#### The Northern Hemisphere NIR Survey by UKIRT : An extended version of the extended UHS

Ji Hoon Kim CEOU, Seoul National University

SSWG Workship @ High I

- an extension of the UKIDSS Large Area Survey (LAS; 4000 deg<sup>2</sup>) covering the whole of the Northern hemisphere visible from UKIRT (12500 deg<sup>2</sup>) to depths of J=19.6 and K=18.2
- Along with the VISTA Hemisphere Survey (VHS), UHS will create the complete NIR sky survey to the depth matching that of SDSS.





# The UKIRT Infrared Deep SkySurvey (UKIDSS)



	7-year plan	Filter	Area sq. degs	Mag. limit (Vega)	t(exp.)	t(total)	Nights
		Y		20.5	40s	367h	
	Large Area Survey LAS	J	4000	20.0	40x2s	734h	262
		н		18.8	40s	367h	
		к		18.4	40s	367h	

7-year plan	Filter	Area sq. degs	Mag. limit (Vega)	t(exp.)	t(total)	Nights
	J	35	22.5	2.1h	415h	
Deep Extragalactic Survey DXS	н	5	22.0	4.4h	124h	118
	к	35	21.0	1.5h	287h	

7-year plan	Filter	Area	Mag. limit (Vega)	t(exp.)	t(total)	Nights
	J		25.0	209h	983h	
Ultra Deep Survey UDS	н	0.77	24.0	174h	818h	296
	к		23.0	58h	271h	



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- nominal areas : RA 0h ~ 24 h, Dec  $0^{\circ}$  ~ 60^{\circ} = 17900 deg<sup>2</sup>
- Avoiding LAS, GPS, and GCS leaves ~12500 deg<sup>2</sup>
- J-band : 40s exposure (19.6 mag, Vega, 5σ, point source)
- K-band : 40s exposure (18.2 mag, Vega, 5σ, point source)





- 62.3 deg<sup>2</sup> per night
- It requires ~400 nights per band and ~800 nights in total.
- It was designed to be complete by the end of September(?), 2013.
- An extended version of UHS to depths of J=20.0 and K=18.6 is proposed in case the operation of UKIRT is extended.





### **VISTA Hemisphere Survey**

an IR survey combined with other VISTA public surveys which covers the whole southern hemisphere (~20000 deg<sup>2</sup>) to depth of J=20.2 and Ks=18.1 by 2014

Survey	Area (deg²)	5σ point source depth (AB mag)				
		Z	Y	J	Н	Ks
VHS (required depths)	18, 000			21.2		19.8
1. VHS-DES	4500	24.7	23.0	21.6		20.2
2. VHS ATLAS	5000		20.9	21.2	20.6	19.8
3. VHS-GPS (5°< b <30°)	8000			21.2		19.8
VIKING	1,500	23.1	22.3	22.1	21.5	21.2
VVV (Galactic Centre)	520	22.4	21.8	21.1		
VMC (Magellanic Clouds)	184		23.3	21.4		



#### **Other IR Surveys**

- Two Micron All-Sky Survey (2MASS) : J, H, and Ks to depths of J=15.8, H=15.1, and Ks=14.3
- 2. IRAS all sky survey :  $12\mu m$ ,  $25\mu m$ ,  $60\mu m$ , and,  $100\mu m$
- 3. ISO : various layered surveys within two wide mid-IR (LW2: 5-8.5 $\mu$ m and LW3: 12-18 $\mu$ m) channels and two far-IR ( = 90 and 170  $\mu$ m) bands
- 4. AKARI all sky survey : MIR (9 $\mu$ m and 18 $\mu$ m) and FIR (65 $\mu$ m, 90 $\mu$ m, 140 $\mu$ m, and 160 $\mu$ m)
- 5. WISE all sky survey : 4 bands at  $3.4\mu m$ ,  $4.6\mu m$ ,  $12\mu m$  and  $22\mu m$
- 6. VISTA Kilo-degree Infrared Galaxy Survey (VIKING) : a companion survey of VHS which covers the 1500 deg<sup>2</sup> of the VST-KIDS survey with the same filter set of VHS to the depth approximately 2 mag deeper (H=21.5) than SDSS (comparable to SDSS stripe 82) and 1.4 mag deeper than UKIDSS-LAS



#### **Other IR Surveys**

- 7. VST ATLAS : a companion survey of VIKINGS covering 4500 deg<sup>2</sup> within the southern hemisphere matching the depth of SDSS
- 8. Dark Energy Survey (DES) : g, r, i, z, Y with CTIO 3.9-m telescope for 525 nights over 5 years covering 5000 deg<sup>2</sup>
- 9. Euclid : two main surveys of a primary wide survey covering 20000 deg<sup>2</sup> with a (very) broad visual band, Y, J, and K bands to mAB=24 and a deep survey covering 40 deg<sup>2</sup> with 2 mags deeper than its wide survey along with spectroscopic survey. It is planned to be launched in 2020.
- 10. WFIRST (Wide-Field InfraRed Survey Telescope) : High Latitude Survey (HLS) covering 3400 deg<sup>2</sup> with Y, J, H, and K bands to the depth of K=26.0 for 2.4 years
- II. JWST survey missions : generally deep narrow missions
- 12. SPICA FPC-S : NEP survey, or any other possibilities?



#### Scientific Goals of them

- I. Ionization history of the Universe :
  - detection of high redshift quasars
- 2. The smallest stars :
  - detection of the coolest objects (Y dwarfs), formation history of brown dwarfs, and discovery of benchmark systems
- 3. Galactic archaeology :
  - investigating Galactic structure through detection of main sequence stars, luminous stars and distant streams
- 4. Large Scale Structure and Dark Energy :
  - discovery of rich clusters and measuring clustering of distant luminous red galaxies (LRGs)



### The Extended Hemisphere Survey by UKIRT

- The depth currently proposed to achieve (either by the current UHS, or the 4year extended version of it) are basically comparable to that of SDSS (up to J=20.0 and K=18.6 for the extended version).
  - Not deep enough for low mass, low luminous, and low surface brightness systems.
- 2. What if we aim to match the depth of SDSS Stripe  $82 : \sim 2$  mag deeper than other SDSS areas
  - ~ 6 times longer exposure
  - $\sim$  650 nights for K bands only, or  $\sim$  1300 nights for both J and K bands
- 3. What if we intend to reach  $10^7 \text{ M}_{\odot}$  regime within nearby galaxies?
  - ~ 60 times longer exposure (not quite DXS deep)
  - .....6500 nights ?



#### The Extended Hemisphere Survey by UKIRT





### Scientific Impact

- I. Legacy value of the survey
  - Combined with LSST and PanSTARRS, it can provide a legacy database for the upcoming ELT era by
  - It can provide K-band coverage (which Euclid lacks).
  - It also provide an earlier epoch baseline for proper motions.
- 2. 2MASS
  - In spite of its shallow depth (compared to the modern NIR surveys, anyway), the database of 2MASS produces 1393 refereed publications as of July, 2005 (2816 publications as of today?).

