The Frontier Fields and Beyond
a sneak peek at JWST’s universe

Jennifer Lotz, STScI
with Matt Mountain and the Frontier Fields Team

STUC meeting May 2014
HST Frontier Fields Implementation Team

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**OPO/Citizen Science team:**
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**Admin Support** - Ana-Maria Valenzulea
HST Frontier Fields: Goals

✦ enable awesome science (on a level playing field)

✦ engage the astronomy community in planning and follow-up

✦ engage the STScI staff and use HFF as vehicle for improvement

✦ strengthen cross-observatory collaborations

✦ engage the broader community in astronomy, HST and deep field science
Milestones Completed

Fall 2012: HDFI SWG presented a unanimous recommendation

Winter 2012: Frontier Fields announced in Cycle 21 call for proposals

All six clusters selected and announced

WFC3/IR F140W filter added to parallel field observations

Blank field positions announced

Spring 2013: ~35 Frontier Fields related proposal received for HST Cycle 21; 3 GO program and 7 archival/theory programs selected.

Public lensing map-makers selected through separate call

Summer 2013: Phasells submitted for first 4 fields

Data Pipeline testing: astrodizzle, tweakreg, + self-calibration

Chandra GO programs awarded

Lensing maps delivered (8/30)
Milestones Completed

Fall 2013:
First Spitzer observations of Abell 2744 obtained 9/14/2013
Frontier Fields ‘readiness review‘ 9/20/2013
Abell 2744 Lensing Map release by MAST/HLSP with interactive tool 10/16/2013

First HST Frontier Field observations - epoch 1 Abell 2744 10/25/2013
v0.5 data releases: 11/01; 11/08; 11/15; 11/22; 11/29
press release announcing Frontier Fields program 10/24/2013
Lensing Map release for all 6 clusters 11/27/2013

Winter 2014:
HST Epoch 1 Abell 2744 complete - 12/10/2013

v1.0 data release for Epoch 1 Abell 2744 - 12/16/2013
AAS poster session + press release - 1/7/2014

HST Epoch 1 MACSJ0416 begins - 1/4/2014
v0.5 data releases: 1/10; 1/17; 1/24; 1/31

v1.0 data release for HST Epoch 1 MACS0416 - 3/1/2014
Spitzer observations of Abell 2744 complete - 2/2014
Abell 2744 - HST Epoch 1 completed Nov. 2013
Abell 2744
Parallel ‘Blank’ Field
epoch 1
HST ACS F435W/
F606W/F814W
Abell 2744 Cluster
epoch 1

public lensing model
red = magnification
at z=9
blue = mass
HST Frontier Fields: Goals

- enable awesome science (on a level playing field)

HST FF data downloaded from >600 IPs (total)

HST Lensing Model data downloaded from >200 IPs (total)
  interactive lensing tool used >400 times

HST Frontier Field website visited by >585 visitors

early days for science..
Early science (Abell 2744)

- z~ 8.2 galaxy with strong 4.5 μm emission (rest-frame [OIII], Hβ)
  - Laporte et al. 2014 (accepted).

- cluster of z~7-8 galaxies?

- triply imaged z~7.5 galaxy
  - Zheng et al. 2014 (submitted)

- no z>9 candidates? ⇒ sharp decline in cosmic SF?
HST Frontier Fields: Goals

✦ engage the astronomy community in planning and follow-up

~35 Frontier Fields related proposal received for HST Cycle 21; 3 GO program and 7 archival/theory programs selected.

approved large Chandra, VLA programs; VLT Hawk-I program K-band program; DEIMOS/Keck program, multiple ALMA proposals; others??

unprecedented coordination of 5 lensing groups for public maps; work is continuing as they analyze simulated FF clusters

HST Cycle 22 response? more ground-based spectroscopy needed? updates to lensing maps with FF data?
### Hubble Space Telescope Frontier Fields

This page is a clearing-house site for links to other public data on the Frontier Fields. If you have data you wish to share, please email frontierfields@stsci.edu. Please credit these data products appropriately -- see the links below.

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Abell 2744</th>
<th>MACS0416</th>
<th>MACS0717</th>
<th>MACS1149</th>
<th>Abell S1063</th>
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HST Frontier Fields: Goals

✿ engage the STScI staff
   and use HFF as vehicle for improvement

MAST: first theory models directly associated with HST data
astrodizzle/tweakreg pipeline testing, scripts
ACS: calibration, bias destriping, self-cal, geometric distortion
WFC3: calibration (flats), variable sky, blobs, persistence checking
scheduling: WFC3 scanned grism persistence time buffer
HST Frontier Fields: Goals

- strengthen cross-observatory collaborations

several joint Spitzer-HST press releases;

Gemini Observatory DD time for GEMS K-band
Abell 2744, MACS0416
-- discussion for more investment?

XMM? ALMA?

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HST Frontier Fields: Goals

- engage the broader community in astronomy, HST and deep field science
the immediate future of the Frontier Fields

first two HST Frontier Fields complete August 2014
Spitzer Frontier Fields DD observations Sept 2013-June 2014
decision on HST Cycle 23 observations expected in Dec. 2014
Upcoming Milestones

March 2014: HST Cycle 22 proposal deadline

May 2014: Abell 2744 Epoch 2 observations start

July 2014: Abell 2744 HST observations complete

full data release for Abell 2744 (v1.0 epoch 2; v2.0 for epoch 1)

August 2014: Spitzer observations of 1st 4 clusters complete

September 2014: MACSJ0416 HST observations complete

MACS0717 HST epoch 1 observations begin

full data release for MACS0416 (v1.0 epoch 2, v2.0 for epoch 1)

November 2014: External committee to decide Year 3 convenes

MACS1149 HST epoch 1 observations begin

December 2014: v1.0 data release for MACS0717 HST epoch 1

January 2015: HST Cycle 23 call for proposals released

Winter AAS meeting

v1.0 data release for MACS1149 HST epoch 1
Upcoming Milestones

Spring 2014:  contact external review committee members

Summer 2014:  HST data pipeline script releases:
              WFC3/IR time-variable sky
              ACS self-calibration
              Frontier Fields Survey Paper submitted
              Frontier Fields HST Data Pipeline Paper submitted;
              scripts/cookbook released.

Fall 2014:    press release announcing complete data for 1st clusters?
              convene external review (October/November)
HST Frontier Fields - Year 3?

external review in October/November 2014 (committee TBD)

Criteria for year 3 observations -

✦ Are we making significant progress toward primary science goals?

(1) probe galaxies >10x intrinsically fainter than any seen before, particularly those before and during reionization

(2) study the early formation histories of galaxies intrinsically faint enough to be the early progenitors of the Milky Way

(3) study highly-magnified high-z galaxies in detail: structures, colors, sizes and provide targets for spectroscopic followup

(4) provide a statistical picture of galaxy formation at early times
HST Frontier Fields - Year 3?

external review in October/November 2014 (committee TBD)

Criteria for year 3 observations -
✧ Are we making significant progress toward primary science goals?
✧ Are the community science needs being meet? (data releases, lensing maps, funding support ..)
✧ Ancillary science impacts (lensing models, cluster science ..)
✧ Synergistic activities (E/PO; improved data techniques; Spitzer)
HST Frontier Fields: Goals

✦ enable awesome science (on a level playing field)
  ⇒ continue to release HST data products in timely manner
  ⇒ update lensing models
  ⇒ publish survey + HST data pipeline papers
  ⇒ fund FF science via HST archival proposals

✦ engage the astronomy community in planning and follow-up
  ⇒ maintain + improve data clearing house page
  ⇒ coordinate/support HST GO Cycle 21/22 FF programs (Treu, Siana, Rodney, ??)

✦ engage the STScI staff
  and use HFF as vehicle for improvement
  ⇒ propagate HFF data pipeline efforts to HST system
  ⇒ release HFF pipeline software & scripts

✦ strengthen cross-observatory collaborations
  ⇒ continue to coordinate with Spitzer, especially on last 2 clusters
  ⇒ talk to Gemini, ALMA, XMM

✦ engage the broader community in astronomy, HST and deep field science
  ⇒ additional press releases as survey develops; encourage community releases
  ⇒ Citizen Science project?