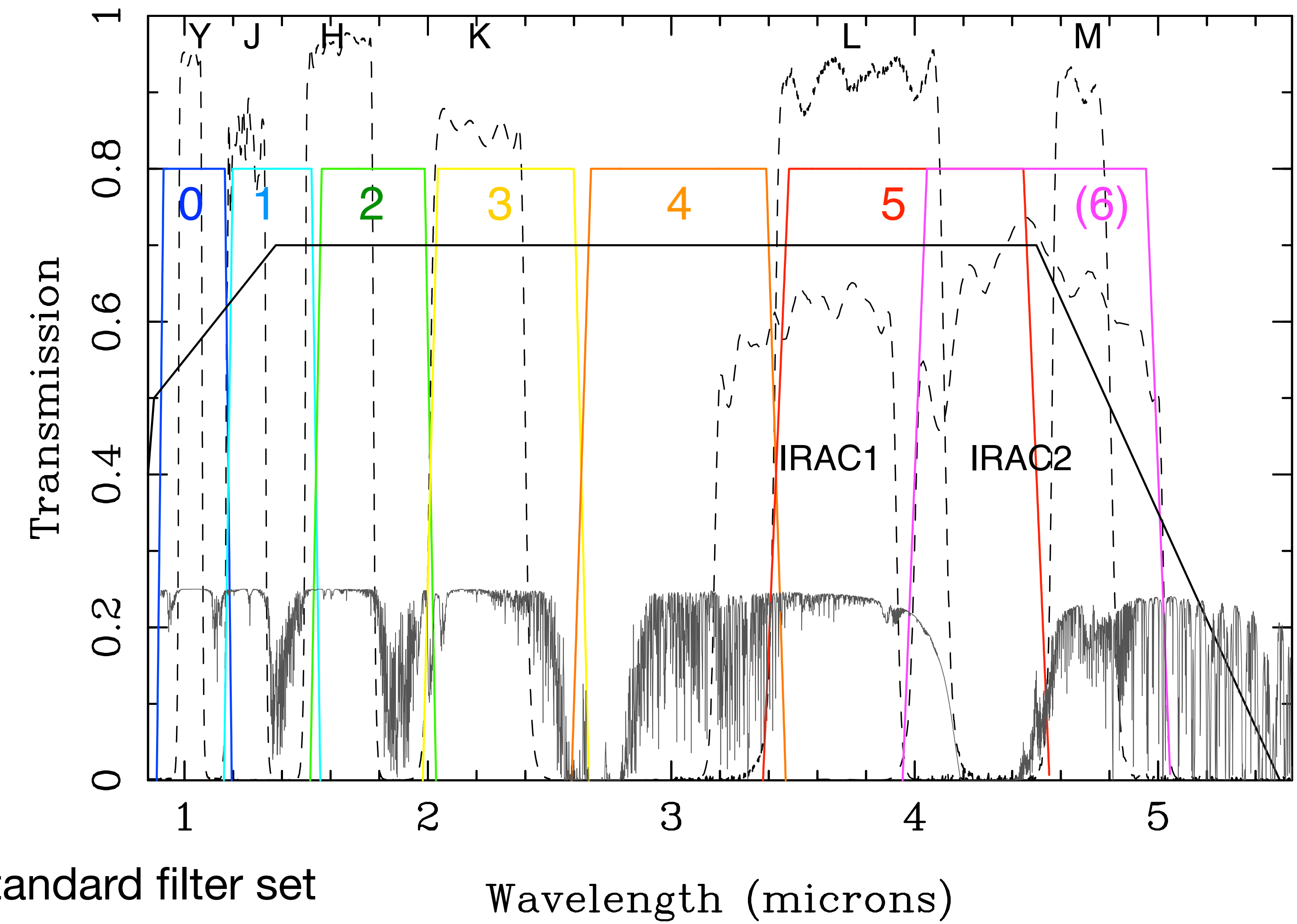
Summary of WISH Survey Plan

Kiyoto Yabe (NAOJ)

Summary of WISH Filter Set and Sensitivity:

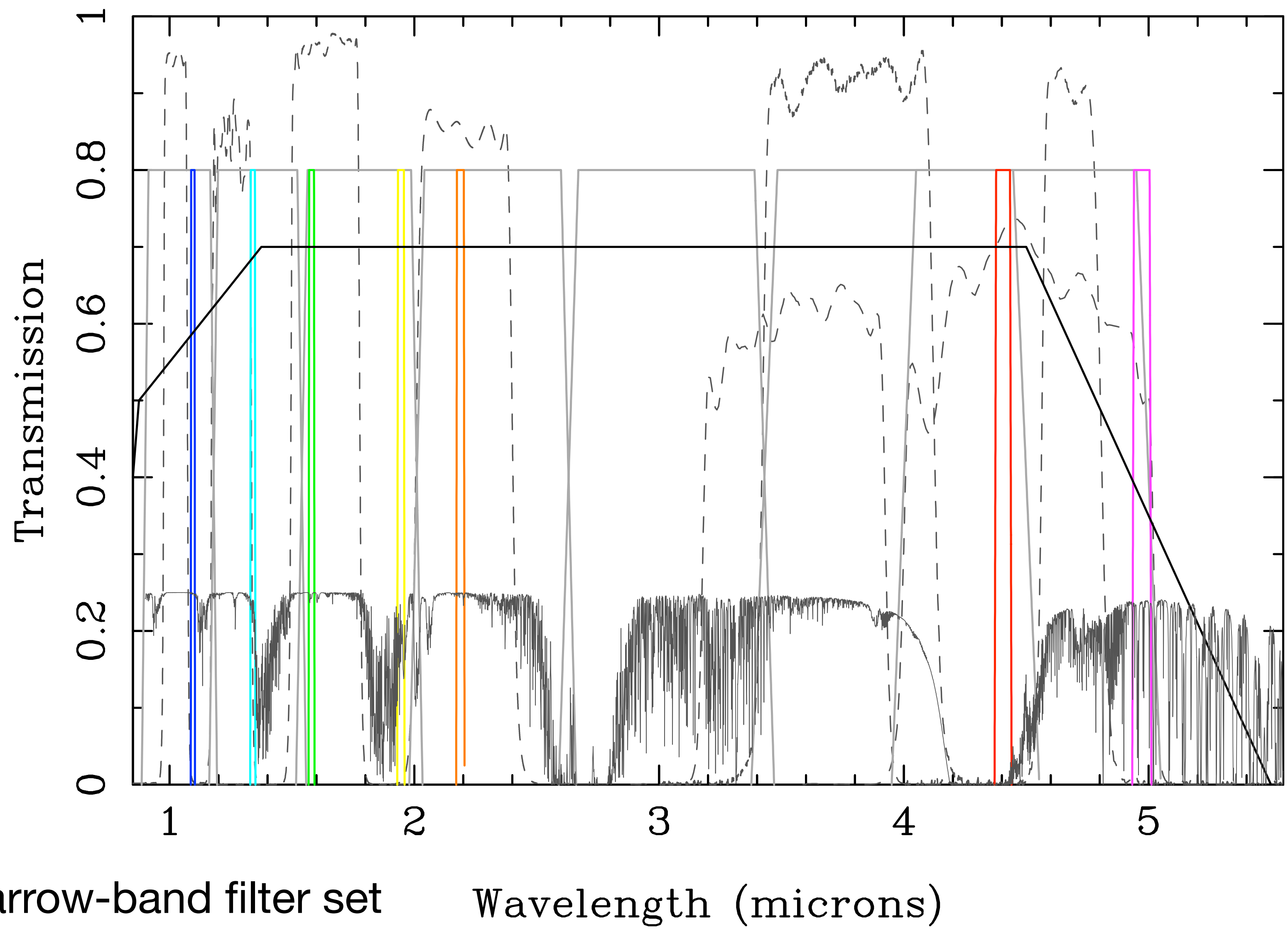
- Filters suitable for various scientific case
- Filters cover wavelength range of 1-5μm without any gaps
- Narrower filters in bluer wavelength region



WISH standard filter set

Summary of WISH Filter Set and Sensitivity:

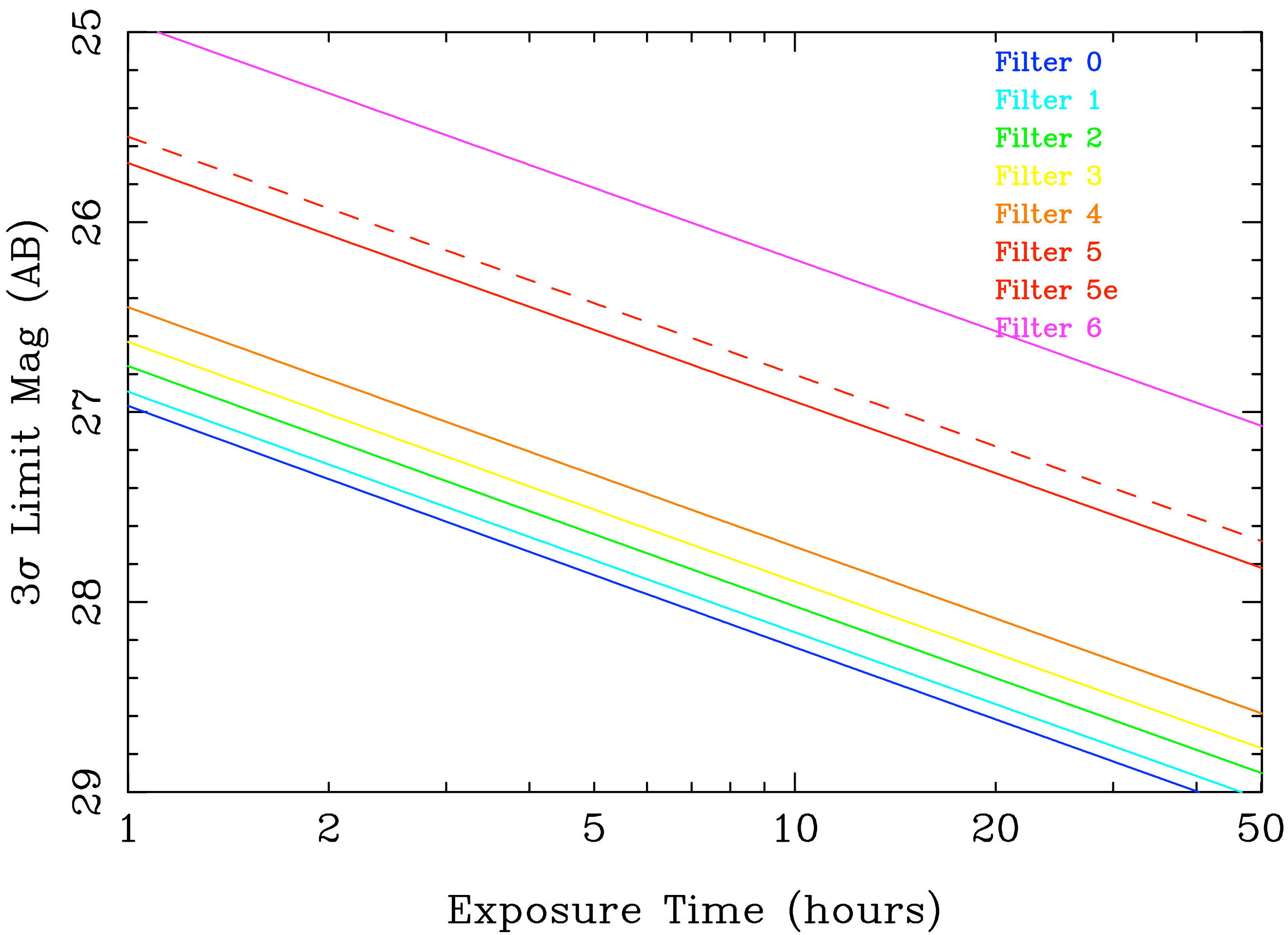
- Narrow band filters are under consideration
- Slitless spectroscopy is also under consideration as option



WISH narrow-band filter set

Summary of WISH Filter Set and Sensitivity:

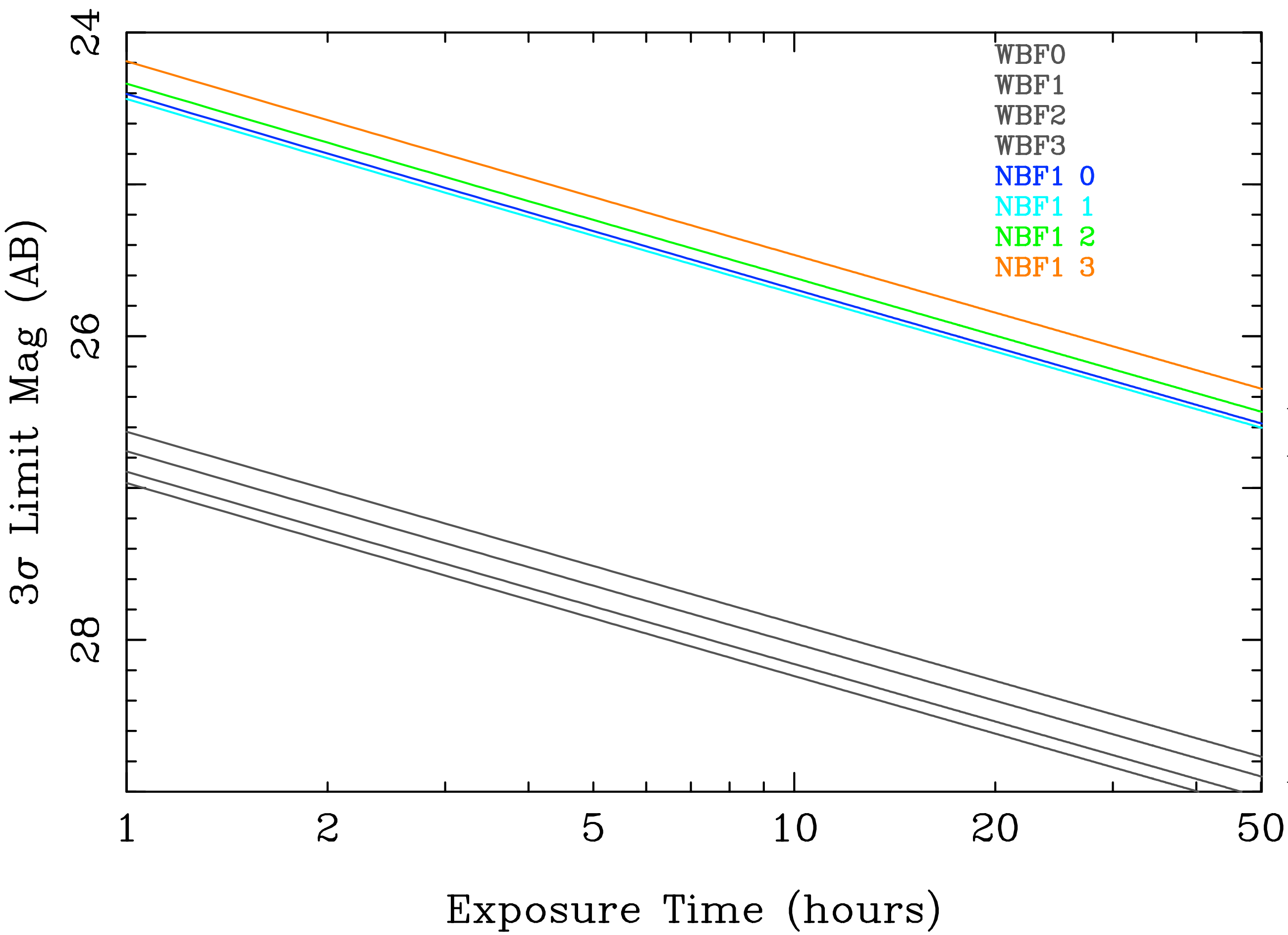
- Limiting magnitudes for the WISH broad band filters
- Reaching 28 mag (AB) in 10-20 hrs exposure in Filter 0-4
- Shallower limiting magnitudes in Filter 5-6 (>50hrs for 28 mag)



Filter	λcenter [μm]	10^h exp. 3σ mag.	hours to reach 28 AB mag.
0	1.040	28.24	6.50
1	1.360	28.16	7.50
2	1.775	28.02	9.67
3	2.320	27.89	12.25
4	3.030	27.71	17.08
5	3.965	26.95	69.67
5e	4.215	26.80	90.42
6	4.500	26.20	43.83(*)

Summary of WISH Filter Set and Sensitivity:

- Limiting magnitudes for the WISH narrow band filters
- Shallower than the those for the broad band filters
- Reaching 26 mag (AB) in ~20 hrs exposure in NB Filter 0-3



Name	λcenter	z	FWHM	R	10h[1]	50h[2]
NB110	1.095	8.0	0.015	73.0	25.69	26.57
NB134	1.340	10.0	0.019	70.5	25.72	26.60
NB158	1.580	12.0	0.022	71.8	25.62	26.50
NB195	1.945	15.0	0.027	72.0	25.47	26.35
NB219	2.188	17.0	0.031	70.6	25.40	26.28
NB441	4.4052	5.71*	0.063	69.9	24.50	
NB497	4.9720	6.58*	0.071	70.0	23.53	

Summary of WISH Science Goals:

- Main scientific goals
  - ✓ **Survey of galaxies at z>7** including high-z QSOs and GRBs
    - Exploring the 1st generation of galaxies
    - Galaxy formation and evolution
    - Cosmic re-ionization process
  - ✓ **NIR survey of Type-Ia SNe** at high redshift
    - Light curves of SNe by multiple observations
    - History of cosmic expansion and dark energy
  - ✓ Broad study on galaxies at z<7
  - ✓ Galactic objects (bulge astrometry, open clusters, disk dynamics)
  - ✓ Extrasolar planes (transit objects, micro-lensing)
  - ✓ Objects in solar system (H_2O ice on asteroids)

Expected numbers of galaxies at z>7:

- Searching for galaxies at z>7 with dropout technique
  ✓ WISH filter set with sharp cutoff
    - Galaxies at z=8-9 as filter0(1.0μm)-dropout
    - Galaxies at z=11-12 as filter1(1.4μm)-dropout
    - Galaxies at z=13-17 as filter2(1.8μm)-dropout

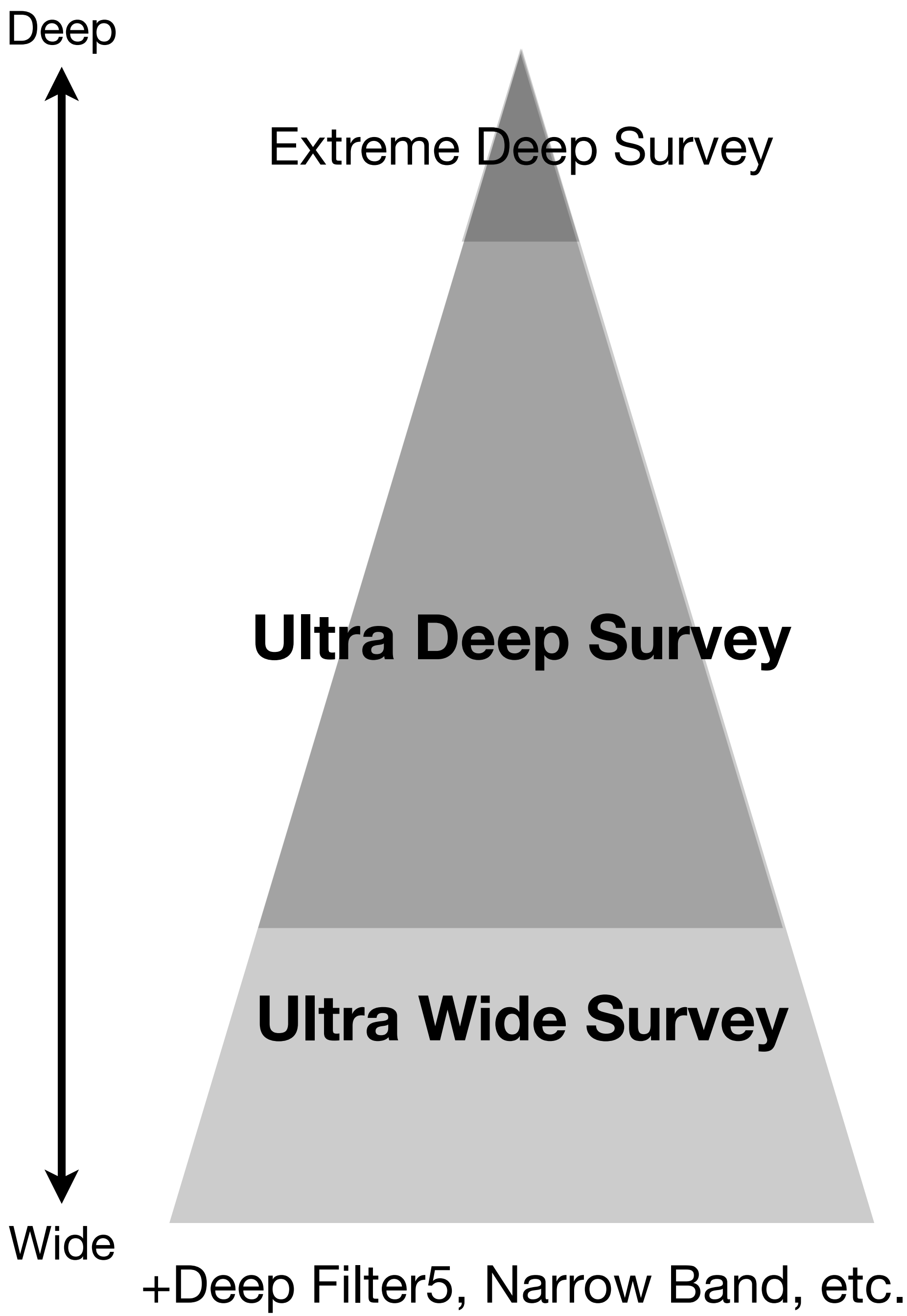
  ✓ Expected number of the galaxy detections
    - w/o LF evolution
    - w/ LF evolution (empirical, from DMH, SAM)

  ✓ ~600, ~50, and ~1 galaxies per 1 deg^2 at z=8-9, z=11-12, and z=14-17, respectively, are expected

*** The expected detection numbers per 1deg^2**

	z	No LF evolution	LF evolution (empirical)	LF evolution (DMH)	LF evolution (SAM)
0-drop	8-9	4000	1690	852.3	631.2
1-drop	11-12	2393	104.2	4.116	49.7
2-drop	14-17	1249	0.723	0.003	1.071

Survey Strategy:



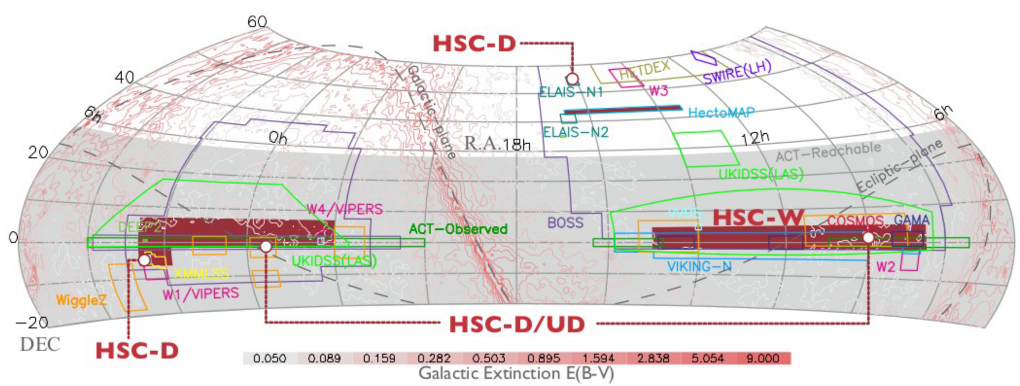
- Survey strategy (total 5 years)
  - ✓ **Ultra Deep Survey (UDS)**
    - ~28 AB mag in Filter 0, 1, 2, 3, 4
    - ~100 deg^2
    - ~1500 days
    - ~10 deg^2 for Filter 5
  - ✓ **Ultra Wide Survey (UWS)**
    - ~25 AB mag in Filter 1, 2, 3 (+4?)
    - ~1000 deg^2
    - ~50 days
  - ✓ Extreme Deep Survey (EDS)
    - ~30 AB mag in Filter 1, 2, 3, 4?
    - 1FoV (~0.25 deg^2)
    - ~20 days
  - ✓ NB filter surveys and other scientific observations
    - TBD

Possible Survey Fields:

- Field selection
  - ✓ Requirements
    - Low zodiacal background (how far from ecliptic plane)
    - Visibility from L2 (ecliptic pole is ideal)
    - Multi-wavelength data (especially deep optical data)

- Field candidates
  - ✓ Hyper Suprime-Cam (HSC)
    - Multi-wavelength data (g, r, i, z, y-bands)
    - Deep and Wide survey (~30 deg. for Deep and ~1400 deg. for Wide)
    - Most fields are near ecliptic plane (Dec.~0 deg.)

Target fields



Wide : Spring/Autumn equatorial region + HectoMAP region

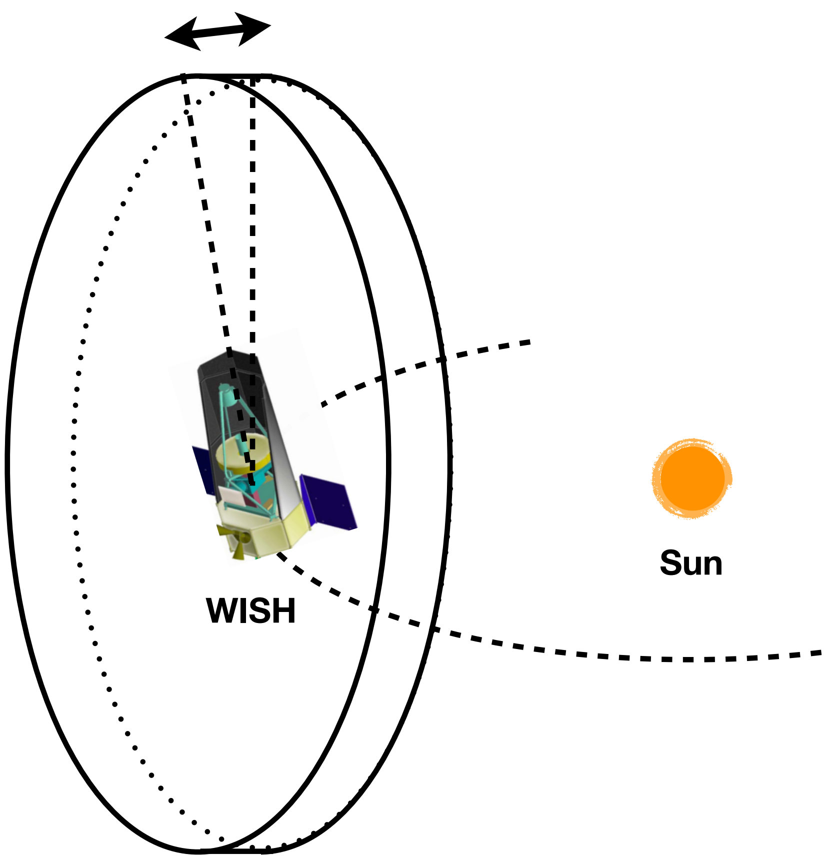
Deep : XMM-LSS, E-COSMOS, ELAIS-N1, DEEP2-3

Udeep : SXDS (XMM-LSS), COSMOS

cf. Subaru/Hyper Suprime-Cam Deep Survey fields (slide by M. Tanaka-san)

Visibility:

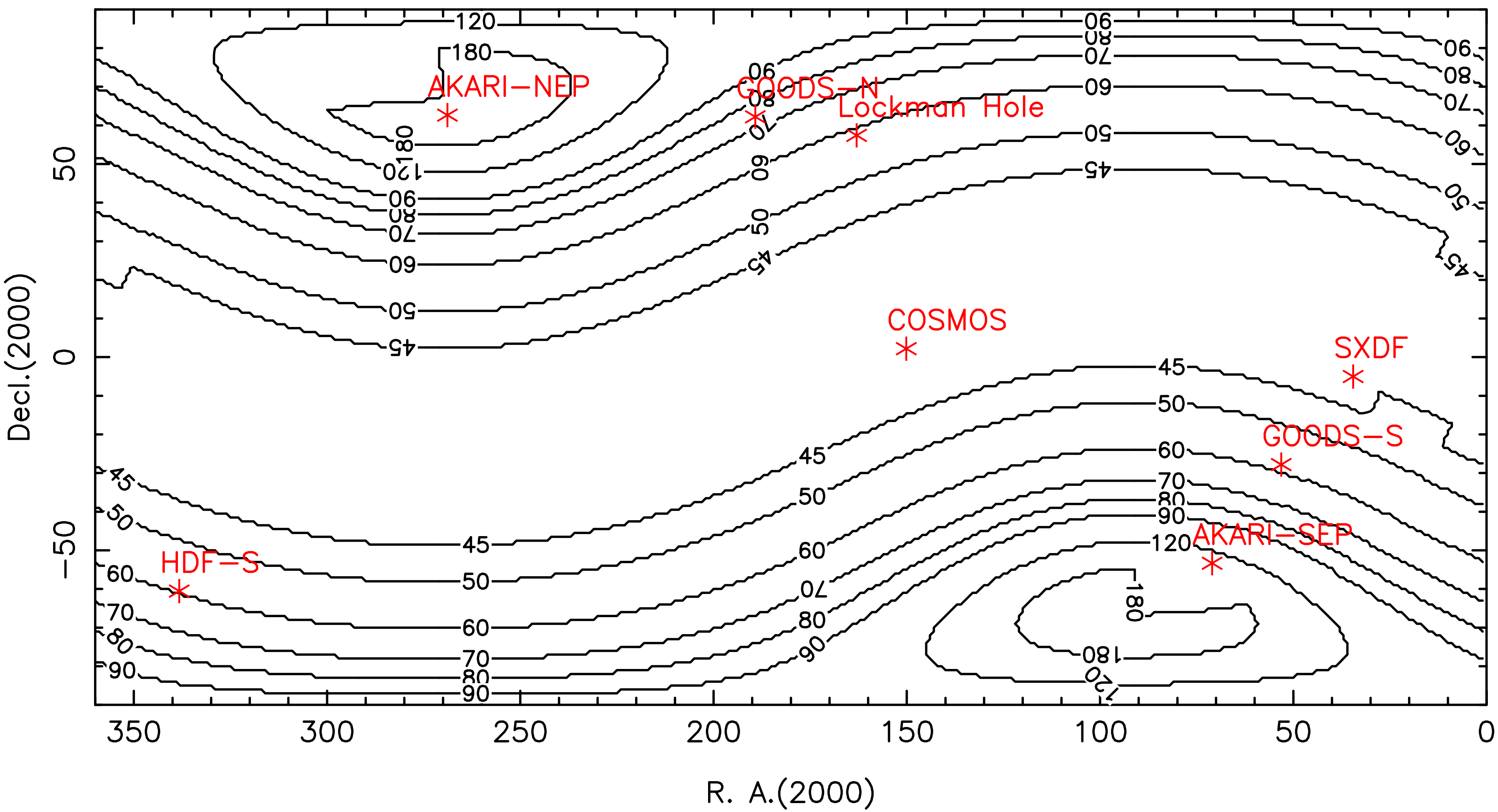
- Angle of the telescope toward and against the sun is limited
  - ✓ Power supply from solar puddle
  - ✓ Thermal environment of satellite bus
  - ✓ Size of the sun shield



- The range of the sky that the telescope can see at some point can also be limited
- The visibility is roughly estimated with the following assumptions
  - ✓ Available angle: 0 deg. toward and 20 deg. against the sun
  - ✓ 1 year = 360 days
  - ✓ Orbit at L2 point is neglected

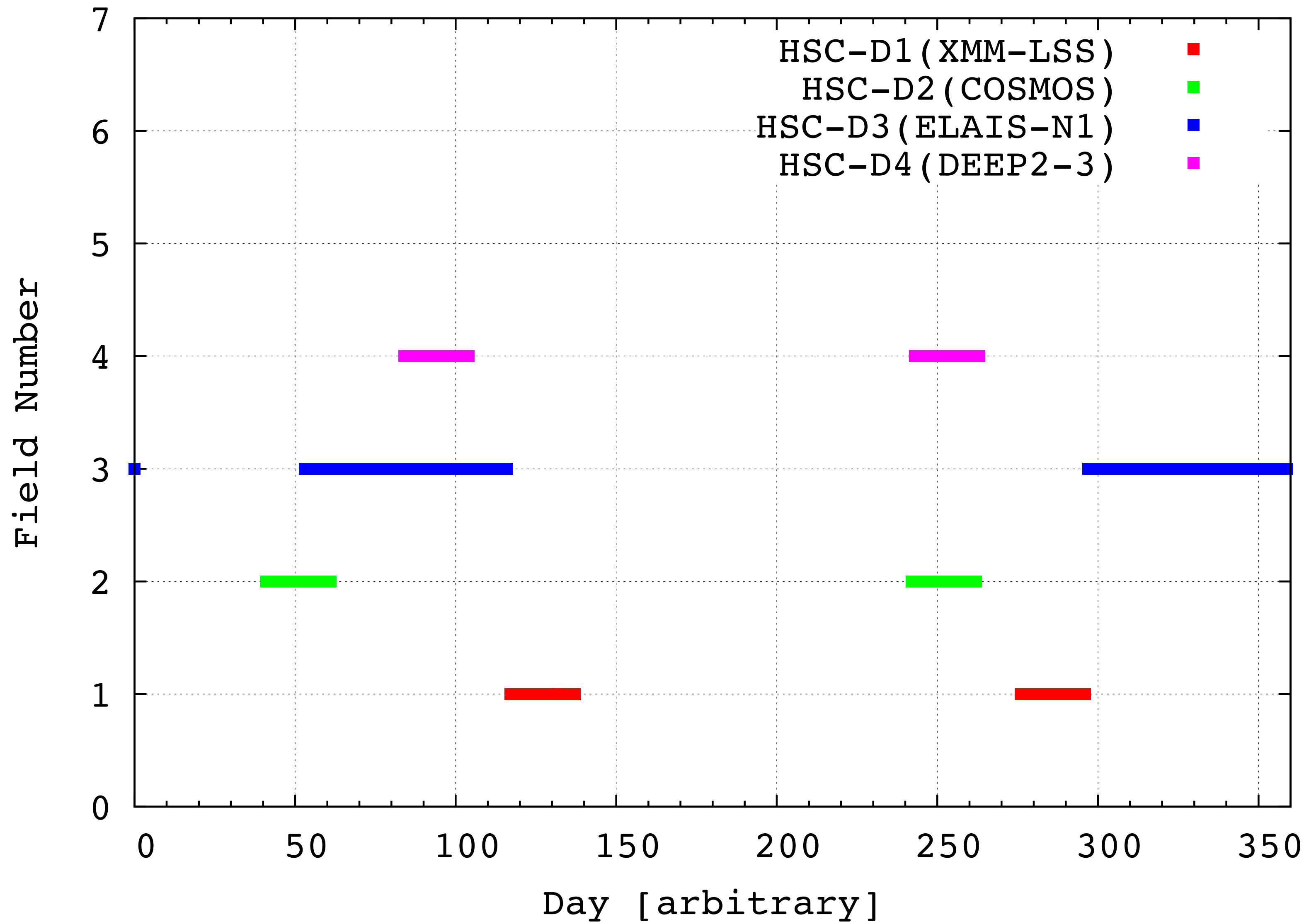
Visibility:

- Visibility map for a given coordinate (R.A. and Dec.), showing the number of visible days
- Higher (lower) visibility near ecliptic pole (plane)



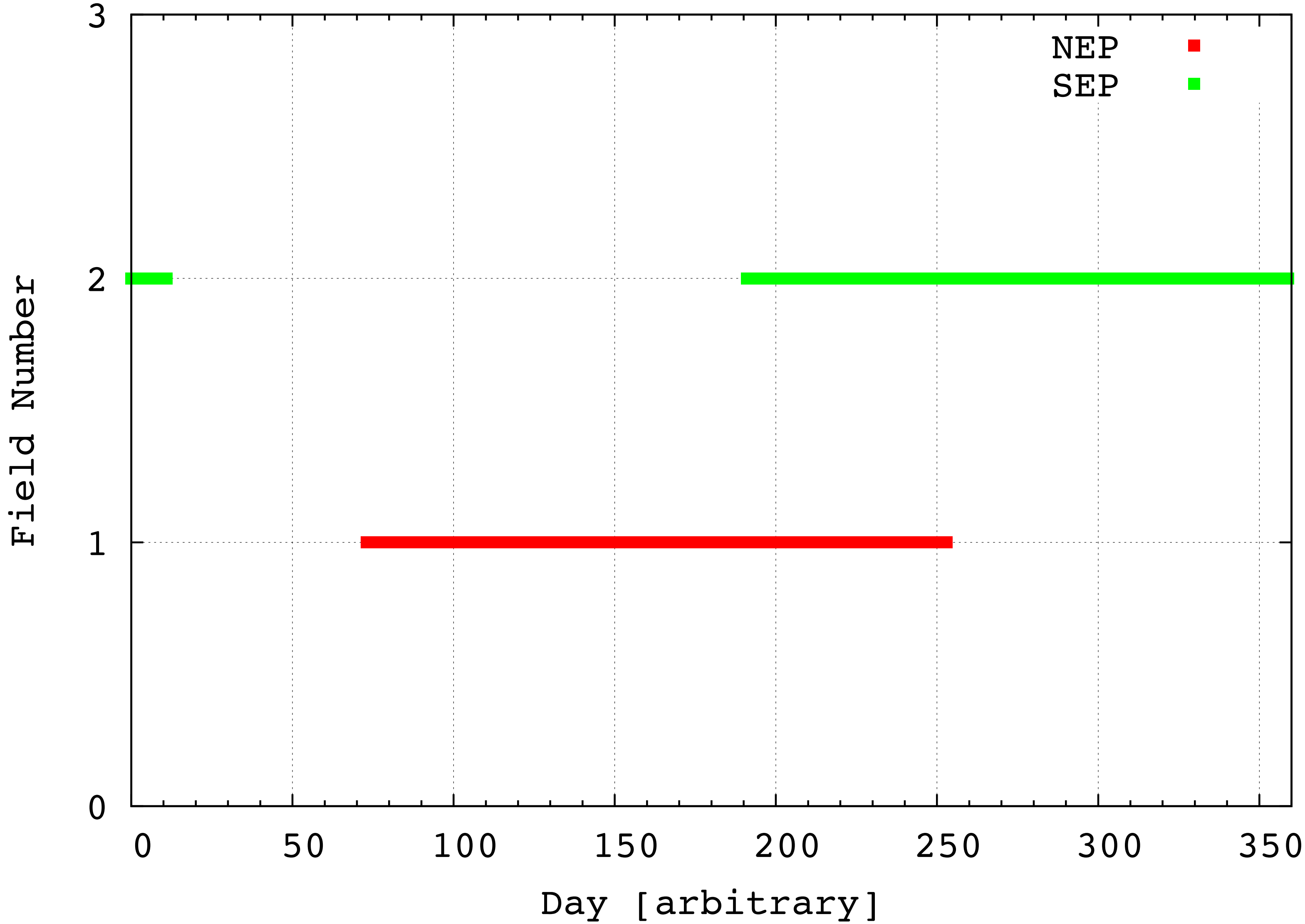
Visibility:

- Visibility at HSC Deep Survey fields (near the equator)
- Visible for ~45 days per year (except for ELAIS-N1)
- The number of days continuously visible is ~20 days



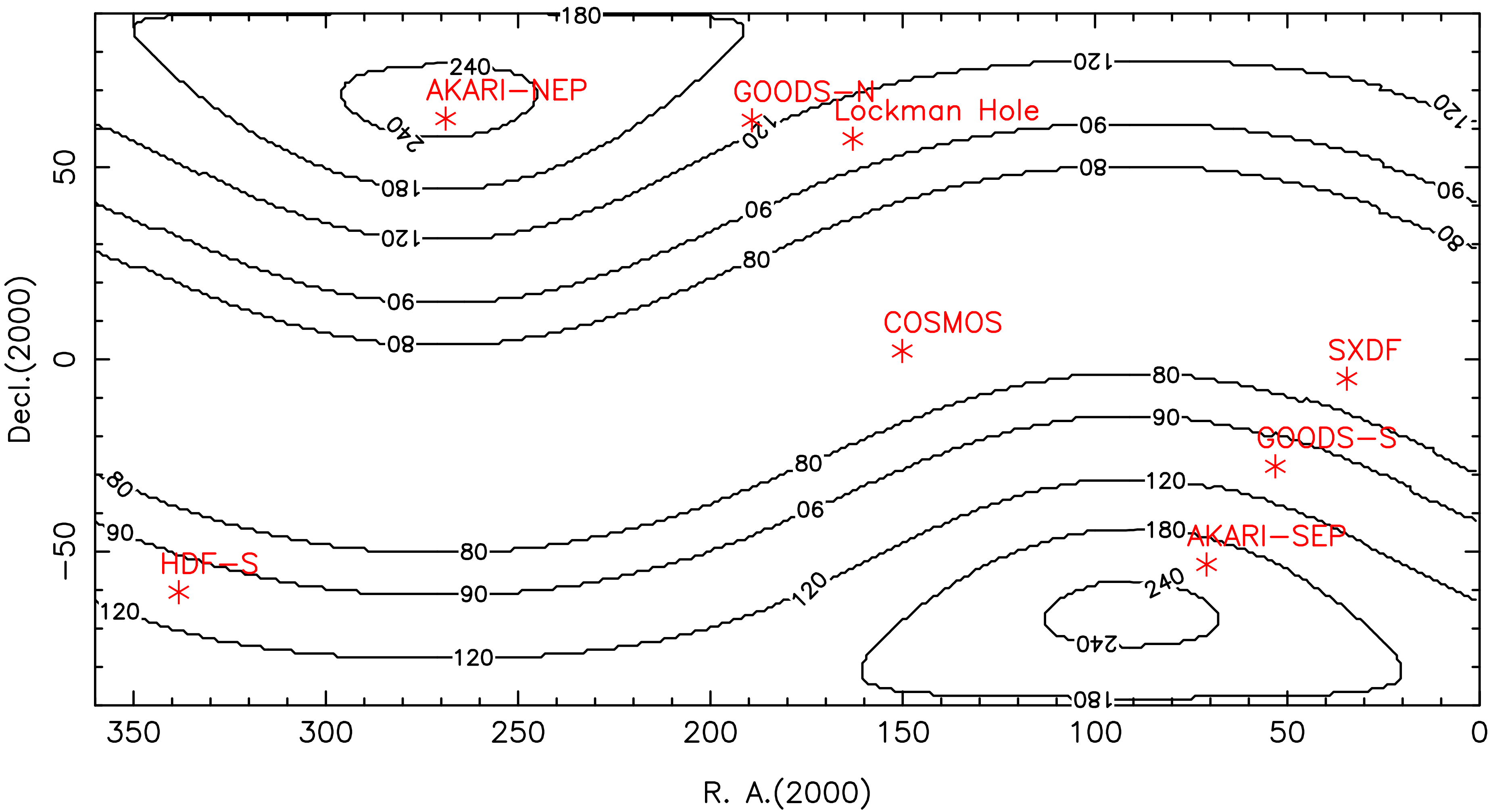
Visibility:

- Visibility at the ecliptic poles (EPs)
- Visible for ~180 days per year
- The number of days continuously visible is ~180 days



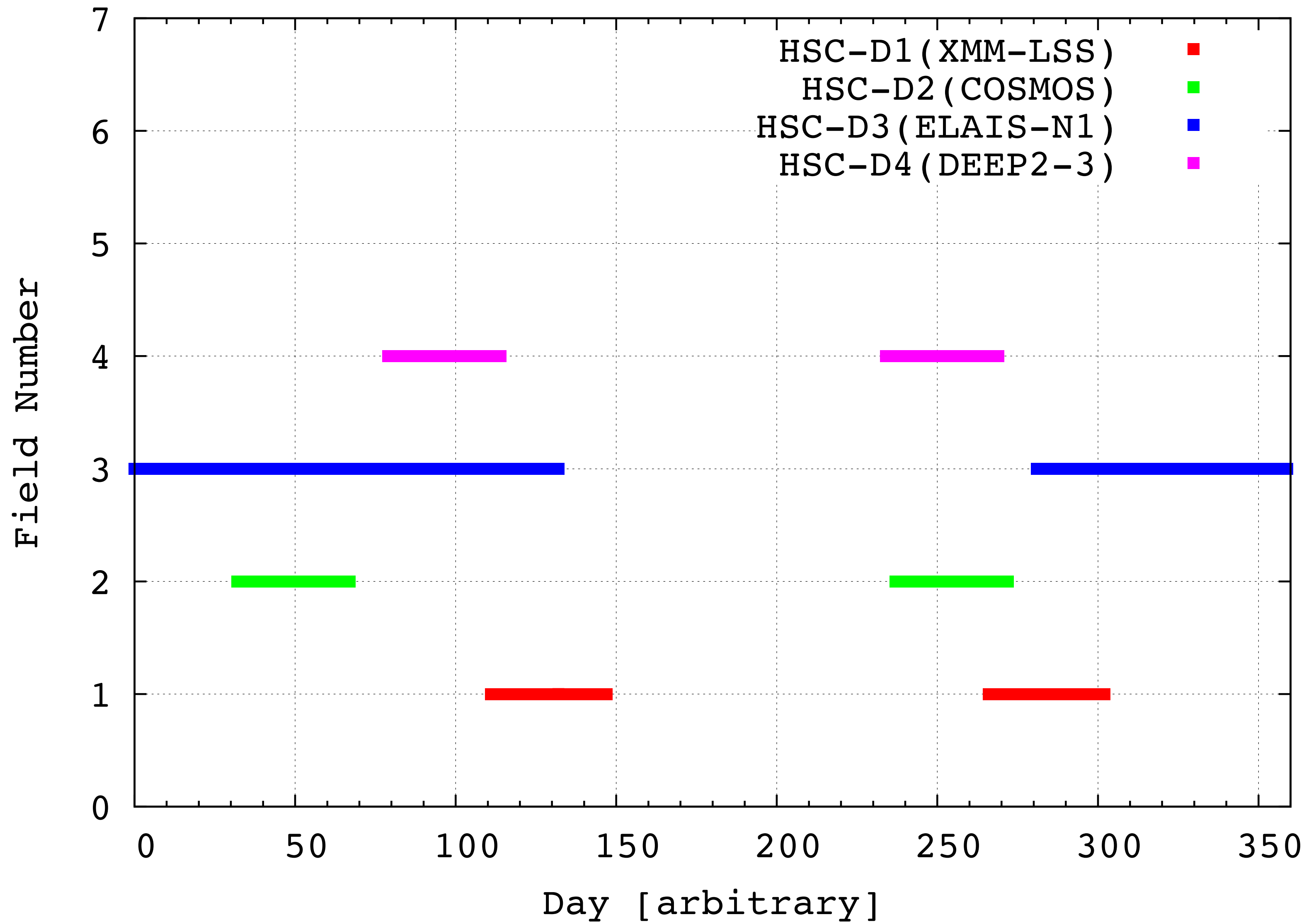
Visibility:

- Visibility map for a given coordinate (R.A. and Dec.), showing the number of visible days (in case of the available angle of -5 deg. toward the Sun and 30 deg. against the Sun)



Visibility:

- Visibility at HSC Deep Survey fields (in case of the available angle of -5 deg. toward the Sun and 30 deg. against the Sun)

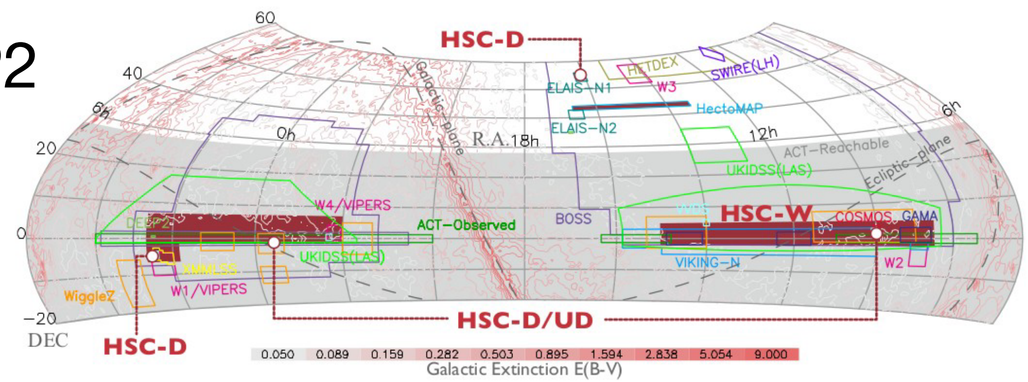


Possible Survey Fields:

- Visibility near the equator
  - ✓ 40-80 days per year
  - ✓ 20-40 continuous days per year
    - Not ideal for the SN surveys
    - SN surveys require >5 different observations every 10 days
    - → >40 continuous days are necessary
- Visibility near Ecliptic pole is good

- Possible Survey Plan
  - ✓ HSC-Deep Fields
    - XMM-LSS, COSMOS, DEEP2
    - ~20 deg^2 (~7 deg^2 each)
    - Deep optical data available
  - ✓ Other fields near EP
    - ~80 deg^2
    - Deep optical data unavailable
    - WISH-Deep Field with HSC?

Target fields



Wide : Spring/Autumn equatorial region + HectoMAP region

Deep : XMM-LSS, E-COSMOS, ELAIS-N1, DEEP2-3

Udeep : SXDS (XMM-LSS), COSMOS

Summary:

- WISH survey strategy
  - ✓ **Ultra Deep Survey (UDS)**
    - ~28 AB mag in Filter 0, 1, 2, 3, 4
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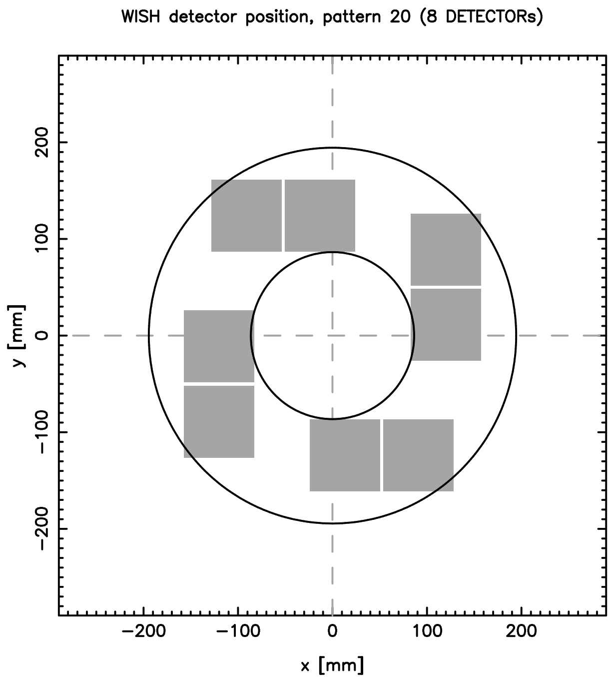
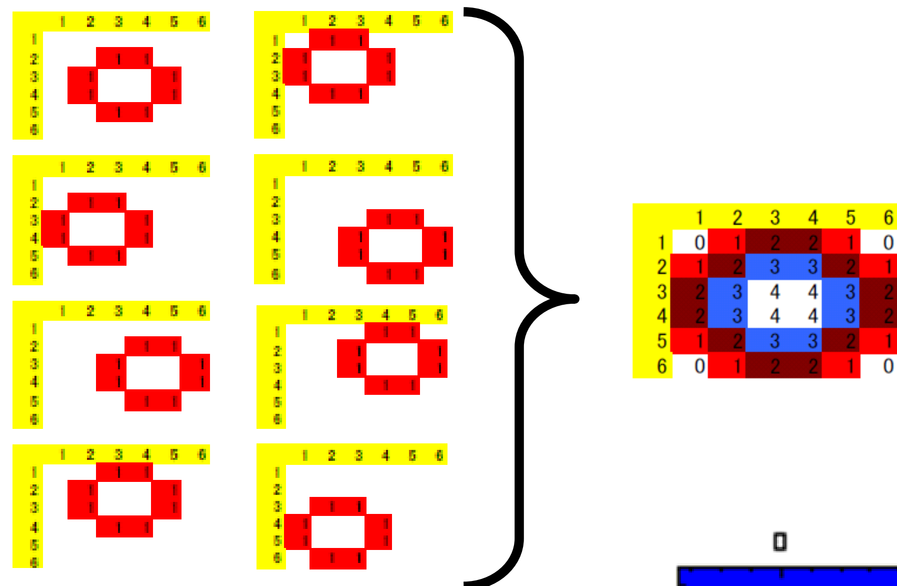
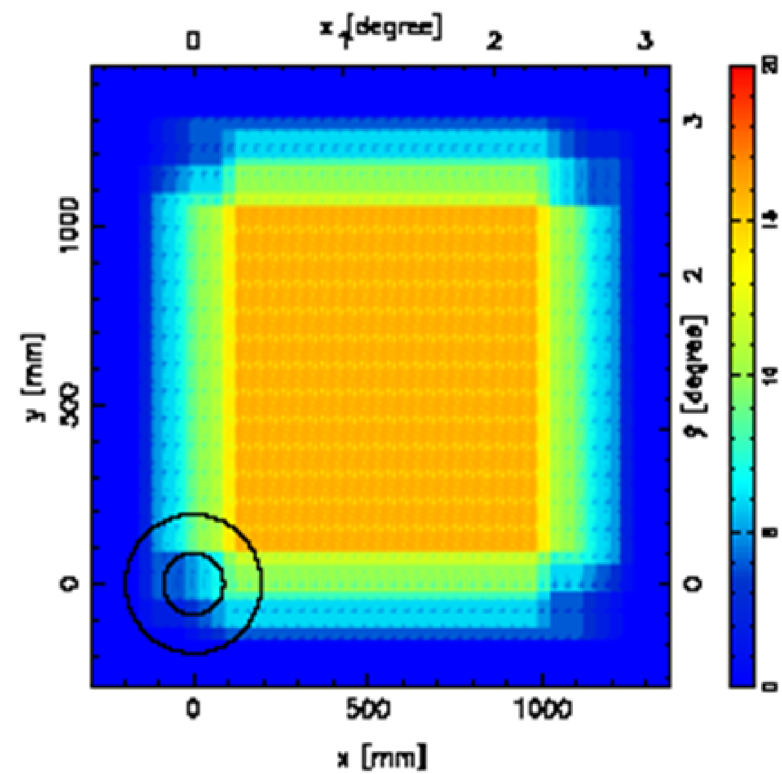
  - ✓ **Ultra Wide Survey (UWS)**
    - ~25 AB mag in Filter 1, 2, 3 (+4?)
    - ~1000 deg^2 in ~50 days
  - ✓ Extreme Deep Survey (EDS)
    - ~30 AB mag in Filter 1, 2, 3, 4?
    - 1FoV (~0.25 deg^2) in xx days?
  - ✓ Narrow Band survey and other scientific observations?
- Possible survey fields for UDS (100 deg^2)
  - ✓ ~20 deg^2 in HSC-Deep fields
  - ✓ ~80 deg^2 in fields near ecliptic poles
  - ✓ Possibility of WISH Deep Survey with Subaru/HSC?

Additional Information:







Peculiar Focal plane on WISH telescope: Multiple dithering can provide us almost uniform field of views. However, detailed strategy of the dithering is still under consideration.

Additional Information:

	redshift	LF 進化なし	'Empirical' 進化	DMH 進化	SAM
0-dropout	8– 9	4,000	1,690	852.3	631.2
1-dropout	11–12	2,393	104.2	4.116	49.7
2-dropout	14–17	1,249	0.723	0.003	1.071

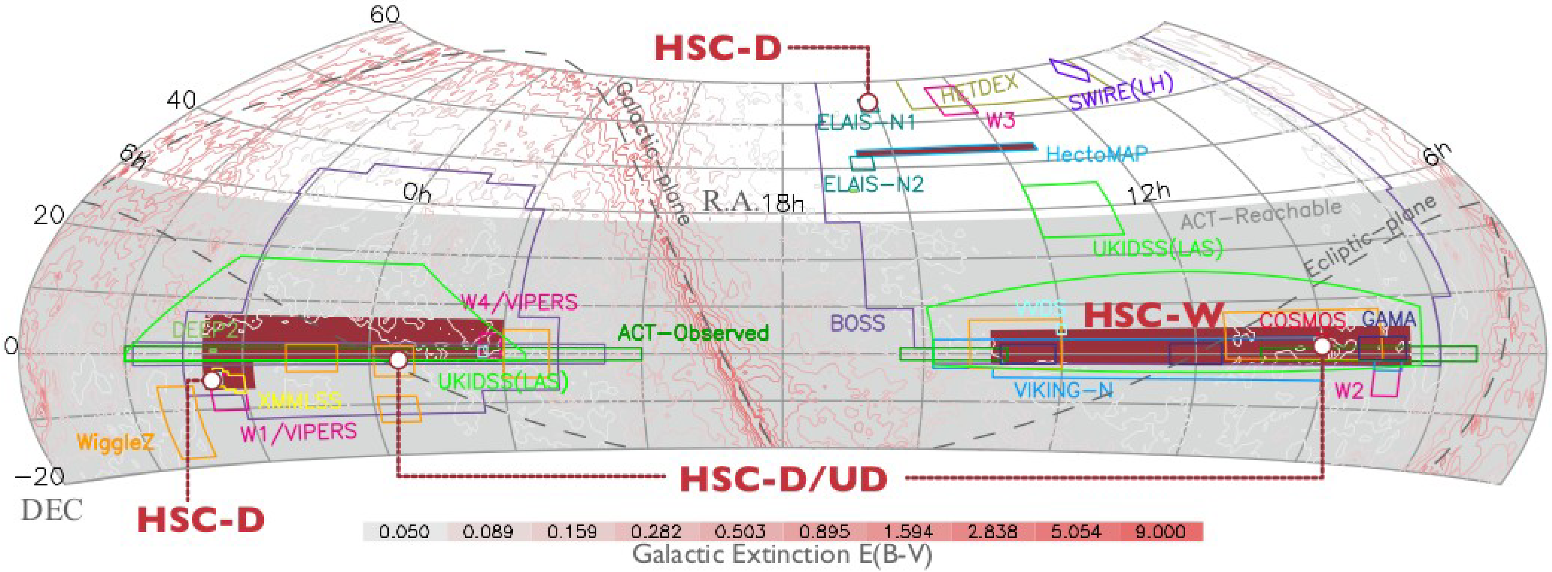
Table 2.2: Lyman Break 銀河の 1 平方度あたりの検出期待数。3σ 28.0 AB 等級の検出限界での期待数。

			N / FoV.	
Filter Name	λ_c	z_{LAE}	10hrs	50 hrs
0200-00	1.092	8.0	12.3	21.3
0200-01	1.336	10.0	1.6	5.2
0200-02	1.580	12.0	5.5×10^{-3}	0.09
0300-00	1.095	8.0	2.1	16.6
0300-01	1.340	10.0	0.22	2.3
0300-02	1.580	12.0	5.1×10^{-3}	0.10

Table 2.4: 狭帯域フィルタでの観測によるオンソース 10 時間 / 50 時間積分での 1 視野あたりの LAE 検出期待数。

Possible Survey Fields:

Target fields



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cf. Subaru/Hyper Suprime-Cam Deep Survey areas (slide by M. Tanaka-san)

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