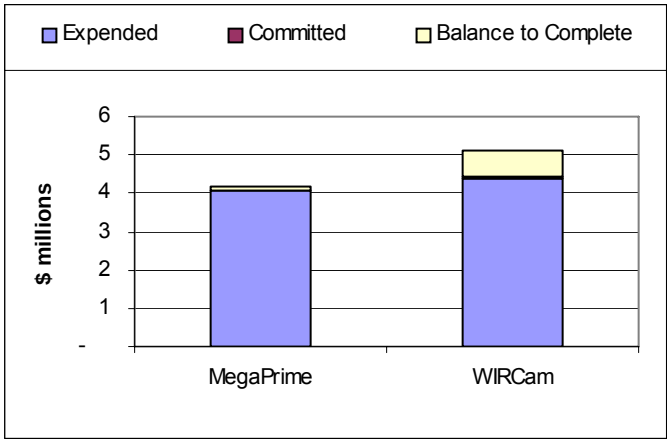
These contributions reflect a 1.8% increase, in anticipation to the Golden Age Plan. Under a financial framework established by the Board of Directors, the operating budget had been frozen during the years 1996 - 2004 at its 1995 amount without adjustment for inflation.

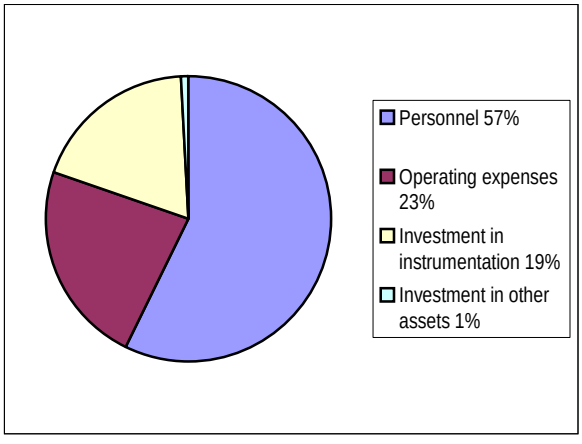
Under collaborative agreements with CFHT, Korea Astronomy Observatory and National Taiwan University remitted $200,000 and $100,666 respectively, as reimbursement for costs associated with their use of the Corporation's facilities. Other sources of funds included $11,881 from the daily surcharge credits at the mid-level facility and $122,002 in earned interest allocated to the contingency reserve fund.

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

Expenditures for 2005	
Observatory facilities and operations	$674,716
Base facilities and operations	628,413
Instrumentation	86,399
Science	57,575
Personnel	4,397,820
General expenses	394,777
Reserve	56,000
Total Operating Fund Expenditures	$6,295,700

During the year $1,458,616 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 $10,029,028. The current appropriation and the portion committed to date are shown in 2005, 92% of total appropriations under the Wide-field Imaging plan were spent or committed. Overall in 2005, 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
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Daniel Rouan[F]	Observatoire de Paris-Meudon
Richard Normandin[C]	National Research Council Canada

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Brent Tully[H]	University of Hawaii

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Derrick Salmon - Director of Engineering	Pierre Martin – Director of Science Operations

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Peter Peacock[C]	National Research Council Canada
Hubert Rédon[F]	Centre National de la Recherche Scientifique

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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 2005A

Ann	MegaPrime	Search for Dwarf Satellite Galaxies in Nearby Giant Spiral Galaxies
Balogh	MegaPrime	UV-derived star formation rates in galaxy groups at z~0.5
Balogh	MegaPrime	Mapping the infall regions of the supermassive galaxy cluster RXJ1347.5-1145
Berdyugina	ESPaDOnS	A probe of the internal structure of starspots with the molecular Zeeman effect
Beuzit	AOB IR	Stellar multiplicity and extra-solar planet formation
Bohlender	Gecko Red	The Interstellar $^{12}C/^{13}C$ Isotope Ratio and the Diffuse Interstellar Bands
Catala	ESPaDOnS	Magnetic fields in the pre-main sequence Herbig Ae/Be stars
Charpinet	LAPOUNE	Determination of the structural parameters of the pulsating B sybdwarf PG 1325+101 from asteroseismology
Chiueh	MegaPrime	Galaxy Clusters as a Dark Energy Probe
Donati	ESPaDOnS	Is the activity of O and early B stars magnetically driven?
Donati	ESPaDOnS	The first magnetic images of classical and weak line T Tauri stars
Donovan	MegaPrime	Measurement of cosmological parameters using weak lensing
Drouin	ESPaDOnS	Seeking the progenitors of magnetic Ap/Bp stars: a search for magnetic fields in Herbig Ae/Be stars
Durant	AOB IR	Phase resolved infrared photometry of Anomalous X-ray Pulsars and broadband energy spectra.
Foing	ESPaDOnS	Dry High-Resolution Spectroscopy & Spectropolarimetry of Diffuse Interstellar Bands, Fullerenes and PAHs
Fontaine	LAPOUNE	Determination of the structural parameters of the pulsating B subdwarf PG 1325+101 from asteroseismology
Forveille	AOB IR	A deep search for very cold brown dwarfs companions
Hanes	MOS	Globular Clusters as Dynamical Probes of Early-Type Galaxies: Omnipresent Dark Halos or Not?
Hoekstra	MegaPrime	Comparison of the weak lensing mass to the baryonic constituents in X-ray luminous clusters of galaxies
Ishiguro	MegaPrime	Contemporaneous survey of dust trails by groud-based telescope and *Spitzer*
Jedicke	MegaPrime	Survey of major mass loss events in comets
Johnson	ESPaDOnS	Abundance Ratios in NGC 6791 with ESPaDOnS
Kawasaki	MegaPrime	Dwarf Galaxies in the Hercules Cluster
Kwok	CFHTIR	Imaging of Planetary Nebulae at Molecular Hydrogen Emission
Landstreet	ESPaDOnS	A spectropolarimetric survey of magnetic stars in open clusters: searching for links between magnetic fields and stellar evolution
Lee	ESPaDOnS	Spectropolarimetry of Raman scattered Balmer wings in young bipolar planetary nebulae
Lim	CFHTIR	Combined Near-IR Stellar and Atomic Hydrogen (HI) Gas Imagining of QSO Host Galaxies
Lin	MegaPrime	MegaCam i' and z' survey of DEEP2 fields
Lyo	MOS	Low-mass population studies in the Ursa Major Group and the Coma Berenices
McGrath	MegaPrime	Characterization of the luminosity function for m*Jy* radio sources
Meech	MegaPrime	The deep impact mission encounter support
Park	MegaPrime	Wide Field CCD Photometry around NGC 6822
Petit	MegaPrime	Kuiper Belt dynamical structure: recoveries and follow-up
Price	MegaPrime	Exploring the Variable Universe
Reipurth	MegaPrime	Ultra-deep Ha imaging of Herbig-Haro flows
Renner	MOS	Physical characterisation of the Karin young asteroid family
Robin	MegaPrime	Cinématique du bulbe galactique : vers une meilleure compréhension de la formation des bulbes
Sanders	MegaPrime	Hawaii imaging (UV/NIR/mm) of the HST-ACS-COSMOS 2-Degree *Treasury* field
Schneider	ESPaDOnS	Etude du comportement de l'étoile τ Boo
Segall	MegaPrime	A la recherche de la queue du Dragon: la mati\`ere noire dans les galaxies naines (suite)
Seymour	MegaPrime	The Origin of the microJansky radio source population and its link to the X-ray and Far Infrared background.
Smith	MegaPrime	Spatially-resolved ages and metallicities in early-type galaxies from u* imaging
Sohn	MOS	Spectroscopy of Early-Type Galaxies in Abell Clusters at Moderate Redshifts
Stalder	AOB IR	AO studies of high redshift radio sources near bright natural guide stars
Takamiya	CFHTIR	Intergalactic globular clusters in Virgo
Tholen	MegaPrime	The population of asteroids interior to Earth's orbit
Tully	MegaPrime	MegaCam Imaging of the M81 Group
Wade	ESPaDOnS	Magnetic Doppler Imaging of Ap stars
Willott	MegaPrime	A Very Wide survey for z=6 quasars and cool brown dwarfs
Yee	MegaPrime	Galaxy Clusters as a Dark Energy probe

Approved Programs 2005B

Baglin	ESPaDOnS	Activité magnétique de HD 49933, cible primaire de COROT
Balogh	MegaPrime	UV-derived star formation rates in galaxy groups at z ~ 0.5
Beuzit	AOB IR	Stellar multiplicity and extra-solar planet formation
Bohlender	ESPaDOnS	Planet-star interactions with ESPaDOns - a multi-wavelength approach
Bouvier	CFHTIR	Proper motion of brown dwarf candidates in the Hyades cluster (ct'd)
Cambresy	CFHTIR	The dust content in the L1506 Taurus starless core
Cameron	ESPaDOnS	2005A: A search for starlight reflected from the giant exoplanet orbiting υ Andromedae.
Chen	WIRCam	Searching Embedded Stellar Content in a High Density Layer with Triggered Star Formation
Chiueh	MegaPrime	Galaxy Clusters as a Dark Energy Probe
Chun	MegaPrime	Photometric redshifts of DLA fields
Cuby	WIRCam	Searching z ~ 8 galaxies with WIRCAM.
Davidge	WIRCam	Tracing the Outer Disks of NGC 2403 and M81
Dinh	ESPaDOnS	High resolution spectro-polarimetry of post-AGB stars
Donati	ESPaDOnS	Are tidal forces strong enough to modify differential rotation and dynamos of cool stars?
Donati	ESPaDOnS	Are magnetic fields of fully convective stars produced by turbulent dynamos?
Doressoundiram	CFHTIR	Visible-infrared colors of the outer solar system objects
Fontaine	LAPOUNE	Structural Parameters of the Pulsating Subdwarf B Star BAL090100001 from Asteroseismology: A CFHT/WHT Campaign with Multicolor Photometry
Forveille	AOB IR	A deep search for very cold brown dwarfs companions
Hoekstra	MegaPrime	Comparison of the weak lensing mass to the baryonic constituents in X-ray luminous clusters of galaxies
Huang	MegaPrime	What is the nature of the X-ray Flashes?
Ibata	MegaPrime	Quantifying the structure and substructure of the outer halo of the Andromeda galaxy. III
Jedicke	MegaPrime	Thousand asteroid light curve survey
Jedicke	MegaPrime	Survey of comet major mass loss events
L.Cowie	MegaPrime	LSS + correlation functions of AGN at z<3
Lim	WIRCam	First Maps of Nearby Galaxies in Molecular Hydrogen Gas
Lyo	MegaPrime	Search for a nearby young cluster in the Northern Hemisphere
Lyo	WIRCam	Search for a nearby young cluster in the Northern Hemisphere (WIRCam)
Magnier	MegaPrime	Pixel observations of M31
Masiero	MegaPrime	Sweet spot NEO survey
Monin	WIRCam	Young Brown dwarfs and free floating planets in the Taurus star forming region
Morrison	MegaPrime	Survey of galaxies within richest clusters
Phan-Bao	ESPaDOnS	High resolution spectropolarimetric observation of nearby ultracool and brown dwarfs
Richer	MegaPrime	The Age of the Outer Halo of M31
Sanders	WIRCam	Imaging of the COSMOS treasury field
Schneider	ESPaDOnS	A search for starlight reflected from the giant exoplanet orbiting upsilon Andromedae.
Shkolnik	ESPaDOnS	Planet-star interactions
Sievers	MegaPrime	What is the Source of the Excess Power in the CMB at Small Angular Scales?
St-Louis	ESPaDOnS	The Role of Magnetic Fields in Massive Stars : First Measures for Wolf-Rayet (WR) Stars
Su	WIRCam	Outflows from Luminous Young Stellar Objects I
Su	MegaPrime	Outflows from Luminous Young Stellar Objects II
Tholen	MegaPrime	Population of asteroids interior to Earth
Tully	MegaPrime	Imaging of the M81 group
van Kerkwijk	AOB IR	How to form close binaries? AOB/PUEO search for hierarchical triples.
van Kerkwijk	ESPaDOnS	How to form close binaries: ESPADONS search for hierarchical triples.
Wade	ESPaDOnS	Search for magnetic fields in the young massive stars of the Orion Nebula Cluster
Wade	ESPaDOnS	Seeking the progenitors of magnetic Ap/Bp stars: searching for magnetic fields in Herbig Ae/Be stars
Wade	ESPaDOnS	Magnetic Doppler Imaging of Ap stars
Willott	MegaPrime	A Very Wide survey for z=6 quasars and cool brown dwarfs
Yee	MegaPrime	Galaxy Clusters as a Dark Energy probe

2005 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."

Adami,C. et al. 2005, Large scale diffuse light in the Coma cluster: A multi-scale approach, A&A, 429, 39-48.

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Hirtzig, M. et al. 2005, Near-infrared study of Titan's resolved disk in spectro-imaging with CFHT/OASIS, P&SS, 53, 535-556.

Hoekstra, H. et al. 2005, Virial masses and the baryon fraction in galaxies, ApJ, 635, 73-85.

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Ilbert, O. et al. 2005, The VIMOS-VLT deep survey. Evolution of the galaxy luminosity function up to z = 2 in first epoch data, A&A, 439, 863-876.

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Kalirai, J.S. et al. 2005, The initial-final mass relationship: Spectroscopy of white dwarfs in NGC 2099 (M37), ApJ, 618, L123-L127.

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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.

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