WFIRST: Science from Deep Field Surveys

WFIRST Deep Field Working Group:

A. M. Koekemoer[1], R. Foley[2] (co-chairs), P. Capak[3]. O. Dore[4], H. Ferguson[1], C. Hirata[5], A. Kim[6], J. Kruk[7], D. Marrone[8], J. Newman[9], J. Rhodes[4], B. Robertson[2], D. Rubin[1], D. Spergel[10], R. Windhorst[11]

[1]STScI, [2]UCSC, [3]Caltech, [4]JPL, [5]OSU, [6]LBL, [7]GSFC, [8]UofA, [9]UPitt, [10]Princeton, [11]ASU

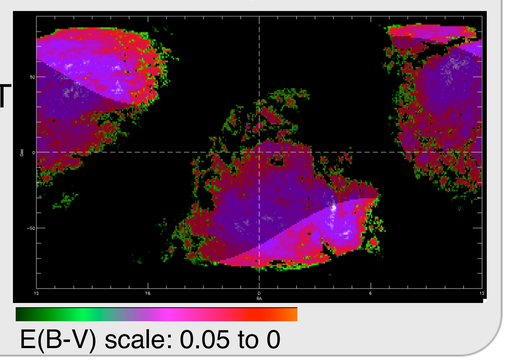
WFIRST will enable deep field imaging across much larger areas than those previously obtained with Hubble, opening up completely new areas of parameter space for extragalactic deep fields including cosmology, supernova and galaxy evolution science. The instantaneous field of view of the Wide Field Instrument (WFI) is about 0.28 square degrees, which would for example yield an Ultra Deep Field (UDF) reaching similar depths at visible and near-infrared wavelengths to that obtained with Hubble, over an area at least 100 times larger, for a comparable investment in time. The WFIRST Deep Fields Working Group has been examining the science considerations for various types of deep fields that may be obtained with WFIRST, and present here a summary of the various properties of different locations in the sky that may be considered for future deep fields with WFIRST.

Potential Deep Dield Science

- Reionization and the role of faint galaxies
- Large scale structure at high redshift
- Clustering constraints on DM halo mass
- SFR, metallicity indicators for galaxy evolution
- Large SN samples to constrain cosmology
- Evolution of faint AGN through reionization

Extinction and WFIRST Deep Fields

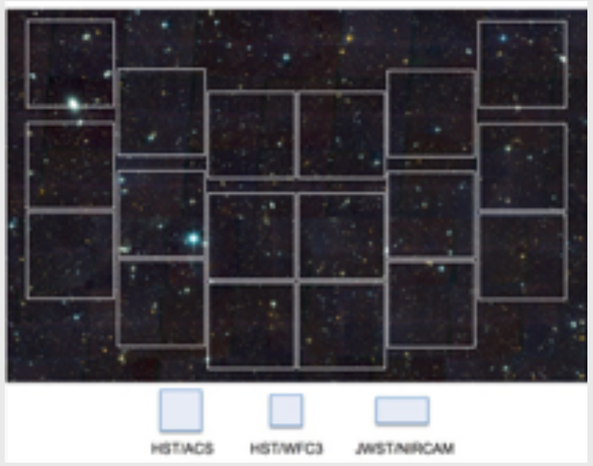
Extinction map:
Black is E(B-V) > 0.05, while extragalactic WFIRST Deep Fields ideally fall in E(B-V) < 0.05 (coloured regions).
CVZ zones (N,S ecliptic) are shaded brighter, and are suited for SN science



E(B-V) scale: 0.05 to 0

WFIRST Field of View

WFIRST offers sensitivity comparable to Hubble and 0.11” resolution over a 0.28 sq deg field of view that is 100x the field of Hubble’s visible cameras.



WFIRST/WFI FOV vs other instruments on HST and JWST. Each of the 18 individual white boxes represents one detector in the WFI FOV.

Representative Extragalactic Survey Fields

There are a considerable number of extragalactic survey fields currently in existence with good ancillary data and/or desired schedulability properties.

Currently it is envisioned that a very small number of locations (eg 1 or 2) would be considered for a deep field program.

The list of fields presented here, and discussed by the Working Group to date, is not exhaustive but can be considered representative of current fields; additional fields could be included for consideration if there is sufficient justification..

Field	R.A.	Dec.	Ecl. Lat.	Area	E(B-V)	Rel. Zodi	Days/Year
CVZ fields (< 36°)							
IRAC Dark Field	17:40	+69:00	+87	0.2	0.043	1.0	365
Extended Groth Strip	14:17	+52:30	+60	0.2	0.009	1.2	365
GOODS-N	12:36	+62:13	+57	0.25	0.012	1.2	365
Deep2A	16:52	+34:55	+57	1	0.018	1.2	365
Elias N-2	16:46	+41:01	+63	5	0.014	1.1	365
Elias N-1	16:11	+55:00	+73	9	0.008	1.0	365
Akari Deep Field South	04:44	−52:20	−73	12	0.008	1.0	365
NEP-JWST-GTO-TDS	17:22	+65:49	+86	0.2	0.042	1.0	365
NEP-Spitzer	18:00	+66:33	+90	10	0.046	1.0	365
SEP-Spitzer	06:00	−66:33	−90	10	0.062	1.0	365
Non-CVZ fields							
CDFS	03:32	−27:48	−45	0.3	0.008	1.4	229
Deep2B	23:30	+00:00	+3	1	0.044	19	146
SSA22	22:17	+00:24	+10	4	0.056	5.6	149
COSMOS	10:00	+02:12	−9	2	0.018	6.0	148
VVDS14h	14:00	+05:00	+16	4	0.026	3.6	153
Elias S-1	00:35	−43:40	−43	7	0.008	1.5	215
Bootes	14:32	+34:16	+46	9	0.016	1.4	236
Lockman Hole	10:45	+58:00	+45	11	0.011	1.4	229
XMM-LSS	02:31	−04:30	−18	11	0.024	3.2	155
SPT Deep	23:30	−55:00	+46	100	0.010	1.4	236
HERA	07:00	−30:43		1200			

A representative selection of fields discussed by the Working Group to date. Additional fields could be considered if warranted.

Current Considerations

- SN science would benefit most from CVZ:
  - Zodi, E(B-V), and schedulability all work against non-CVZ
  - Examining pros/cons of CVZ-S vs N (impacted primarily by availability of various ground-based facilities/instruments)
- Galaxies, AGN, and LSS science can be broadly accommodated by two types of "deep field":
  - ”Medium" deep field, similar size to SN field (~10 deg^2) benefit from being located on SN field; may include grism
  - “Ultra deep" field, smaller size (eg ~1 sq deg) can be more easily decoupled from SN fields and placed elsewhere, with ancillary data important (incl non-CVZ fields, eg CDFS etc)
- Ancillary & ground-based facilities are important in all cases

Please contact any of the Working Group members for further details or to engange in current discussions and considerations.