Current Status & Future Plans at CFHT

- Recent Facility Upgrades
- New Instrumentation
- Large Surveys
- Strategic Initiatives
- MSE
- Tying it all together
Overall pleased with dome vent performance and an improvement in delivered image quality of at least 0.1 arcsec (median, 500 nm). Will continue to record seeing measurements year-round to identify seasonal effects. Consideration being given to further improvements – options for better mirror flushing, perhaps LO/MIT dome paint.
New vs. Old MegaCam Filters
New UV Filter

New vs. Old MegaCam U Filters

Transmission (%) vs. Wavelength (nm)

New

Old

Atmosphere
**CFHT Large Area U-band Deep Survey (CLAUDS)**

- Program by Sawicki et al. to add deep (U ~ 27 AB) MegaCam u-band data across ~25 deg² to HSC grizy survey, enhancing photo-z measurements
- 60 nights over 4 semesters with broad interest -
  - #1 ranked proposal in Canada
  - #2 ranked in China
  - #4 ranked in France
- Demonstrates effectiveness of “leveraging” via u-band in deep photo-z surveys and will take advantage of new enhanced u-band sensitivity of MegaCam
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Tying it all together
SITELLE

- Imaging Fourier Transform Spectrometer built by ABB in collaboration with U. Laval and CFHT
  - Intended to study the structure and kinematics of emission line sources (nebulae, galaxies, clusters)
  - Wavelength range: ~350-970 nm
  - Resolution: Tunable up to ~5000
  - Field of view: 11x11 arcmin
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Excellent progress made at ABB in recent months, demonstrating high modulation efficiency including at UV wavelengths

Modulation efficiency is a measure of fringe contrast in the output interferogram
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- Intended to study the structure and kinematics of emission line sources (nebulae, galaxies, clusters)
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Excellent progress made at ABB in recent months, demonstrating high modulation efficiency including at UV wavelengths

- Flexure tests recently completed
- Cold tests are next major milestone before shipping to Hawaii
SPIRou

Cassegrain Unit

- Deployed at CFHT f/8 focus
- NIR high speed guide camera for tip/tilt compensation
- Fiber links to calibration sources and spectrograph
- Atmospheric Dispersion Compensator
- Thermo-electrically cooled stop
- High performance Rhombs and Wollaston prism
SPIRou

Spectrograph Unit

- Deployed in CFHT Coude room
- Ultra stable cryogenic temperature control
- R2 echelle grating fed by reflective image slicer and collimator
- H4RG 1-2.5 µm science detector
- Prism cross-disperser yielding YJHK single shot spectra at R~70K with ~ 1 m/s stability
SPIRou

Ultra-pure ~35 m fluoride fibers that transmit through 2.5 µm
SPIRou in Fabrication

Key components under development

- H4RG science detector
- Fluoride fiber system

Anticipated delivery of SPIRou – 2018

Total project cost ~$15-18M

Once deployed, anticipate major (hundreds of nights) of time dedicated to exoplanet survey
Current Status & Future Plans at CFHT

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Clear evidence that major surveys increase the scientific productivity of CFHT – meaning we should continue them in the future.

Commitment to build SPIRou, which is a survey machine, means large amounts of telescope needed to justify exoplanet investments.

In France, EUCLID mission critically requires ground based northern-sky optical survey to complete photo-z mission.

Current Large Programs underway will be completed by end of 2016...
From the September 2013 SAC meeting –
“We note that for maximum scientific return, either of the two options [MegaCam Upgrades or SPIRou] will require observing time commitments of the order of 1000 nights to realize the full potential of these instruments. We recommend that CFHT carry out future very large, proposal-driven, community-based collaborative surveys in the spirit of CFHTLS.”

From the November 2014 SAC Meeting -
“The SAC recommends that a first call for LPs be issued in early 2015 for selection at the May 2016 SAC meeting. This will be for up to a total of 429 nights contributed by the Canada (60% of national time) and France (70% of national time) Agencies...SAC recommends that a second call for Large Programs be issued once SPIRou has been commissioned and its performance is known.”
Net result is that starting in 2017, ~2/3 of CFHT time will be dedicated to large surveys that will be take at least 5 years to complete.

This greater reliance upon surveys is expected to -

- Keep CFHT competitive through this decade
- Help secure commitments to operate CFHT, and
- Function as a segue to MSE...
Recent Facility Upgrades
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Strategic Initiatives
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Tying it all together
CFHT’s agreement with NAOC (National Astronomical Observatories, China) was set to expire at the end of 2014B

Negotiated a new agreement between NAOC and CFHT Corp. that –

- Extends through the next 4 years
- Provides up to 15 nights/semester
- Identifies specific avenues for participation in MSE Project Office

CFHT provides China with vital access to Maunakea astronomy data and through this collaboration the Chinese community should continue to gain important experience in advance of TMT's arrival
Conducted numerous meetings at Indian Institute of Astrophysics (IIA - Bangalore) in conjunction with Rick Murowinski and John Hutchings last month

Considerable interest expressed in collaborating on MSE, given synergies with TMT and their own 10 m telescope project

Beyond MSE collaboration expressed interest in possibly joining CFHT as an Associate Partner

Anticipate further on-site interactions in Bangalore, Pune, etc. in 2015+
The East Asian Observatory is born...
Eliminate current MOU’s between CFHT and our existing East Asia Associate Partners and renegotiate a single agreement between CFHT Corp and EAO Corp, providing essentially the same terms but everything would be handled under one “umbrella”

- Does not imply any difference in costs to any partner – essentially a consolidation of community access to CFHT and participation in CFHT development
- EAO members would all have access to CFHT and would need to self-organize to coordinate proposal submissions, distribution of time within nominal min/max limits, etc.
- Could be a mechanism to jointly use EAO time on CFHT for strategic purposes, e.g. up to ~30 nights/semester for large programs w/out any commitments of funds beyond what is already in place
Benefits to EAO include –

- Bilateral corporate level agreement would provide an additional form of “presence” in Hawaii astronomy for EAO, through formal partnership with a long-established entity like CFHT
- Possibility of pooling telescope access across all EAO partners to perform projects that would otherwise not be possible
- Segue to further/deeper partnership in the future

Japan currently not a partner with CFHT but could gain access through EAO if desired -

- Note that CFHT is the only northern hemisphere facility supporting high quality panoramic UV imaging - important in several major surveys (HSC)
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Common MSE Questions

What?

- Fiber Coupling
- ~1.5° Field
- ~3000 Fiber Positioner
- ~10 m Primary
- Low/High-res spectrometer bank

Replace CFHT telescope and dome with new 10 m class telescope and highly multiplexed spectrometer
Common MSE Questions

**What?**

Unique spectroscopic survey machine, capable of producing SLOAN-class survey every 4-5 months (see mse.cfht.hawaii.edu for science case)

**Why?**

The future is now:
Gaia and stellar astronomy in the Galaxy

- Gaia will obtain proper motions and parallaxes for all object to $G=20$, radial velocities to $G=16$, and abundances to $G=12$
- Multiple 4m MOS instruments will complement Gaia by obtaining radial velocities and chemical abundance information for stars in the nearby Galaxy (e.g., 4MOST, HERMES)
- Only the MSE can obtain detailed abundances for the full range of Gaia targets, and push chemodynamical studies of the Galaxy to larger radius, e.g. based on $r=16$ or $r=20$

The MSE Galactic Archaeology Survey

- Baseline survey: mapping 10000 square degrees of the Galaxy at intermediate resolution ($R=6500$) and high resolution ($R=20000$)
- Two pairs of spectral windows, one in each mode:
  - $R=6500$: 381-439nm, 770-889nm
  - $R=20000$: 426-491nm, 585-675nm

The global context of the MSE:
The international network of astronomical observatories I.

- Optical and near-IR:
  - Vast number of past, current and near-future optical and near-IR wide field imaging surveys. The entire Northern Hemisphere is surveyed to a depth of $g=23.6$ @S/N=5 by PS1 (data available internationally at the end of the year). Also Subaru SuprimeCam as well as HSC, CFHT, Euclid...
  - Half of southern hemisphere also visible from Maunakea at airmass=1.5 or better
Common MSE Questions

What?

Why?

When?

Roughly a decade to complete

Construction Proposal Complete 2018

MSE Commissioning 2024
Common MSE Questions

- What?
- Why?
- When?
- How much?

Roughly $250M
Common MSE Questions

- What?
- Why?
- When?
- How much?
- Biggest concern?

Roughly $250M
Common MSE Questions

What?
Why?
When?
How much?
Biggest concern?
Same as PFS?

No – main differences include (1) fully optimized spectroscopy facility, (2) high-res spectroscopy, (3) survey machine, not multi-purpose telescope
Common MSE Questions

- What?
- Why?
- When?
- How much?
- Biggest concern?
- Same as PFS?
- What’s “real”?
Project Office launched after March planning retreat to identify strategic goals in 2014 and pick a new name for ngCFHT...

2014 activity focused heavily on partnership building and laying foundation of Construction Proposal

2015 will include filling out Waimea based Project Office team, science requirements, various engineering studies, launch EA/EIS, etc.
Recent MSE Activity

- Project Office launched in Waimea with interim staff –
  - Rick Murowinski – Project Manager
  - Alan McConnachie – Project Scientist
  - Derrick Salmon – Project Engineer

- Recruiting full time PM and PS

- MSE Advisory Group established

- Building partnership with particular emphasis on founding CFHT partners, East Asia, Australia, India

- Science team assembled to evaluate Point Design in context of new SRD

- Exploring permitting issues with OMKM, UH, private consultants
A Growing International Science Team

🌟 Project Scientist - Alan McConnachie, MSE Project Office

🌟 Contact Scientists –

🌟 Australia: Andrew Hopkins, Australian Astronomical Observatory
🌟 Canada: Michael Balogh, University of Waterloo
🌟 China: Eric Peng, Kavli Institute of Astronomy,
🌟 France: Nicolas Martin, Observatoire de Strasbourg
🌟 India Contact Scientist: Gajendra Pandey, Indian Institute for Astrophysics

🌟 Lead Scientists –

🌟 The Milky Way and Resolve Stellar Populations: Carine Babusiaux, Observatoire de Paris
🌟 Nearby and Low Redshift Galaxies: Michael Balogh, University of Waterloo
🌟 High Redshift Galaxies and Cosmology: Lisa Kewley, Australia National University
MSE Emerging as a Priority in Strategic Plans Globally

- **Canadian** Mid-Term Review (MTR) of 2010-2020 Decadal Plan
  - Results to be released Q2 2015 but given origins of MSE (ngCFHT) concept, anticipate support of MSE in MTR report

- **French** (5 yr) Prospective
  - French participation in MSE Construction Proposal given “Priority 0” status in 2015-2020 French astronomy strategic plans

- **Australian** 2015-2025 Decadal Plan
  - Results to be released mid-2015 but already informed that MSE will be identified as a high priority future interest

- **China** – Joined MSE Advisory Group and providing engineering support from 2 engineers at NIAOT; engineering workshop planned for Nanjing in March 2015

- **India** – Anticipate providing 1-2 FTE’s engineering support, starting 2015, from Indian Institute of Astrophysics

- **Japan** – Interest in collaboration? Links to PFS are clear and EAO/CFHT could be the pathway...
A Growing International Science Team

Nobuo Arimoto, Subaru/NAOJ, Japan
Martin Asplund, Australian National University, Australia
Herve Aussel, CEA Saclay, France
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MSE
Tying it all together
Seeing Into the Next Decade
Strategy → Objective

Facility Evolution  Facility Transformation
FUTURE

SUBARU+MSE (via EAO)

SUBARU+TMT via (TIO)
Aloha from...
Questions?