# 2 The CFHLS in short - Draft Version - Sept. 11, 2001

## 2.1 Three surveys... from the remote universe to the solar system

The CFHLS will address many scientific issues, through three surveys covering what can be made with a wide field imaging telescope:

### 2.1.1 A very wide shallow survey

Covering 5000 square degrees in two filters on the ecliptic, the survey will be made of sequences of three 2mn r' exposures (r'=24.1 on a single exposure, 24.7 if stacked) and one 2mn exposure in z', reaching z' = 22.0. The observations will be sequenced on a night in r' over at least three hours with the z' observation the following day. This survey will provide an unprecedented sampling of our galaxy and a unique exploration of the ecliptic, leading to more than 2000 Kuiper Belt Object discoveries, including a few Neptune-like objects (if any), and to a first sampling to such a depth on such a field of the Main Belt and Near Earth asteroids.

### 2.1.2 A wide synoptic survey

Covering 208 square degrees in four patches, three of $6 \times 6$ degrees and one of $10 \times 10$, through the whole filter set (u*g'r'i'z') down to r'=26.0, this survey will allow the study of the large structures and matter distribution in the universe, through weak lensing and galaxy distribution. Thanks to the sequencing of the r' observations in two phases, early in the survey and three years later, proper motions will be available for galactic structure studies. All fields will be used for stellar population investigations and searched for moving objects and transient phenomena.

### 2.1.3 A deep synoptic survey

Covering 4 square degrees in four MegaCam fields through the whole filter set (u*g'r'i'z') with integration times ranging from 44 to 176 hours depending on the filter (u*:44, g':44, r':88, i':176, z':88), this survey will be sequenced over 5 years at an average rate of 7 nights a dark run (namely each other night) for 5 runs in a row each year on each field. Aimed mainly at the detection and monitoring of as many as 2000 type I SNe and at the study of the galaxy distribution on images reaching r'$\simeq$ 28, this survey will allow a better understanding of the early universe as well as a determination of the dark energy parameter $w$ with an unprecedented accuracy. Thanks to the sequencing, transient phenomena and moving objects will be detected and followed up, providing a unique monitoring over five years of fields at various galactic and ecliptic latitudes.

## 2.2 The CFHLS at a glance

| **Survey**<br>*Location* | area<br>deg x deg | filters | depth<br>$5\sigma/3$" | total<br>exp time | observing<br>strategy | Total<br>nights |
|---|---|---|---|---|---|---|
| **Very Wide** | | | | | | |
| *Ecliptic* | 5000 | r' | 24.1 (2mn) | 3x2mn | spread over 2 hrs | |
| *+/- 7 deg* | | z' | 22.0 | 2mn | 2 day after r' obs. | **125** |
| **Wide Synoptic** | | | | | | |
| *02:20 -5 (XMM)* | 10x10 | u* | | 1 hr | | |
| *10:00 0* | 6x6 | g' | 26.8 | 1 hr | | |
| *14:00 +52* | 6x6 | r' | 26.0 | 1 hr | 1/2hr early | |
| *(Growth Strip)* | | | | | 1/2hr 3yrs later | |
| *22:00 0* | 6x6 | i' | 25.3 | 1 hr | | |
| | | z' | 24.3 | 2 hr | | **192** |
| **Deep Synoptic** | | | | | | |
| *A 1x1 subset* | 4(1x1) | u* | | 44 hr | 7 nights | |
| *of each of the* | | g' | | 44 hr | per run | |
| *fields of the* | | r' | $\simeq 28$ | 88 hr | 5 runs a year | |
| *Wide Synoptic* | | i' | | 176 hr | for each field | |
| | | z' | | 88 hr | | **272** |

- Fields for the Wide Synoptic survey have been selected for their interest (XMM and Growth Strip) and the fact that they allow a spread of the observations all along the year. Other choices can be made, though the 10x10 patch makes really sense on the XMM field.
- The depths reached by MegaPrime, expressed in the Vega system for point source detection, come from simulations made independently by two groups for the preparation of the SNe program and based on CFH12K observations measured quantum efficiencies of the MegaPrime CCD's, comparison of the CFH12K and MegaPrime optics throughput and anticipated transmission of the AR coating of the MegaPrime wide field corrector lenses. The following table summarizes the anticipated performances:

| | u* | g' | r' | i' | z' |
|---|---|---|---|---|---|
| limiting magnitudes (Vega)<br>*(30mn - 0.8" seeing - $5\sigma/3$" point source)* | | 26.4 | 25.6 | 24.9 | 23.5 |

- The CFHLS would mainly need a seeing of 0.9" or better, which is anticipated to happen 85% of the clear observing time.

## 2.3 How many nights?

The CFHLS will require 589 scheduled nights in Queued Service Observing (QSO) mode, based on the current definition of a QSO night (6.5 hr of integration on science fields). The QSO night takes into account the overheads for calibrations and the fraction of the time lost to bad weather. If the CFHLS is implemented without the participation of UH, about 30% of the dark/gray time with a seeing of 0.9" or better available to the C and F communities will still be open to original programs at the discretion of the Time Allocation Committees.