Preliminary survey design

ULTIMATE-Subaru Working Group

Overview

Note: Here we list 5 EXAMPLE survey designs. All these are very preliminary just to demonstrate what levels of survey can be done with reasonable observing time (i.e. SSP framework= ~300 nights).

(A) ULTIMATE imaging survey # 1

- "Balanced" survey: use several NBs (in all JHK) & MB+BB (in K-band) to exploit as many "unique points" as possible.
- Assume 2-deg^2 survey in COSMOS & SXDF.
- Assume broad-band J/H will be taken by WFIRST.
- Take long exposure for NB(J)s because these filters are for detecting very high-z (z>7) LAEs.

Survey type	Filters	Exp. time per FoV [hrs] (including overheads)	Limit mag. (5σ, AB)	N. of nights
NB imaging	$NB_J \times 2$	8.0 (10.0)	27.0	64
	$NB_H \times 2$	4.0 (5.0)	24.2	32
	$NB_K \times 2$	4.0 (5.0)	24.1	32
MB imaging	*K1*	10.0 (13.0)	26.1	42
	K2	10.0 (13.0)	26.1	42
	K3	10.0 (13.0)	26.1	42
BB imaging	*K*	9.0 (13.5)	26.7	45
Total time	–	–	–	299

(B) ULTIMATE imaging survey # 2

- "NB-only" survey: e.g. 10 NB filter survey to maximize NB capability of ULTIMATE – not available with e.g. WFIRST.
- "Ultra-deep" for 30' x 30' field + "Deep" for 2-deg^2.
- Again, we assume we can use broad-band J/H from WFIRST.

U-Deep (0.25deg^2)	Exp. time per FoV	(with overhead)	Limit mag.	N. of nights
NBJ x 3	16-hrs	(20-hrs)	27.4	24.0
NBH x 3	16-hrs	(20-hrs)	25.0	24.0
NBK x 4	16-hrs	(20-hrs)	24.9	32.0
K	8-hrs	(12-hrs)	26.4	4.8

84.8 nights

+

Deep (2 deg^2)	Exp. time per FoV	(with overhead)	Limit mag.	N. of nights
NBJ x 3	4-hrs	(5-hrs)	26.6	48.0
NBH x 3	4-hrs	(5-hrs)	24.2	48.0
NBK x 4	4-hrs	(5-hrs)	24.1	48.0
K	2-hrs	(3-hrs)	25.6	9.6

169.6 nights

=

254.4 nights

Note: Alternatively, you can also consider to use tunable filter instead of many NBs.

(C) ULTIMATE imaging survey # 3

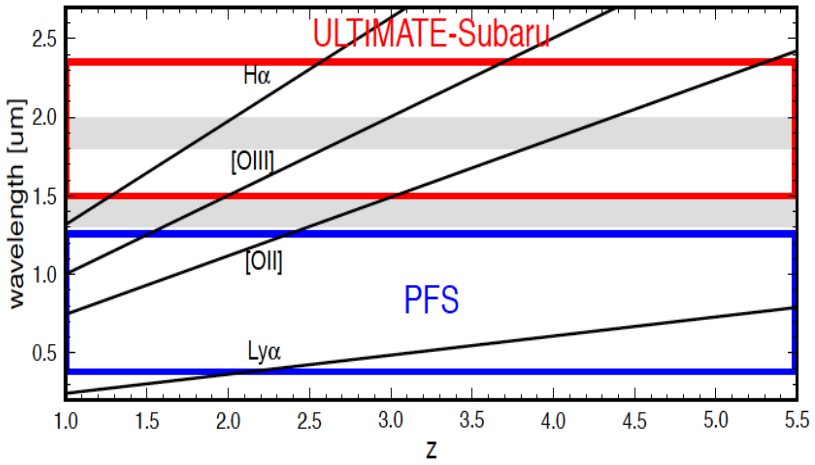
- "K-only" survey : This is another extreme case to maximize synergy with WFIRST (and HSC), and to enhance the use from broad science interests.
- Simply K-band imaging (5-hrs on-source, 7.5-hrs incl. overhead, down to 26.2 mag [5σ, AB]).
- Take 120-hrs to complete 1-deg2 – yielding total 240 nights to cover 20 deg^2.
  - Note1: UKIDSS-UDS covers ~0.8 deg2 down to ~25 mag [5σ, AB].
  - Note2: WFIRST typical depths – J=26.9, H=26.7.
- Survey area size is comparable to "HSC-deep".
- Again, we need to completely rely on WFIRST for J/H.

K-only (20 deg^2)	Exp. time per FoV	(with overhead)	Limit mag.	N. of nights
K	5-hrs	(7.5-hrs)	26.2	240

(D) ULTIMATE MOS spec. survey

(Preliminary design by Tadaki-san et al.)

- "Completely mass-limited sample" : H+K spectroscopy for a mass-complete sample of ~15,000 galaxies with logM>10.5 at z=2-2.6 selected from 3 deg^2 field.
- "PFS follow-up survey" : NIR (H+K) spectroscopy of ~10,000 higher-z targets (LAEs/LBGs) with PFS spectra.
- 200 nights in total.



Target selection	Redshift range	$N_{\rm gal}$
Mass-selected (log M_* >10.5)	2.0 – 2.6	15k
Lyman break (w/ PFS spectra)	2.0 – 2.6	4k
Lyman break (w/ PFS spectra)	3.0 – 3.7	2.5k
Lyman break (w/ PFS spectra)	4.4 – 5.2	0.5k
Lyα emitter (w/ PFS spectra)	2.2, 3.3, 4.9	3.2k

(E) ULTIMATE IFU spec. survey

According to Study Report by AAO:
http://www.naoj.org/Projects/newdev/ngao/20160113/20151211AAO_ULT_PLN_002_v5_Prototyping.pdf

- 3000 galaxies at z=0.7, 0.9, 1.4 from ~1-deg^2 region of COSMOS and SXDF-UDS (total 2-deg^2).
- Target galaxies are within the HSC-ultra-deep field.
- ~2-hrs exposure for each target, down to (roughly) SFR~10M$\odot$/yr at z=1.
- Simultaneous observation of 13 targets.
- Total 50 nights.
- Direct extension of SAMI project toward high-z.
  - See talk by Chris Lidman (AAO)