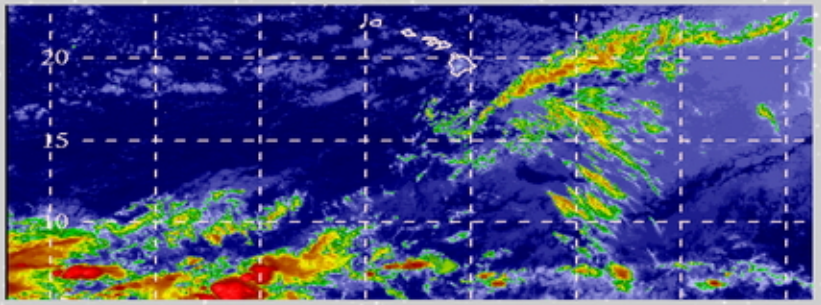
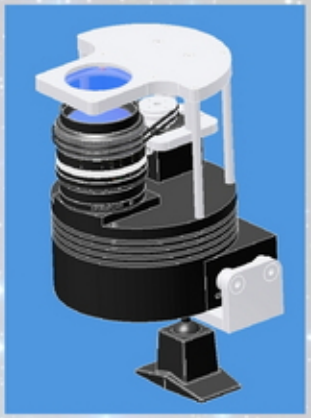
SkyProbe

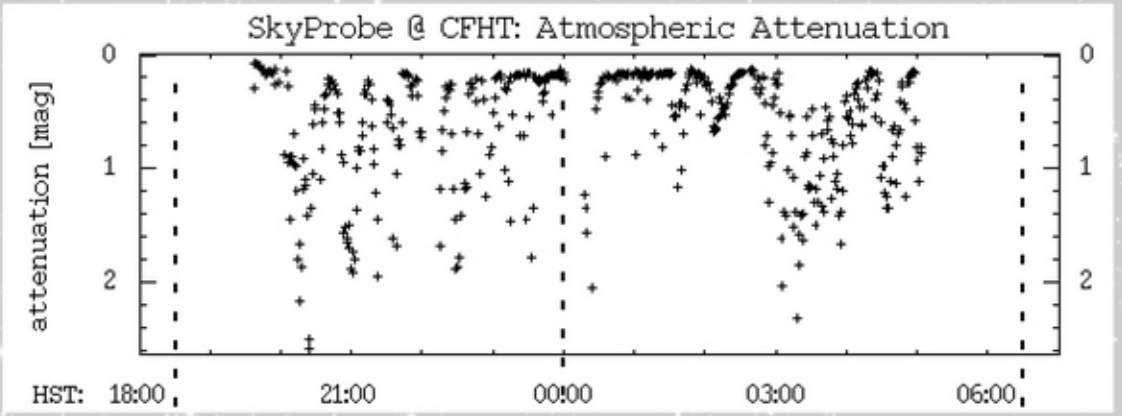
Monitoring the absolute atmospheric transmission in the optical (to optimize science operations)

Jean-Charles Cuillandre, Billy Mahoney, Kanoa Withington
Canada-France-Hawaii Telescope Corporation

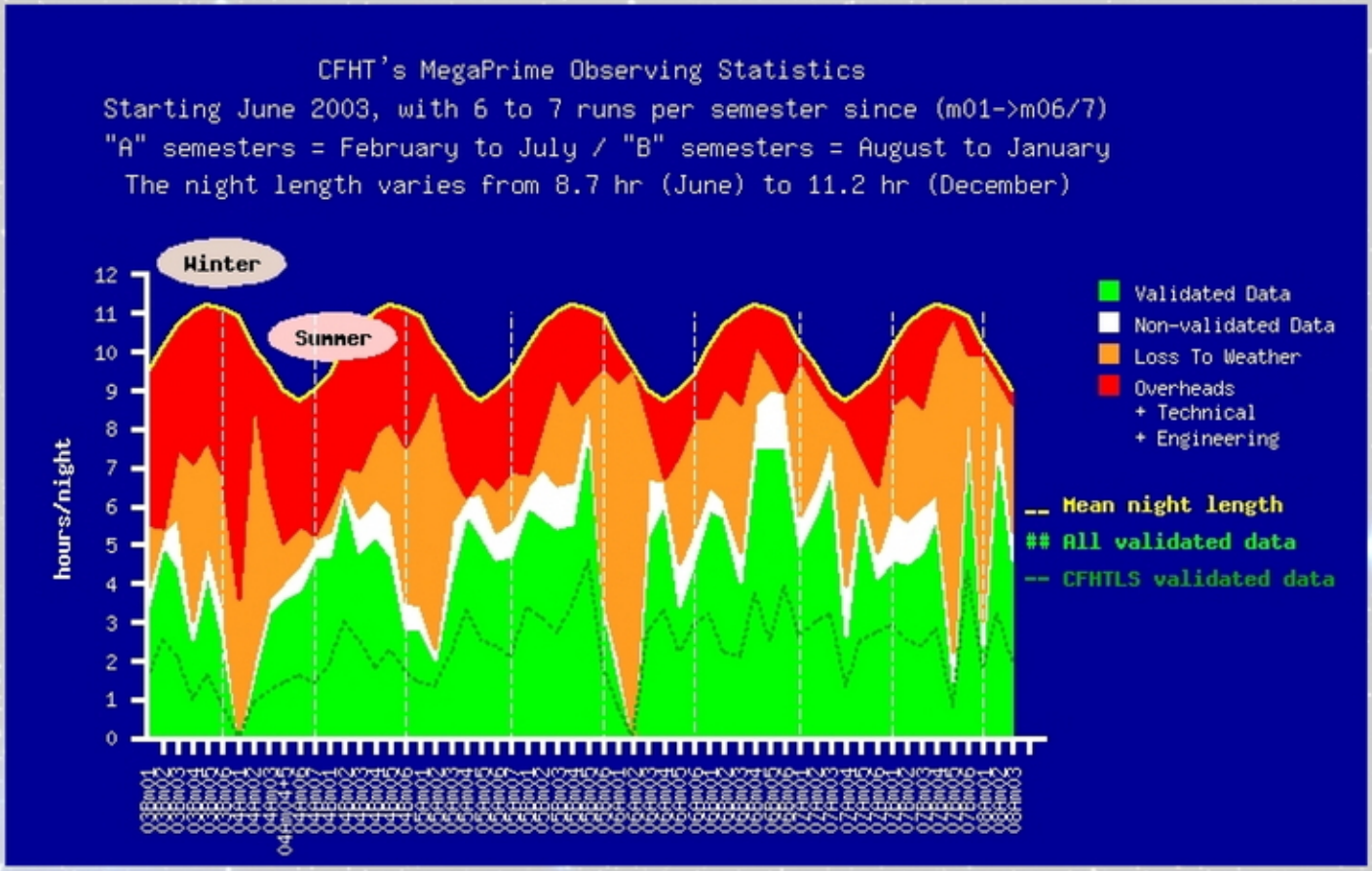
Eugene Magnier
Institute for Astronomy - University of Hawaii







Five years of MegaCam observing statistics



Mauna Kea: 25% of the night time is lost to weather

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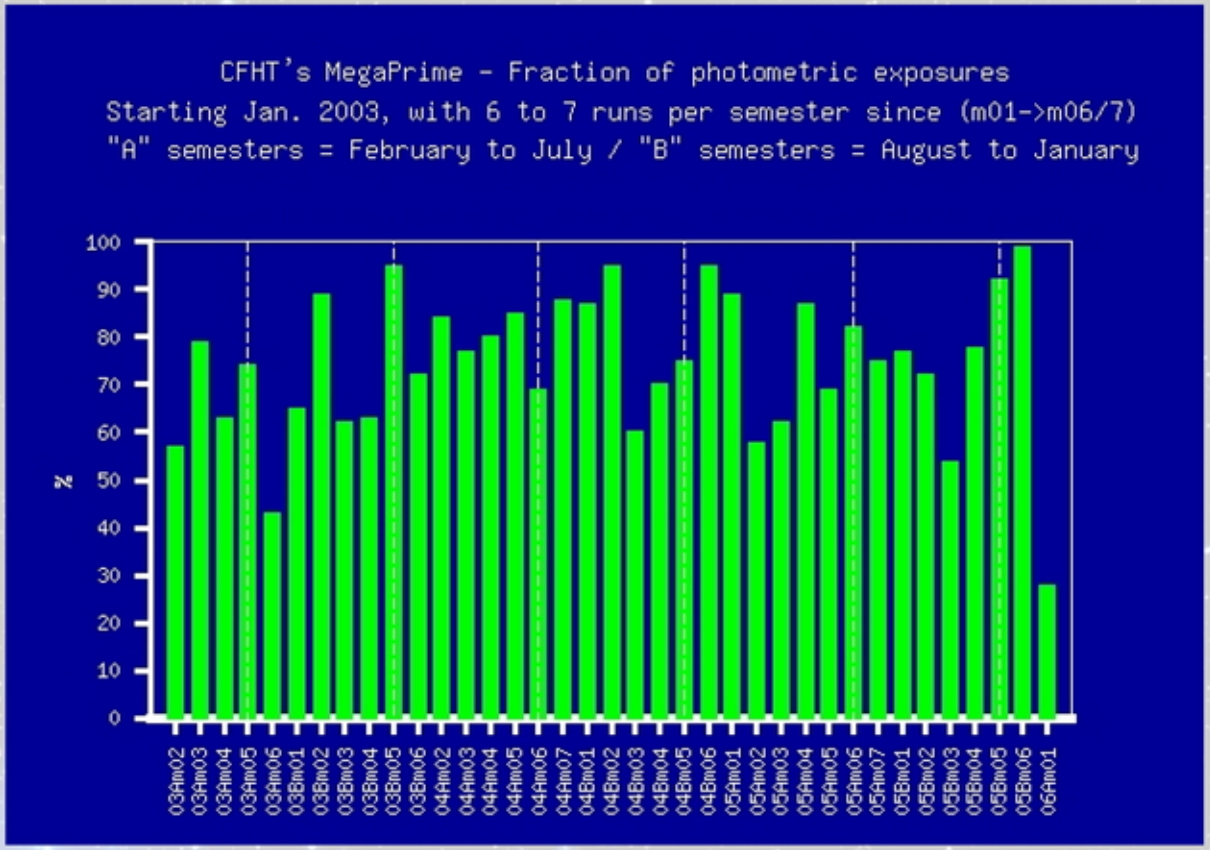
Fraction of MegaCam data gathered in photometric conditions



25% of observed time is affected by cirrus: 68 nights per year

All in all, Mauna Kea offers ~200 "clear" nights per year

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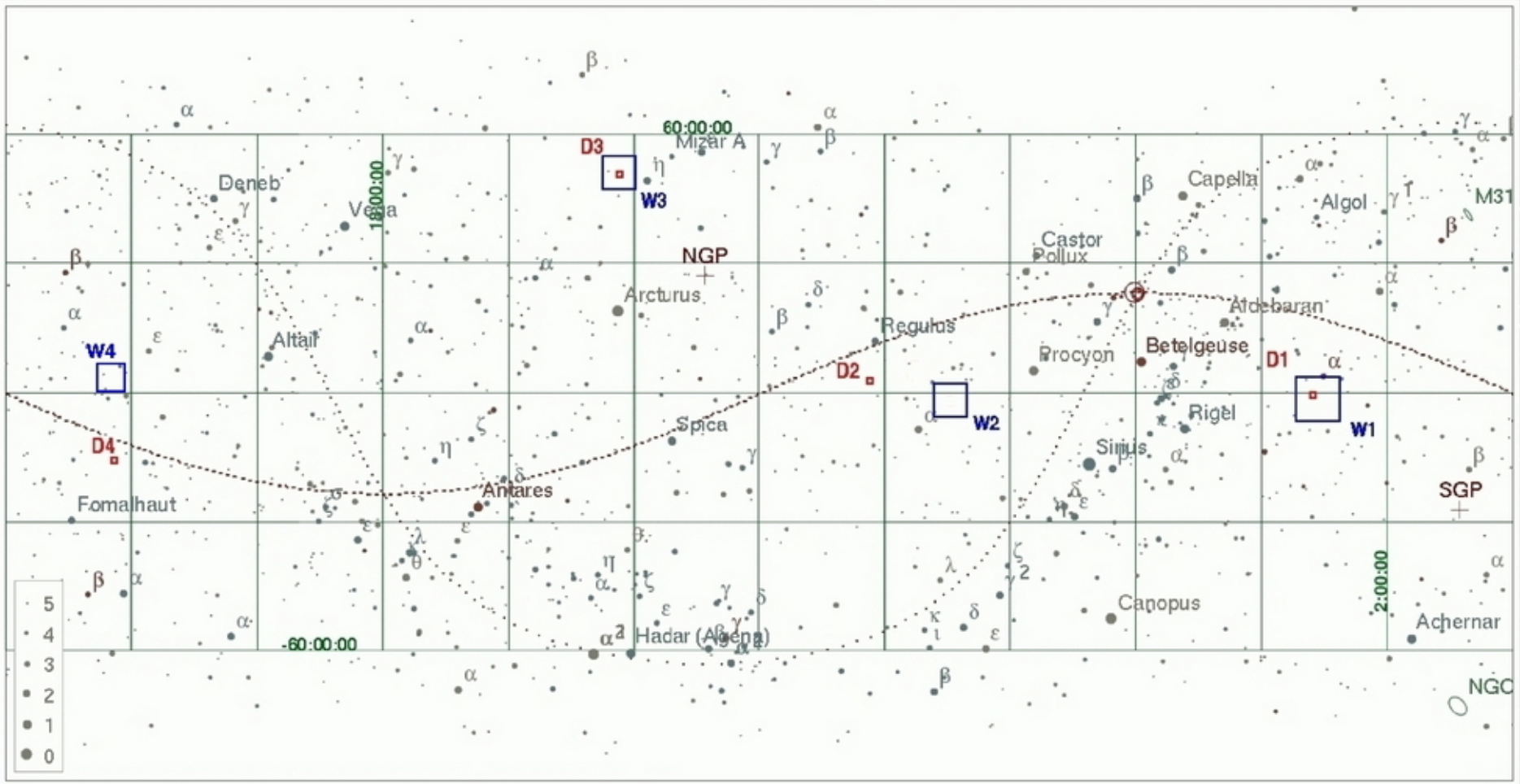
CFHTLS (Legacy Survey): a 500 nights program from 2003 to 2008

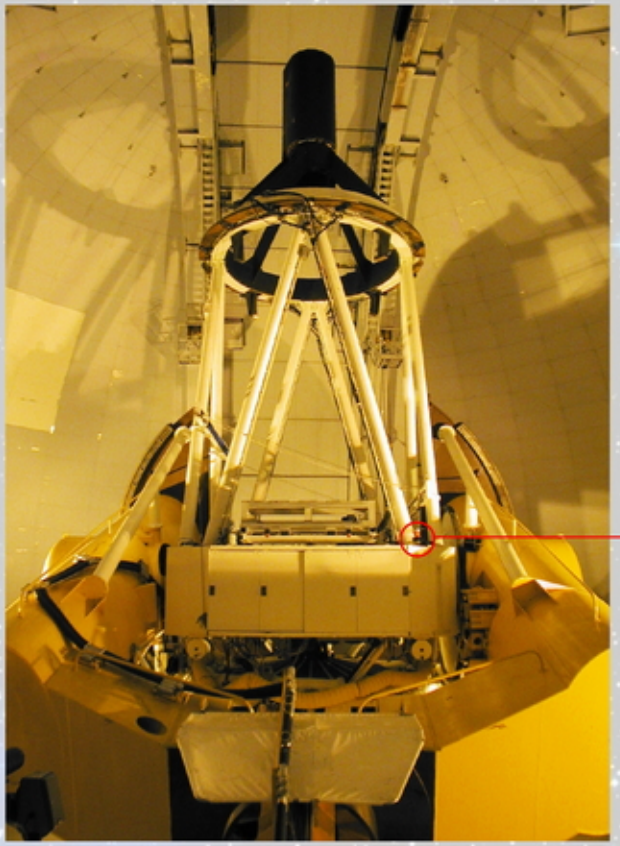


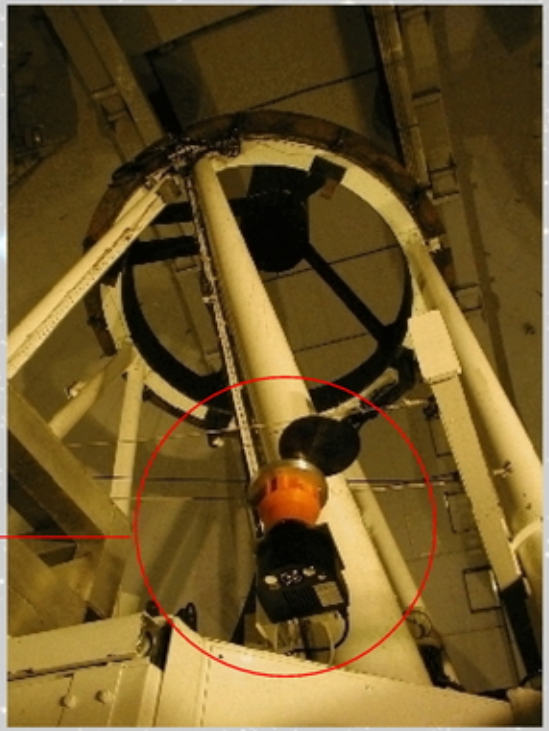
Survey	Area (sq. deg.)	Location	u*	g'	r'	i'	z'
SNLS	4	D1/2/3/4	28.7	28.9	28.5	28.4	27.0
Wide	170	W1/2/3/4	26.4	26.6	25.9	25.5	24.8
Very Wide	410	On ecliptic		25.5	25.0	24.4	

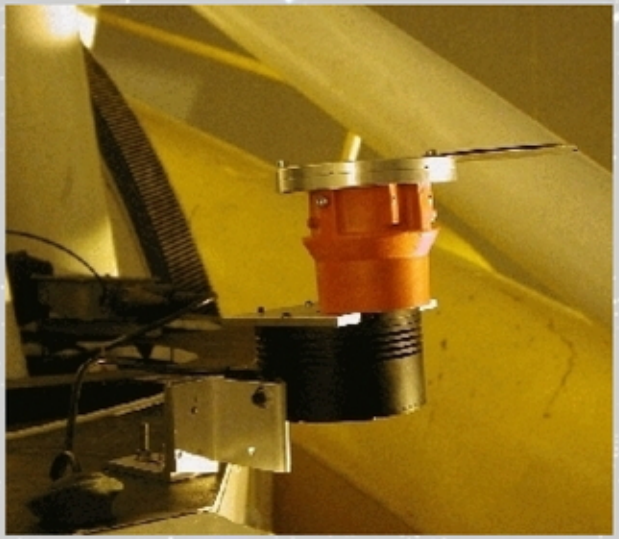
CFHTLS

SkyProbe (2000–today): V–band atmospheric transmission monitor

Cuillandre et al., SPIE 4844, p.501, 2002







Developed as a full-time observatory facility

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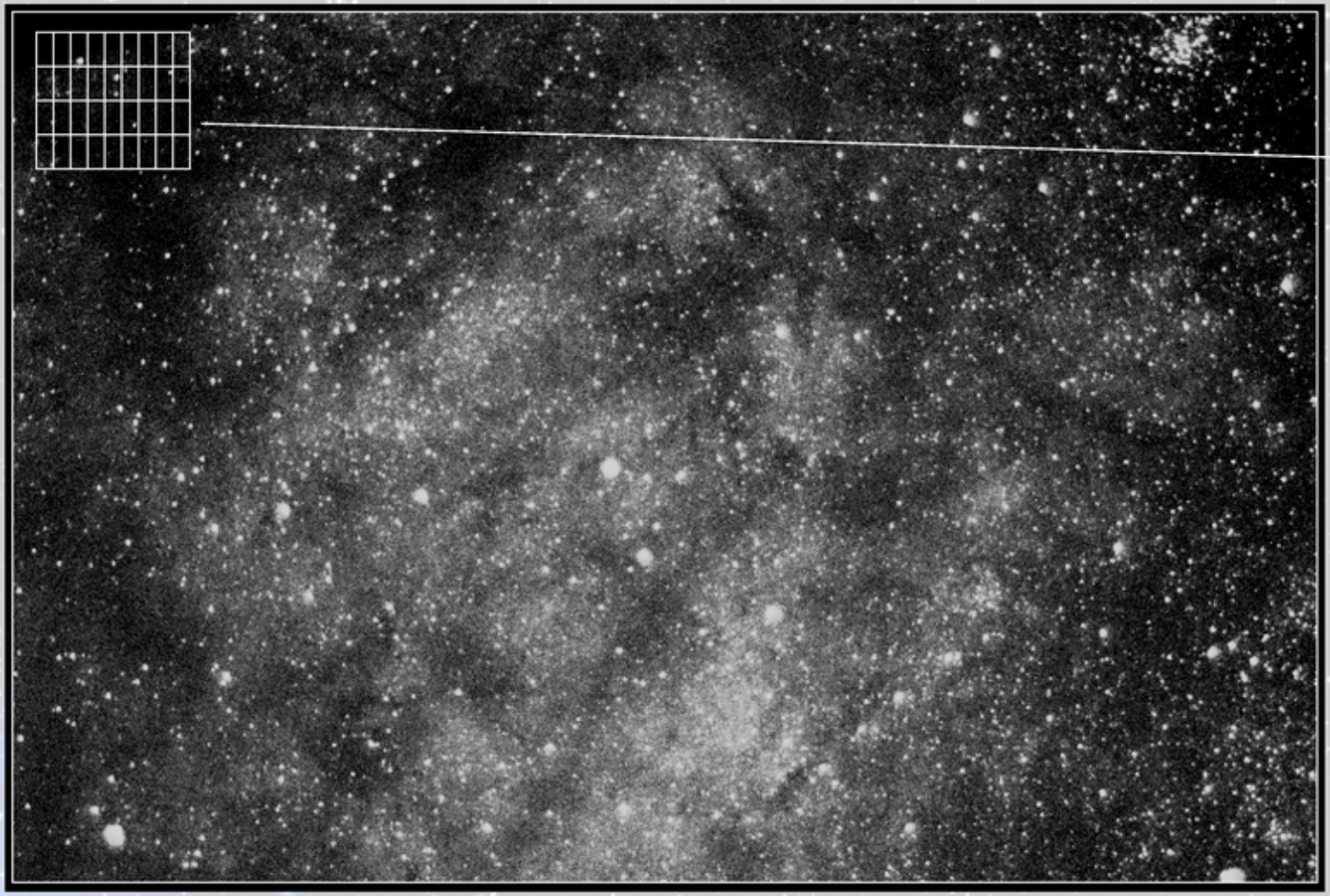
SkyProbe field of view and 30 sec. exposure depth



7x5 sq. degrees for a 765x510 CCD -- 35 arcsec. per pixel!

Uses a Nikon 50mm lens (f/1.8)

Reaches V=12 mag. in 30 seconds

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SkyProbe in a nutshell

Limitations of standard approaches:

- All-sky IR (10um) cameras provide only a low resolution (but important) map of the cloud distribution
- Satellite imagery can only be used as a warning tool

SkyProbe specifications:

- Low cost (<$3K for hardware) & very high reliability
- Provides an absolute zero point in the V band
- Stable response, few percents photometry accuracy
- Field of view encompassing the telescope science field
- Frequent measurements (every minute)
- Maintenance free system over 10 yrs (~1.5 million exposures)

Key developments:

- Low-cost reliable CCD cameras from the amateur astronomy
- Full sky precision photometry catalog: Tycho2 from Hipparcos
- Elixir: CFHT's optical imaging data pipeline (12K, MegaCam)

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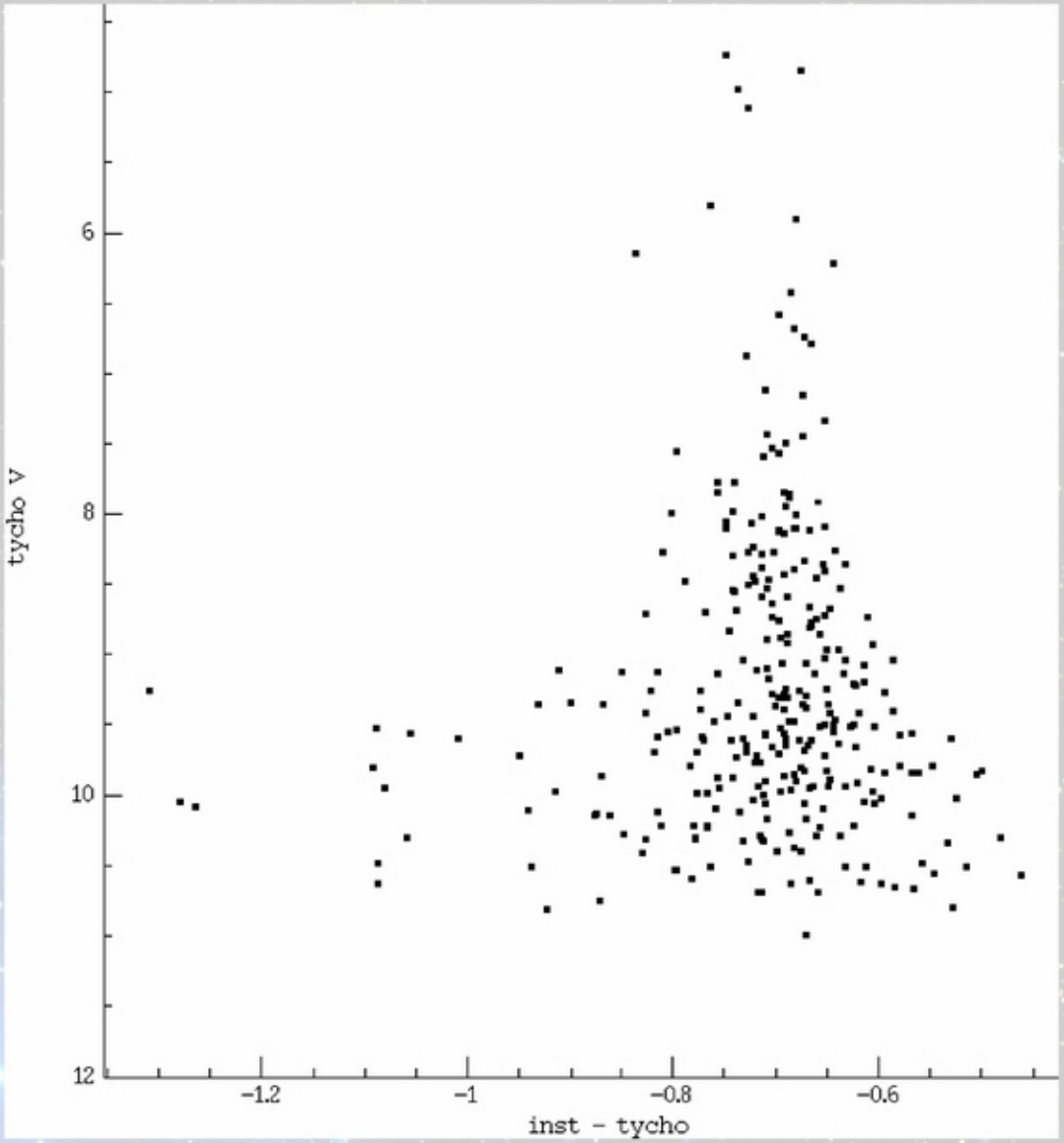
Photometry challenges



Mag-Mag diagram: scatter
- sampling
- de-focusing

CCD design:
- transparent gate
- sub-pixel response

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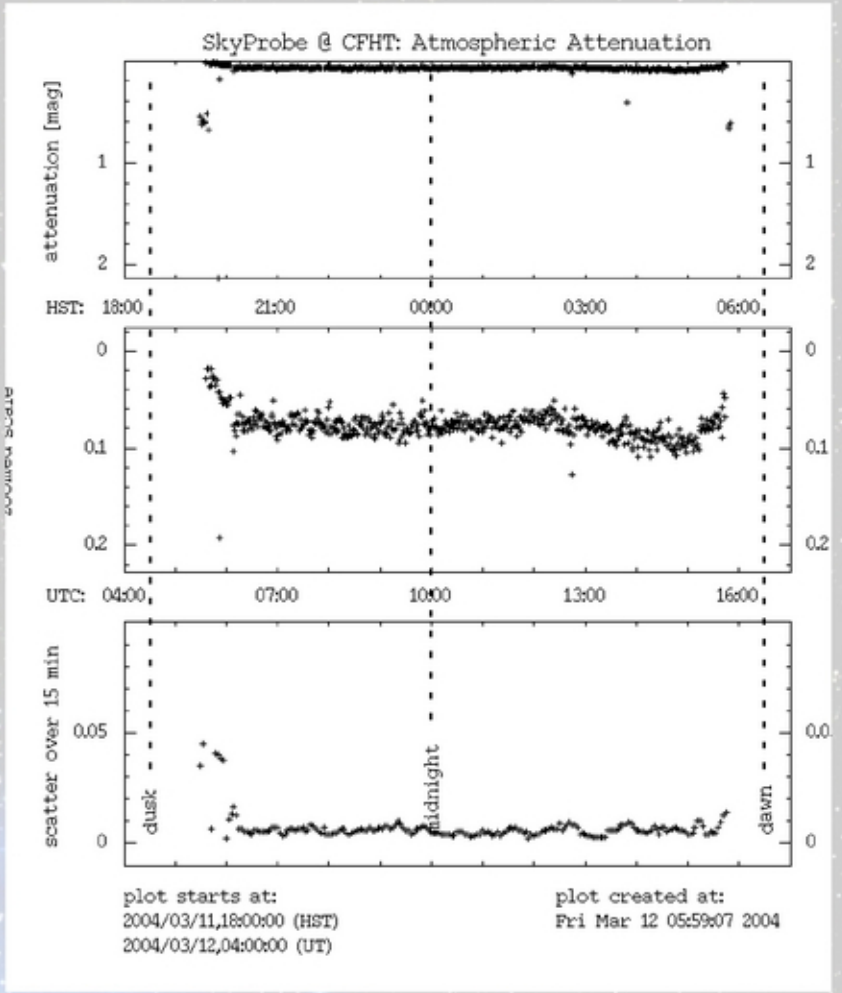
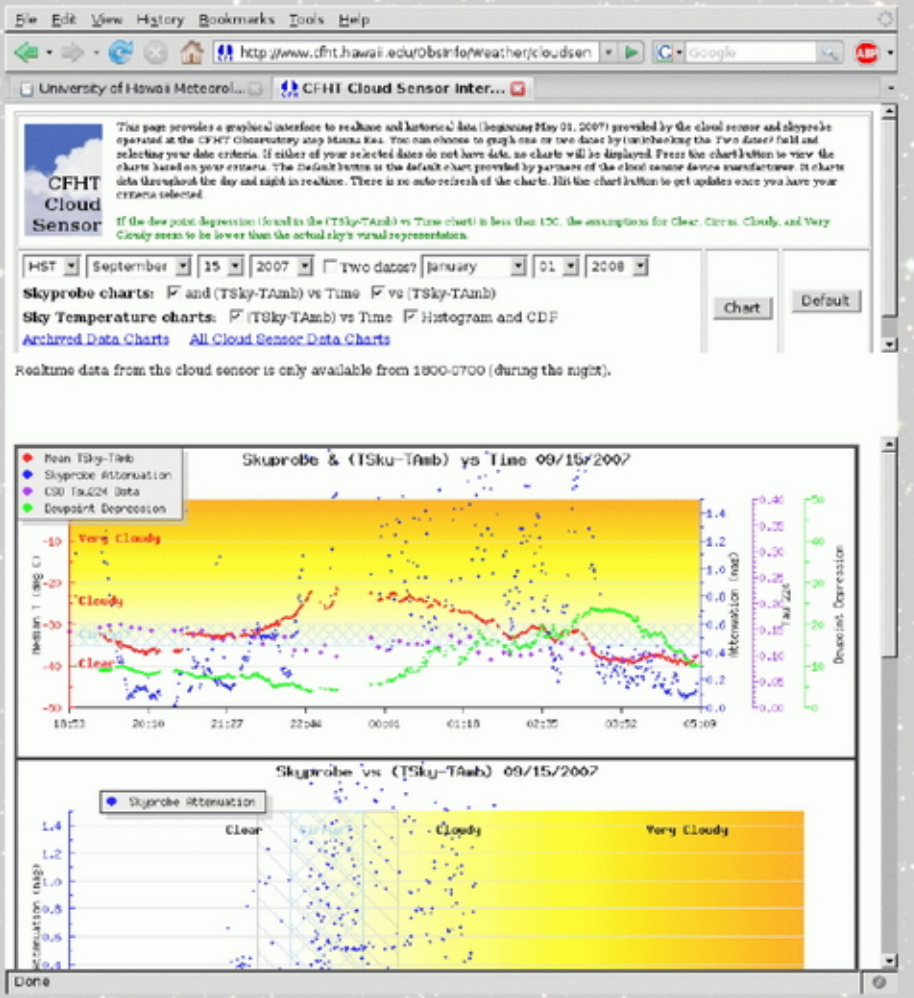
User's interface





Standalone mode (www) & CFHT Service Observing weather central

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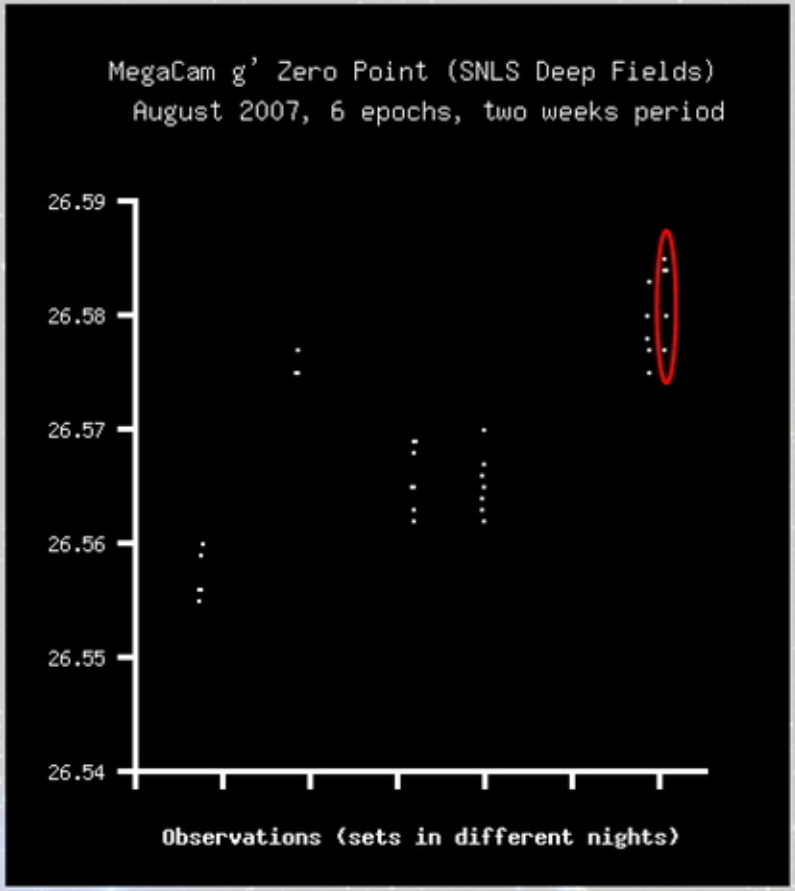
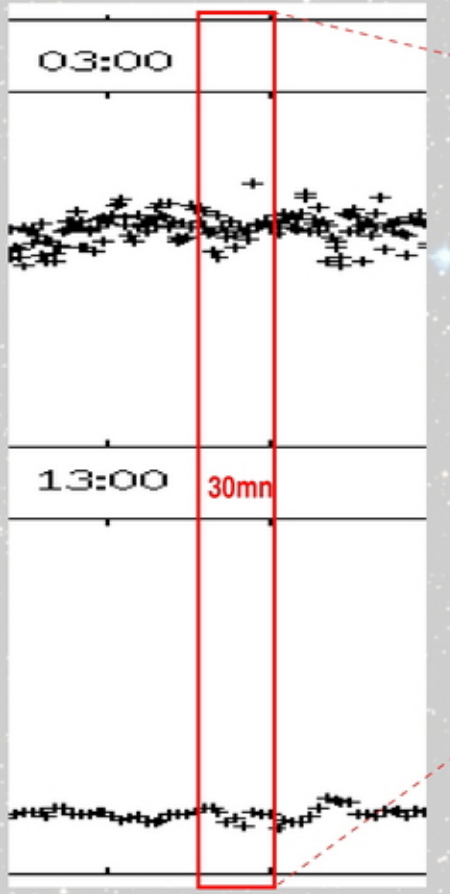
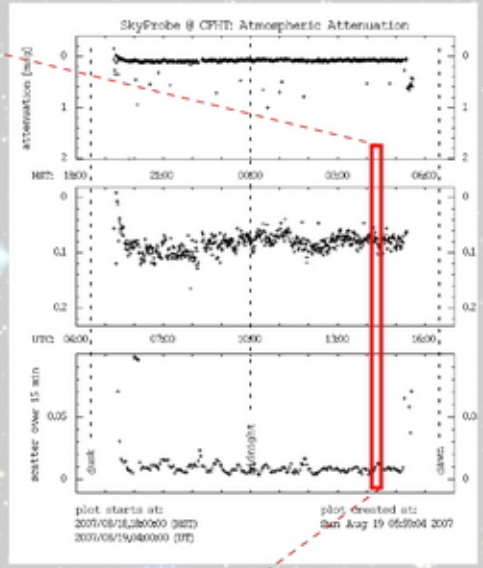
How accurate is SkyProbe? (answer: quite accurate actually!)







MegaCam g′ zero points from CFHTLS Deep/SNLS fields
Sets of 5 exposures taken over 30mn on different nights
Red circled sequence: ref, −0.001, −0.008, −0.005, −0.001 mag.
Extinction from particulates varies above Mauna Kea from
1 to 2% on timescale of minutes, pure clear sky is very rare!

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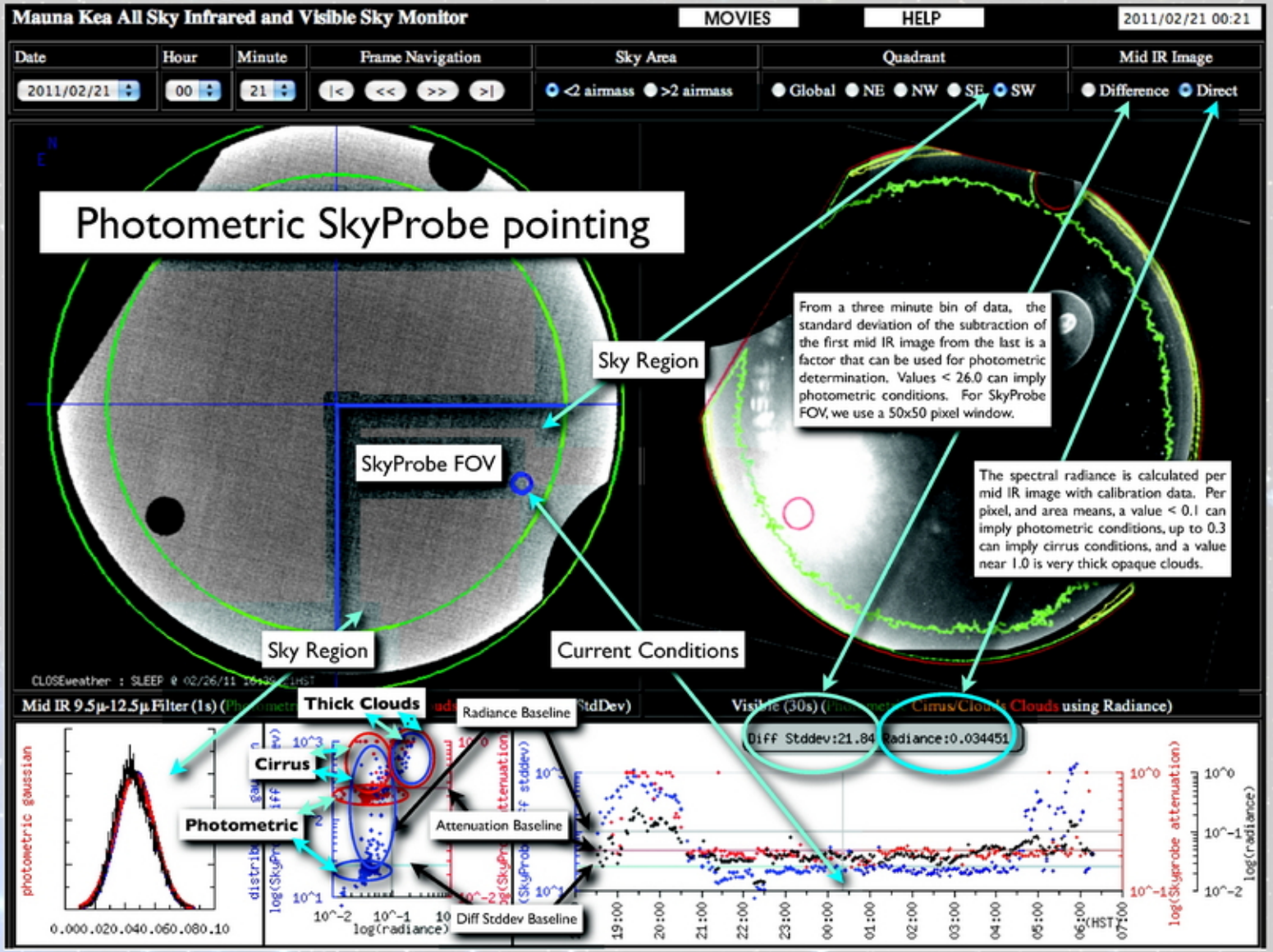
Interfacing with the infrared all–sky camera (ASIVA)



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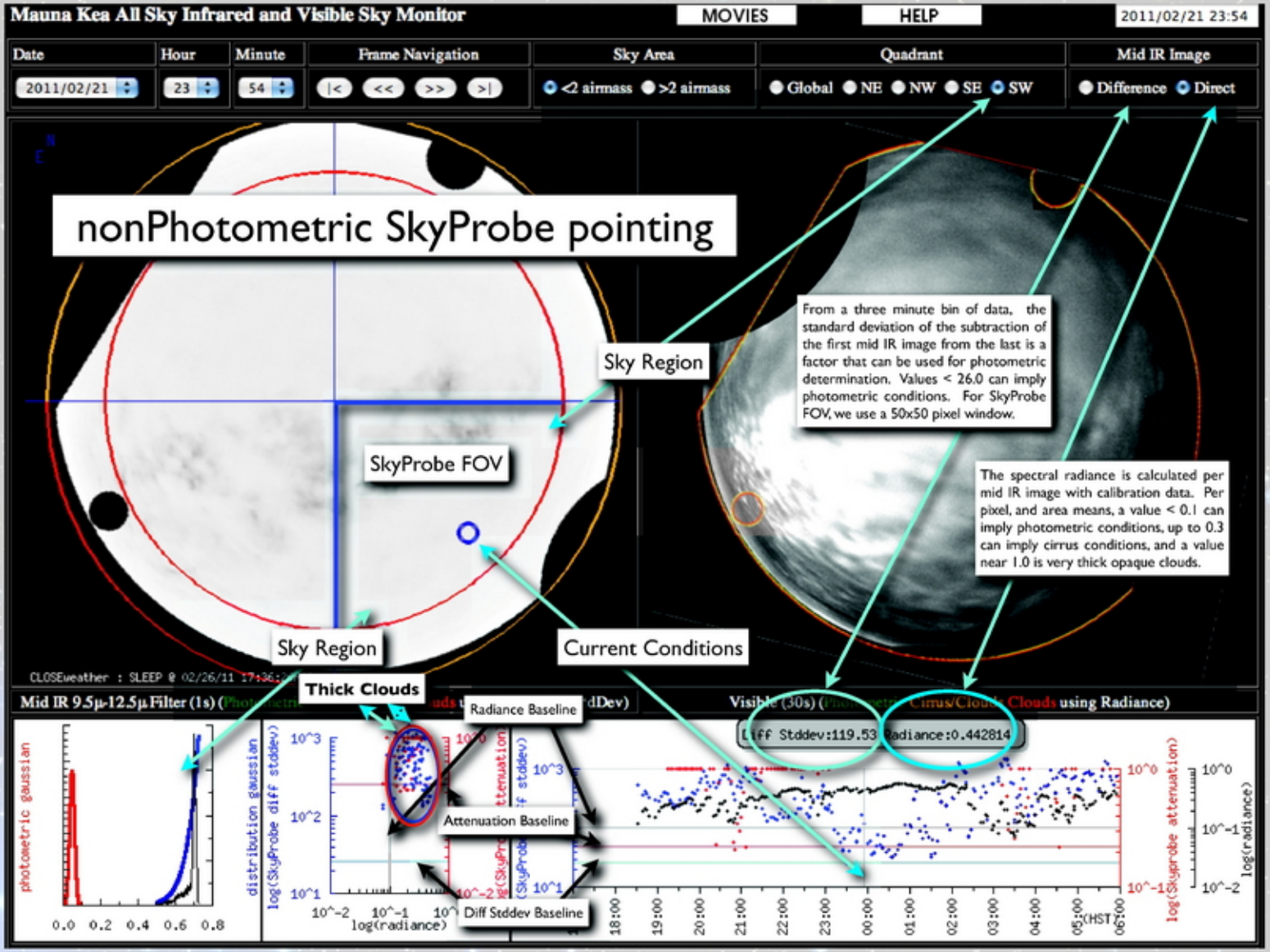

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CFHT's CloudCam: a nighttime color webcam

Awesome Canon technology!

Sturdy housing

90 degrees

60 degrees

CMOS imaging (IR blocking filter removed)
Image shows airglow (strong I-band contribution)

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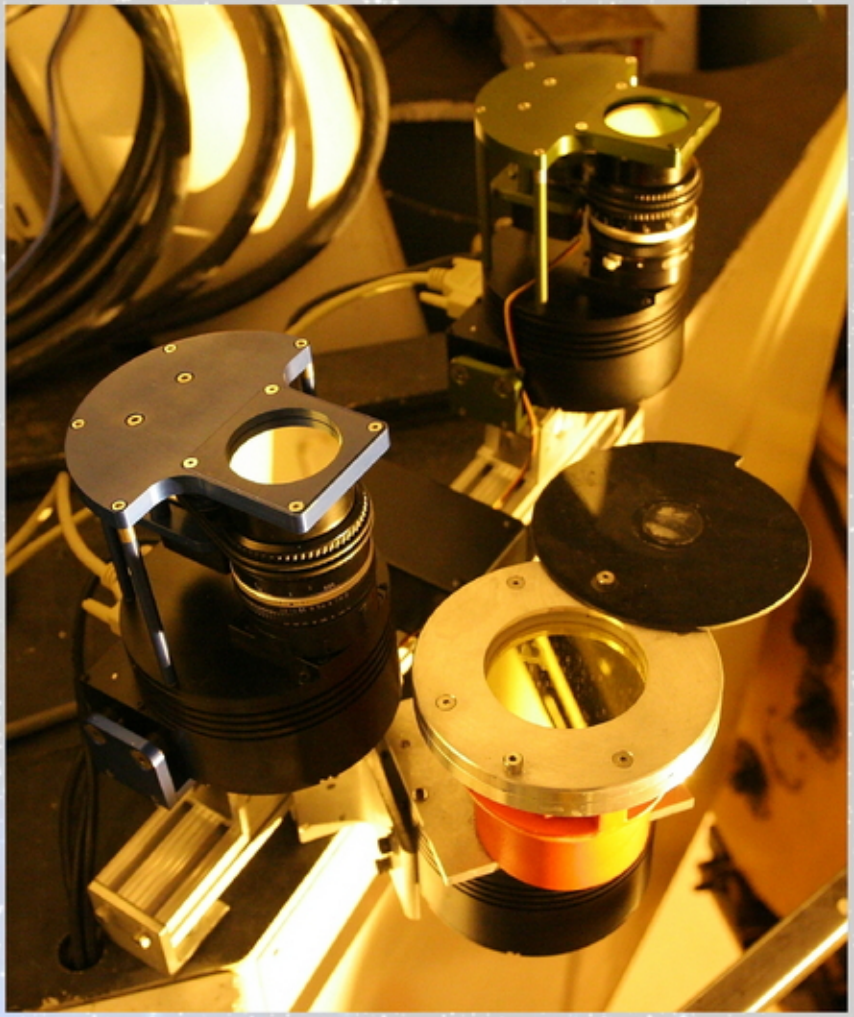
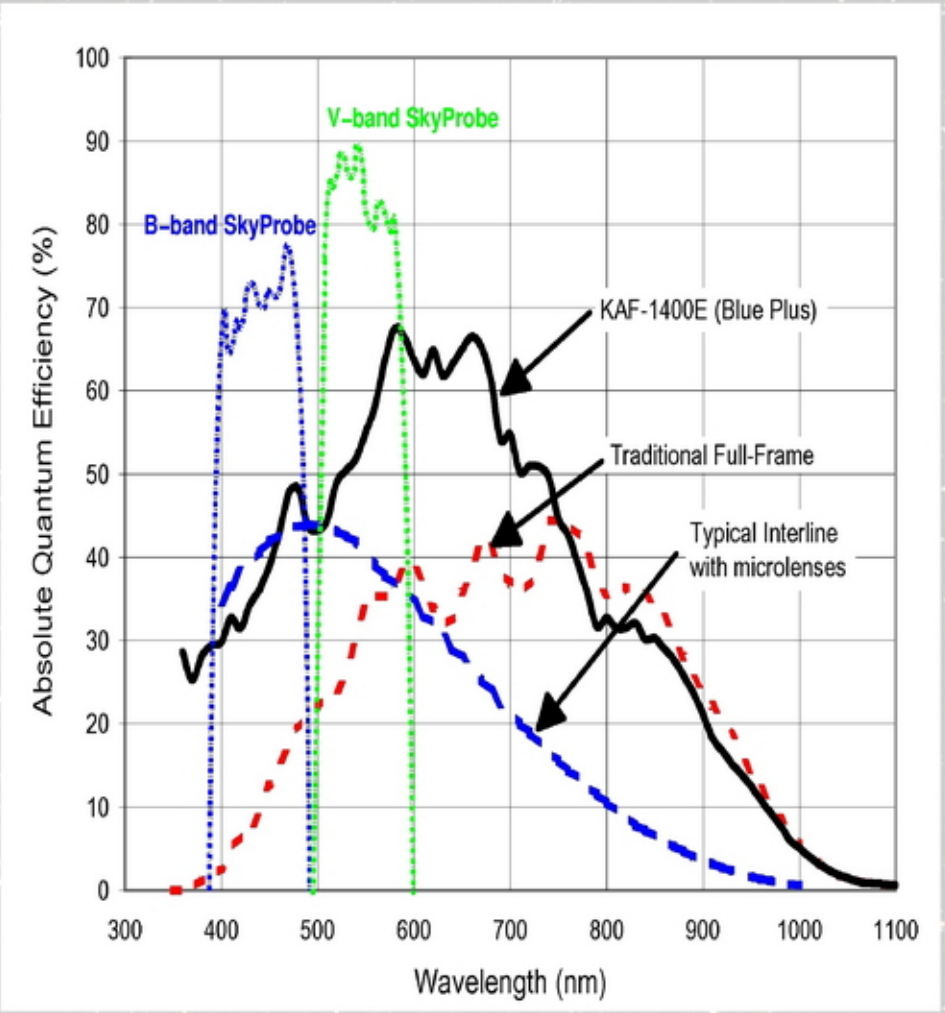
An upcoming dual–channel system: SkyProbeBV



SkyProbeBV & SkyProbe at CFHT



SkyProbeBV filters bandwidth

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