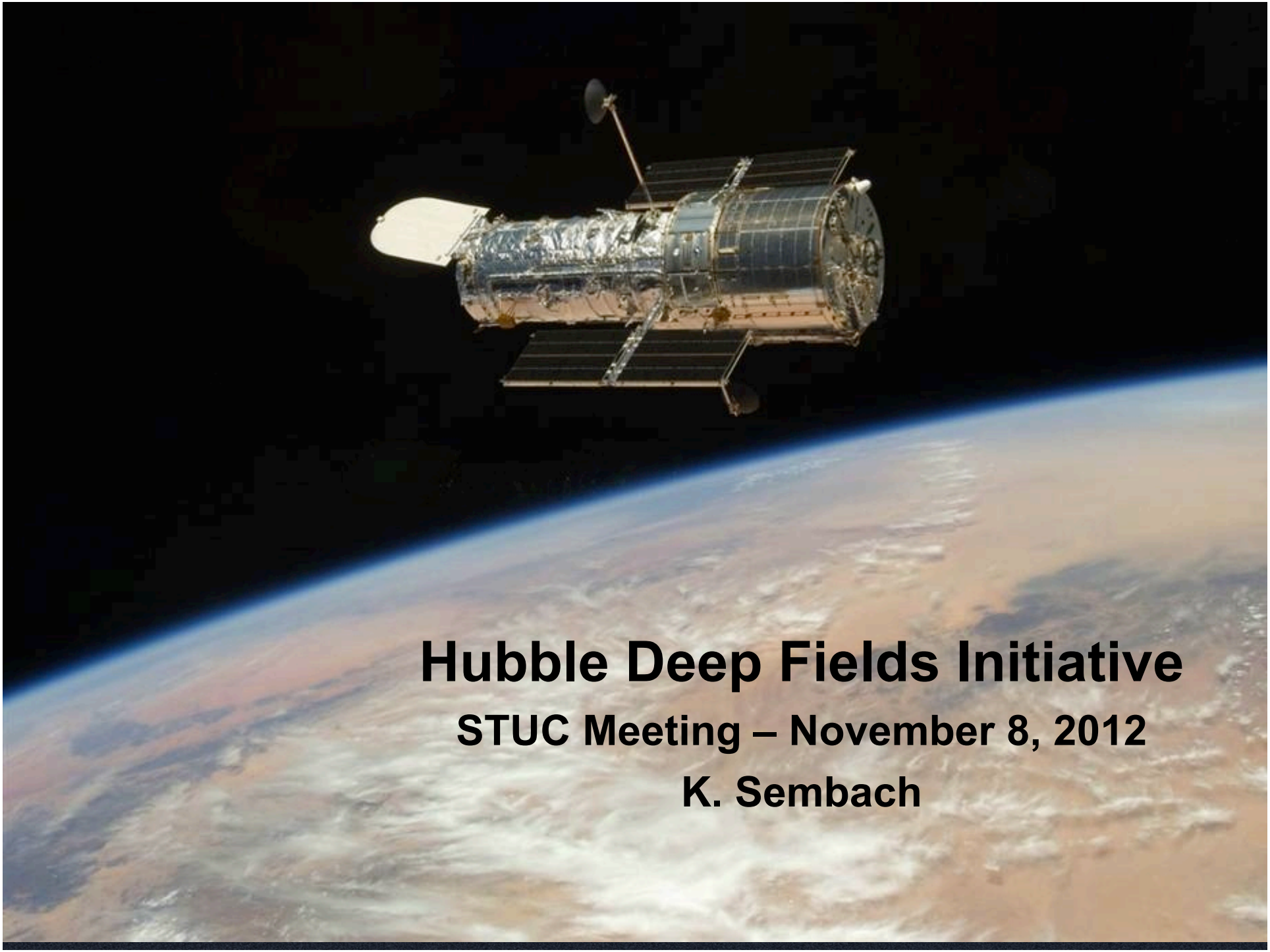


Hubble Deep Fields Initiative

STUC Meeting – November 8, 2012

K. Sembach

Hubble's Full Color Ultra Deep Field (aka "Extreme Deep Field")

Combined all public data available at time of release

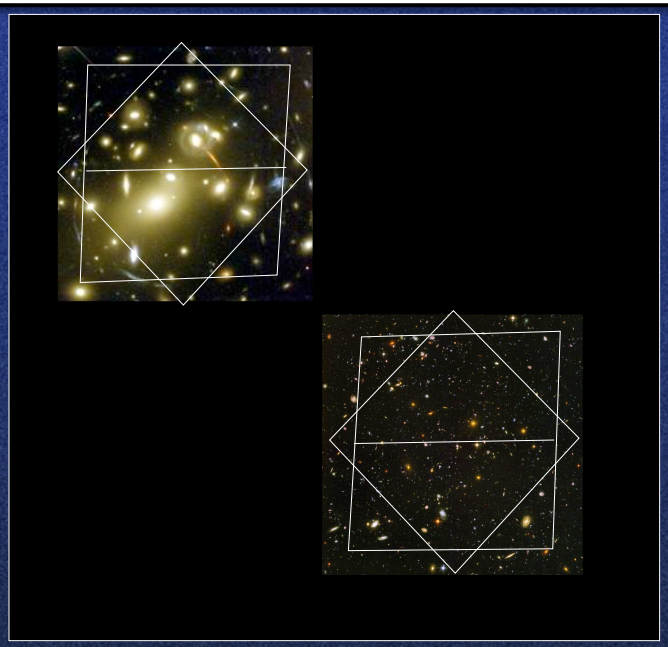
Issued as a Photo Release
+ Webinar/Video
+ Google Hangout

Other UDF programs have completed recently and will provide still deeper views:

- Ellis (Deep WFC/IR)
  - 128 orbits
- Teplitz (Deep WFC3/UV)
  - 90 orbits

Credit: NASA, ESA, G. Illingworth, D. Magee, and P. Oesch (UCSC), R. Bouwens (Leiden University), and the HUDF09 Team

Hubble Deep Field Initiative (HDFI)

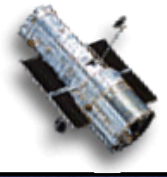


James Bullock (UC-Irvine) [Chair]
Mark Dickinson (NOAO)
Steven Finkelstein (UT Austin)
Adriano Fontana (INAF, Rome)
Ann Hornschemeier Cardiff (GSFC)
Jennifer Lotz (STScI)
Priya Natarajan (Yale)
Alexandra Pope (U. Mass)
Brant Robertson (Arizona)
Brian Siana (UC-Riverside)
Jason Tumlinson (STScI)
Michael Wood-Vasey (Pittsburgh)

The Committee was charged by the STScI Director to:

- Solicit input from the astronomical community in defining the science goals and recommendations.
- Define the science case and a set of science goals for a new set of ultra-deep imaging fields with sensitivity depths comparable to those of the HUDF and HUDF-09 infrared follow-up. Provide an assessment of the urgency of pursuing this science.
- Assess the prospects for near-field science that can be achieved with these deep-field observations.
- Recommend the number of fields, location, filters, and depths that should be obtained to meet the science goals.

HDFI: Background and Process



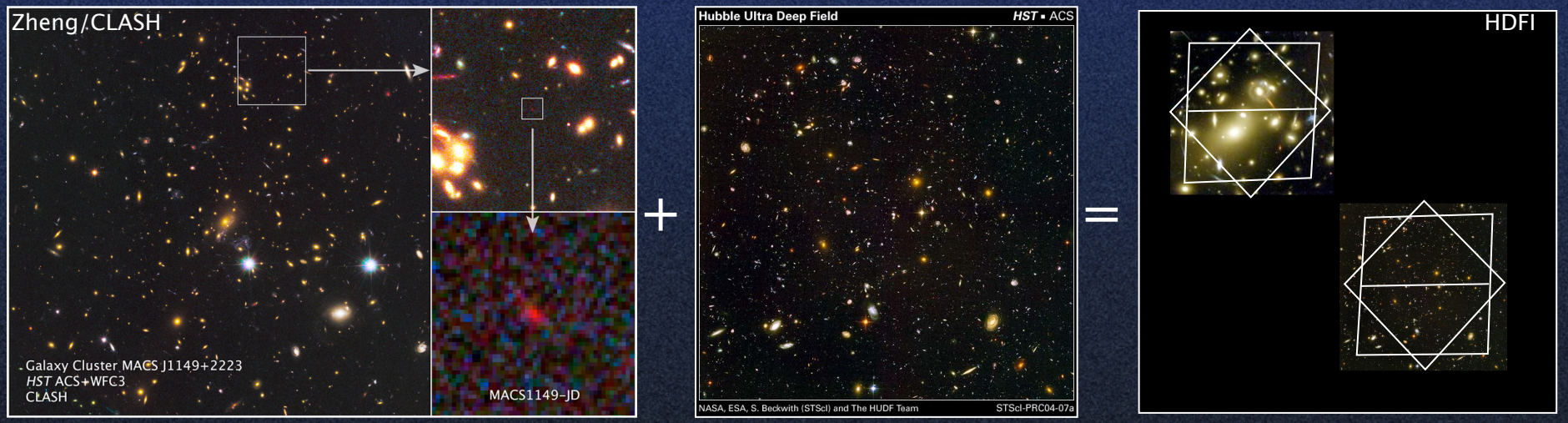
- STScI solicited community input (pro/con) on the idea of devoting time to a new deep field initiative ("Deep Fields Beyond the HUDF")
  - Responses were due August 31, 2012
- Committee reviewed and discussed 32 white papers submitted by the community
- Considered a broad set of topics
  - Deep blank fields
  - Fields lensed by foreground clusters
  - Grism observations
  - Deep fields in parallel with COS spectroscopy
  - Synergy with JWST and other observatories, E/PO, implementation strategies, etc…

The committee presented a unanimous recommendation to the Director.

HDFI: The High Redshift Frontier

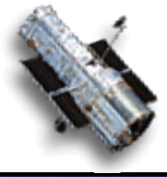
- Current frontier is z = 8-10 but we only see the brightest galaxies that are too rare to be the progenitors of ~L* galaxies in the local Universe.
  ⇒ Need to go deeper

- Cosmic variance at all redshifts is a concern, but especially at z > 7.
- z ~ 7-10 galaxies which are magnified enough for spectroscopic follow-up are (very) rare, as are z ~ 5-7 galaxies bright enough for studies of internal structure.
  ⇒ Need to go wider



Lensed Fields + "Blank" Fields = New parameter space

HDFI: Science Aims



- Discover new population of z=5-10 galaxies,10-100x fainter than any known
  The building blocks of typical ~L* galaxies in the local universe.

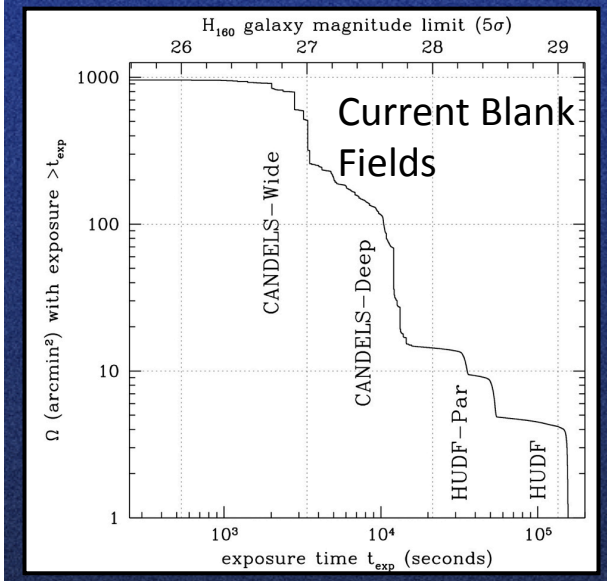
- Characterize stellar populations of faint galaxies at high redshift
  and solidify our understanding of stellar mass functions at the earliest times.

- Do astrophysics at $z > 8$ by finding galaxies magnified enough for spectroscopic follow-up and/or stretched out enough to measure sizes and internal structure.

- Provide, for the first time, a statistically meaningful morphological characterization of star forming galaxies at z>5.

By imaging optimal galaxy cluster lenses, HST can detect *and study* galaxies that are as faint as anything detectable by JWST in a blank field.

HDFI: New Frontiers at High Redshift

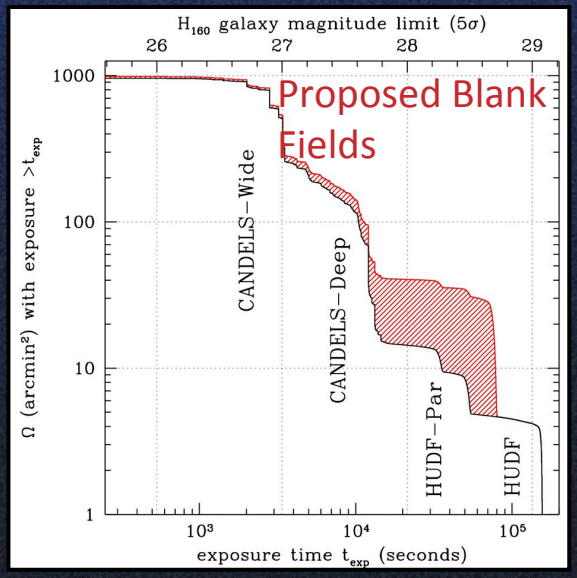


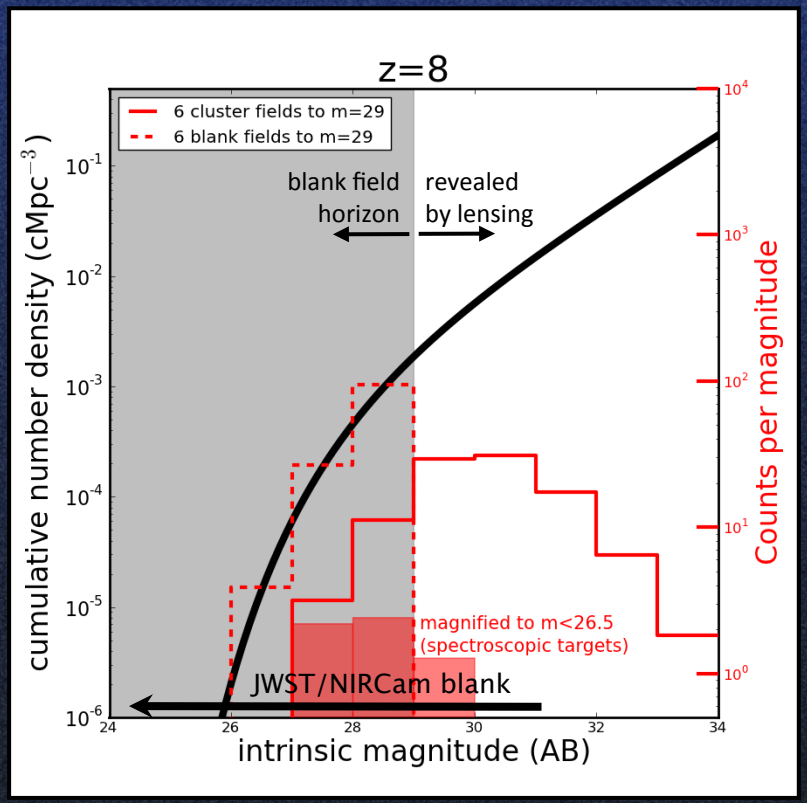
WIDER

(3-5)x increase in galaxy counts with respect to the HUDF and its parallels

DEEPER

Clusters magnify by up to 10-100x, reaching L* galaxy progenitors and equalling NIRcam in blank fields.





HDFI: The Proposed Program (Director's Discretionary time only)

Table 1: ACS

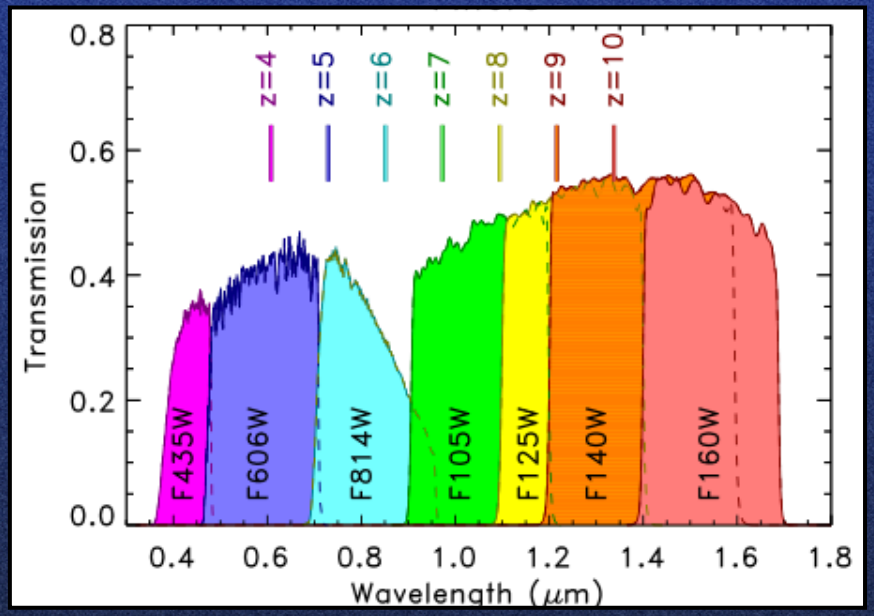
Filter	# Orbits	Exptime (ksec)	Total Mag (AB)	SNR	Fraction of PSF	Aper Corr (mag)	Total mag_{corr} (AB)
F435W	17	42.5	29.10	4.98	0.85	−0.34	28.76
F606W	10	25.0	29.12	5.02	0.85	−0.34	28.78
F814W	43	100	29.46	5.01	0.85	−0.34	29.12

Table 2: WFC3

Filter	# Orbits	Exptime	Total Mag	SNR	Fraction of	Aper Corr	Total mag_{corr}
F105W	29	84.1	29.30	4.98	0.75	−0.21	29.09
F125W	14	40.6	28.79	5.01	0.70	−0.13	28.66
F160W	27	78.3	28.79	5.02	0.62	—	28.79

Table 3: WFC3 (cluster field option)

Filter	# Orbits	Exptime	Total Mag	SNR	Fraction of	Aper Corr	Total mag_{corr}
F105W	24	69.6	29.19	5.02	0.75	−0.21	28.98
F125W	12	34.8	28.70	5.04	0.70	−0.13	28.57
F140W	11	31.9	28.72	5.03	0.66	−0.07	28.65
F160W	23	66.7	28.70	5.03	0.62	—	28.70

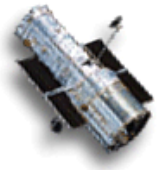


Six new fields centered on strong lensing clusters AND six nearby parallel blank fields.

Images in 6-7 bands to AB ~ 28.7 with ACS and WFC3/IR in 140 orbits per field
(840 orbits in the proposed program)

Clusters are chosen from a candidate list of ~25, weighing strength/quality of lensing map, galactic foregrounds, JWST visibility, Spitzer scheduling, and visibility to other facilities (ALMA, EVLA, future GSMTs). Exact choice of clusters is still pending and will be announced to the community in the near future.

HDFI: Proposed Next Steps



Implementation

- Convene "HDFI Implementation Team"
- Final selection of clusters based on science priorities from panel and practical considerations
- Define the actual observing program, coordinate with other observatories (Spitzer in particular), create observing specification, and build long range scheduling plan

Community Engagement

- Announce initiative to the community if Matt approves
- Establish website for regular updates and reference
- Issue guidance on program so GOs can propose to supplement or analyze these data in C21.
- Engage lensing experts to support the broader community with high-quality, user-friendly lensing maps, and support their maintenance.
- Upcoming lensing workshop at STScI (April 2013).