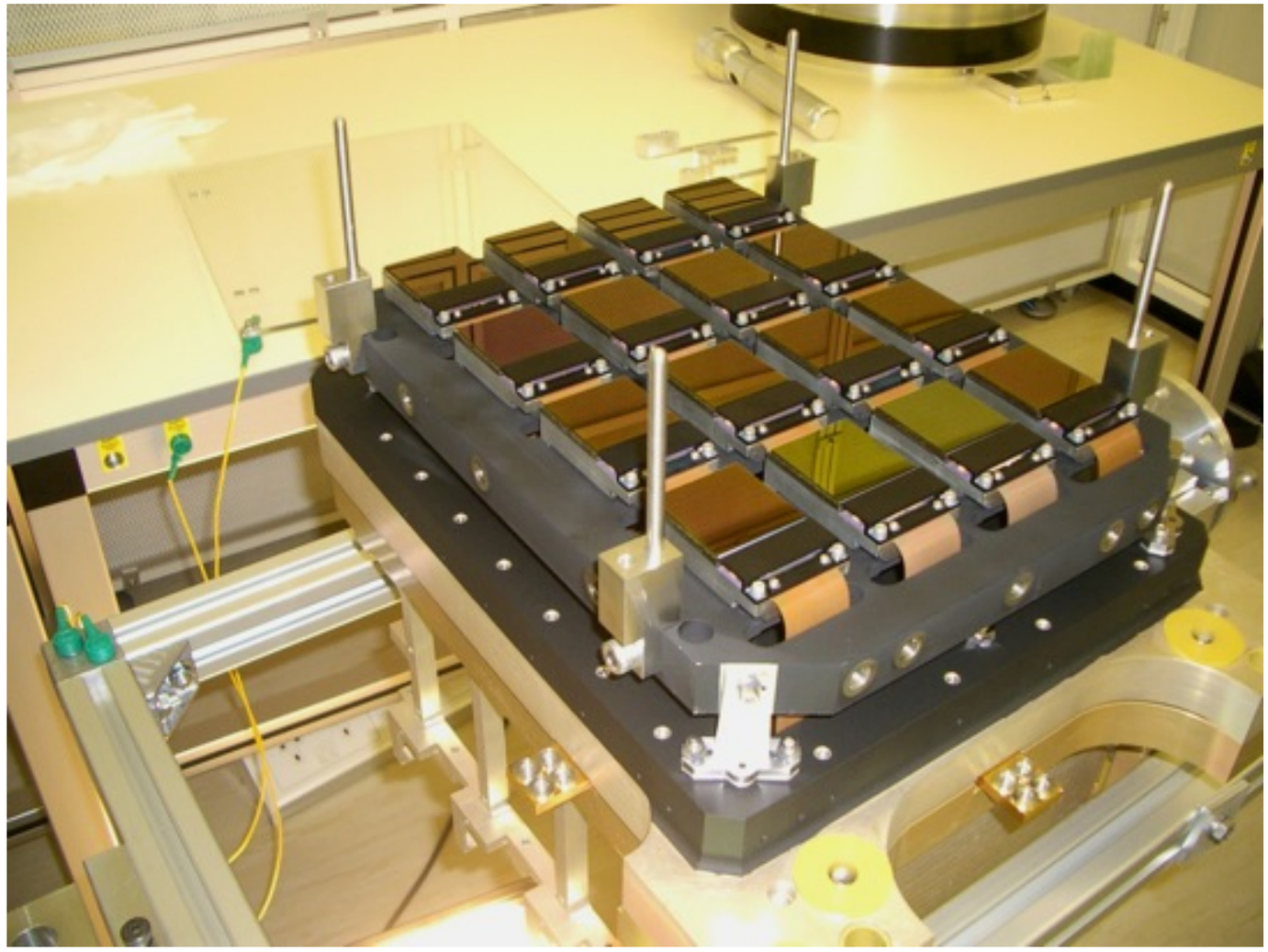
VISTA/VST in the LSST and Euclid era

H. J. McCracken

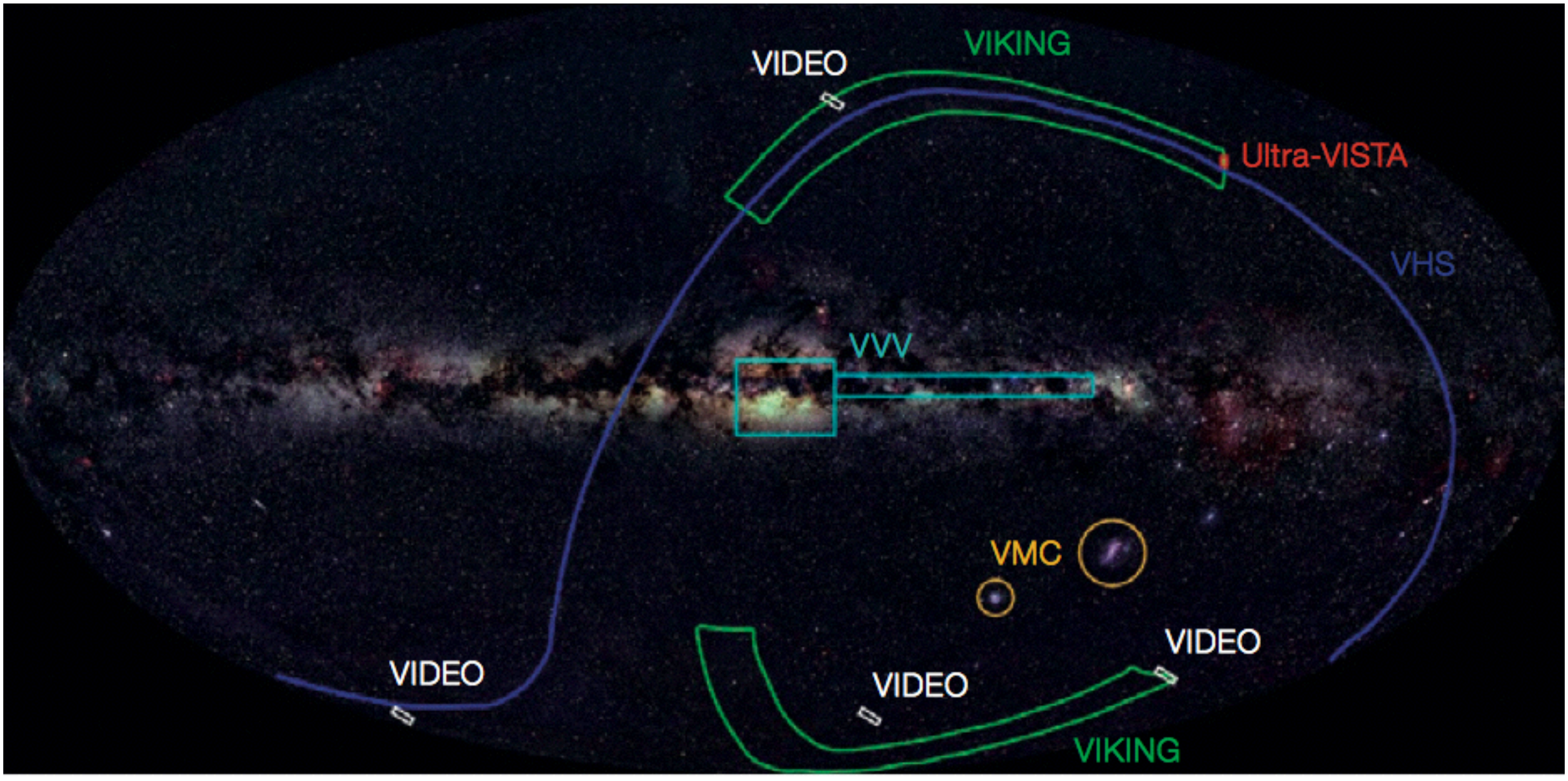
VISTA/VIRCAM Summary

- **Location**: ESO, Paranal, Chile
- **Aperture:** 4.1 m diameter f/1 primary
- **Field of view**: 1.65 degree diameter
- **Instrumentation**: VIRCAM — 8k x 8k sparse filled mosaic near-infrared camera
- **Detectors**: 16 x 2k x 2k pixel (Raytheon VIRGO HgCdTe); 67 megapixels
- **Wavelength range**: **0.84–2.5 microns**
- **Pixel scale**: 0.34 arcseconds/ pixel
- **Filled field of view:** 0.60 deg^2



x3 more efficient than any **current** NIR detector

Current VISTA public surveys



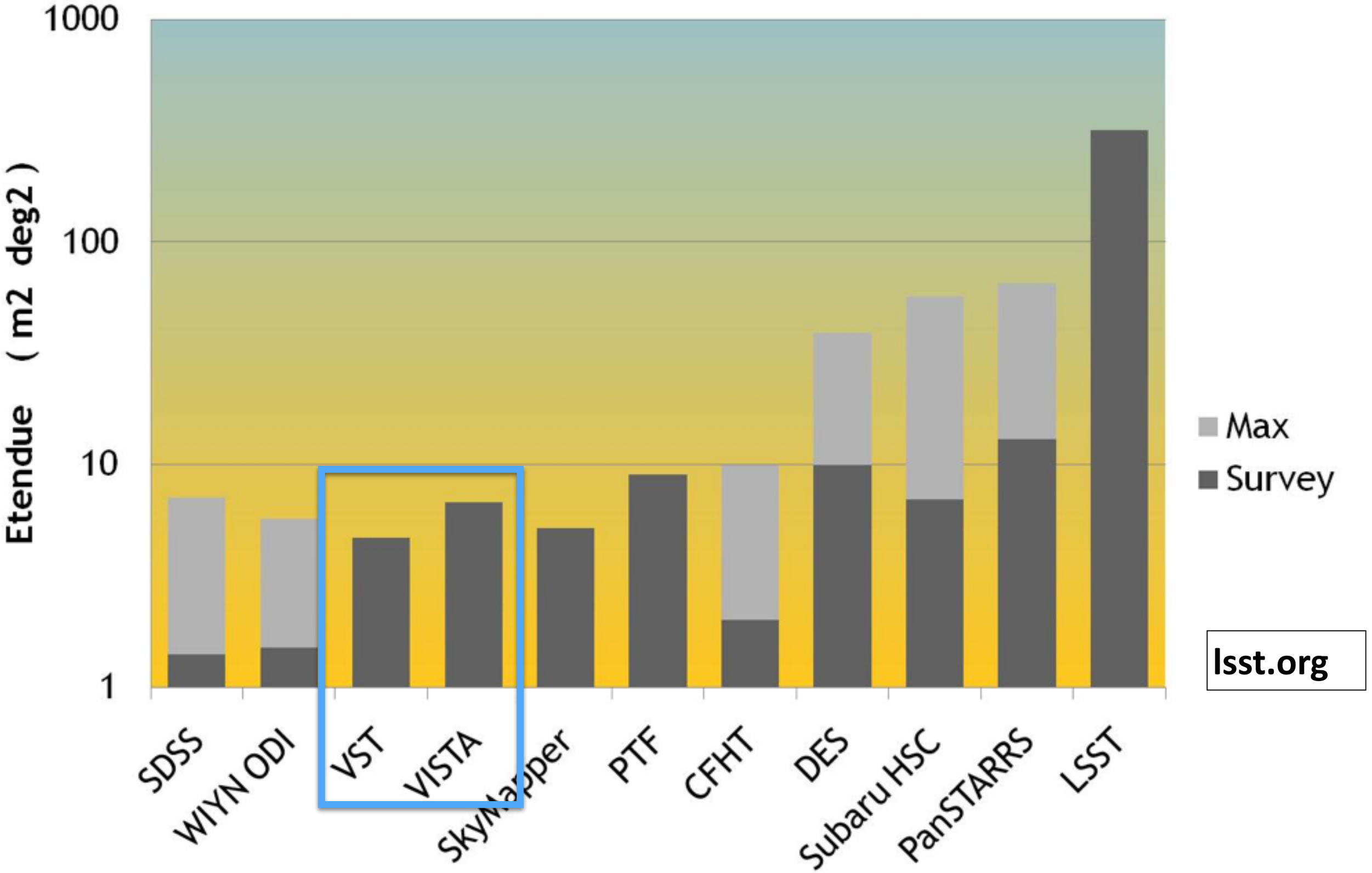
Current VISTA surveys

Survey	Area [deg$_2$]	Filter	Magnitude limit	Limit Measure
Ultra-VISTA	0.73 (ultra-deep)	*Y*	26.7	5σ (AB)
		J	26.6	
		H	26.1	
		K_s	25.6	
		NB	24.1	
VHS	20000	*Y*	21.2	5σ (AB)
		J	21.1	
		H	20.6	
		K_s	20.0	
VIDEO	15	*Z*	25.7	5σ (AB)
		Y	24.6	
		J	24.5	
		H	24.0	
		K_s	23.5	
VVV	520	*Z*	21.9	5σ (Vega)
		Y	21.2	
		J	20.2	
		H	18.2	
		K_s	18.1	
VIKING	1500	*Z*	23.1	5σ (AB)
		Y	22.3	
		J	22.1	
		H	21.5	
		K_s	21.2	
VMC	184	*Y*	21.9	10σ (Vega)
		J	21.4	
		K_s	20.3	

- These surveys will be completed by 2017-2018
- There may be a new call for public surveys 2018+ depending on when 4MOST is ready

So, what could VISTA bring in the era of Euclid/LSST?

MISSION: IMPOSSIBLE


1000
100
10
1
Etendue (m2 deg2)
Max
Survey
lsst.org
SDSS
WIYN ODI
VST
VISTA
SkyMapper
PTF
CFHT
DES
Subaru HSC
PanSTARRS
LSST

The scope of the Euclid surveys

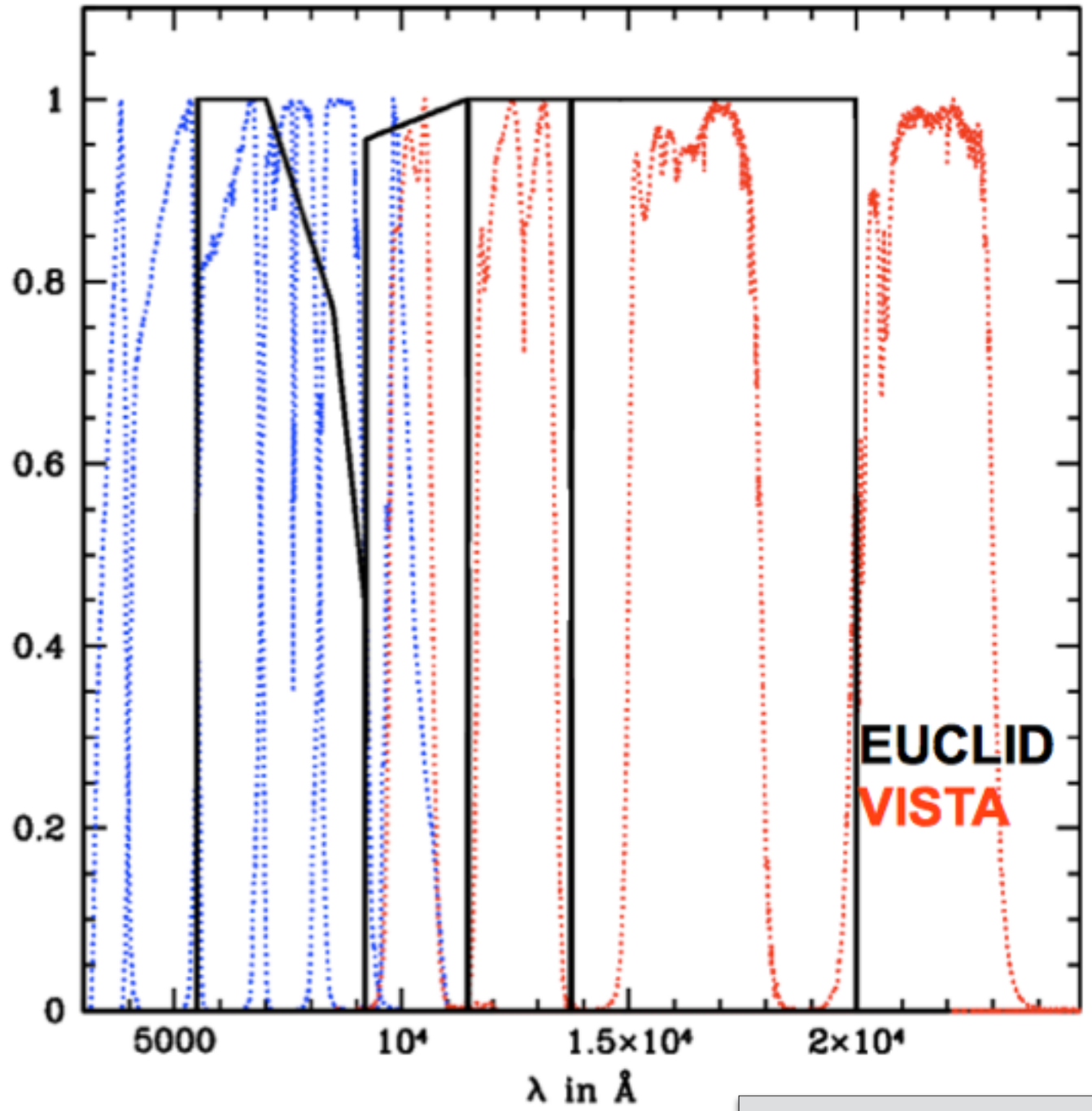
- Wide survey 15,000 deg^2 YJH_{AB}=24 would take 680 years with VISTA or 66 years with SASIR (2017)
- Deep survey 40 deg^2 YJH_{AB}=26 would take 72 years with VISTA or 7 years with SASIR
- The Euclid surveys are >100 times more ambitious than anything underway and at least >10 times more ambitious than anything else currently conceived

SV2 Edinburgh Dec 05

Steve Warren, EC legacy scientist

Euclid/VISTA coverage

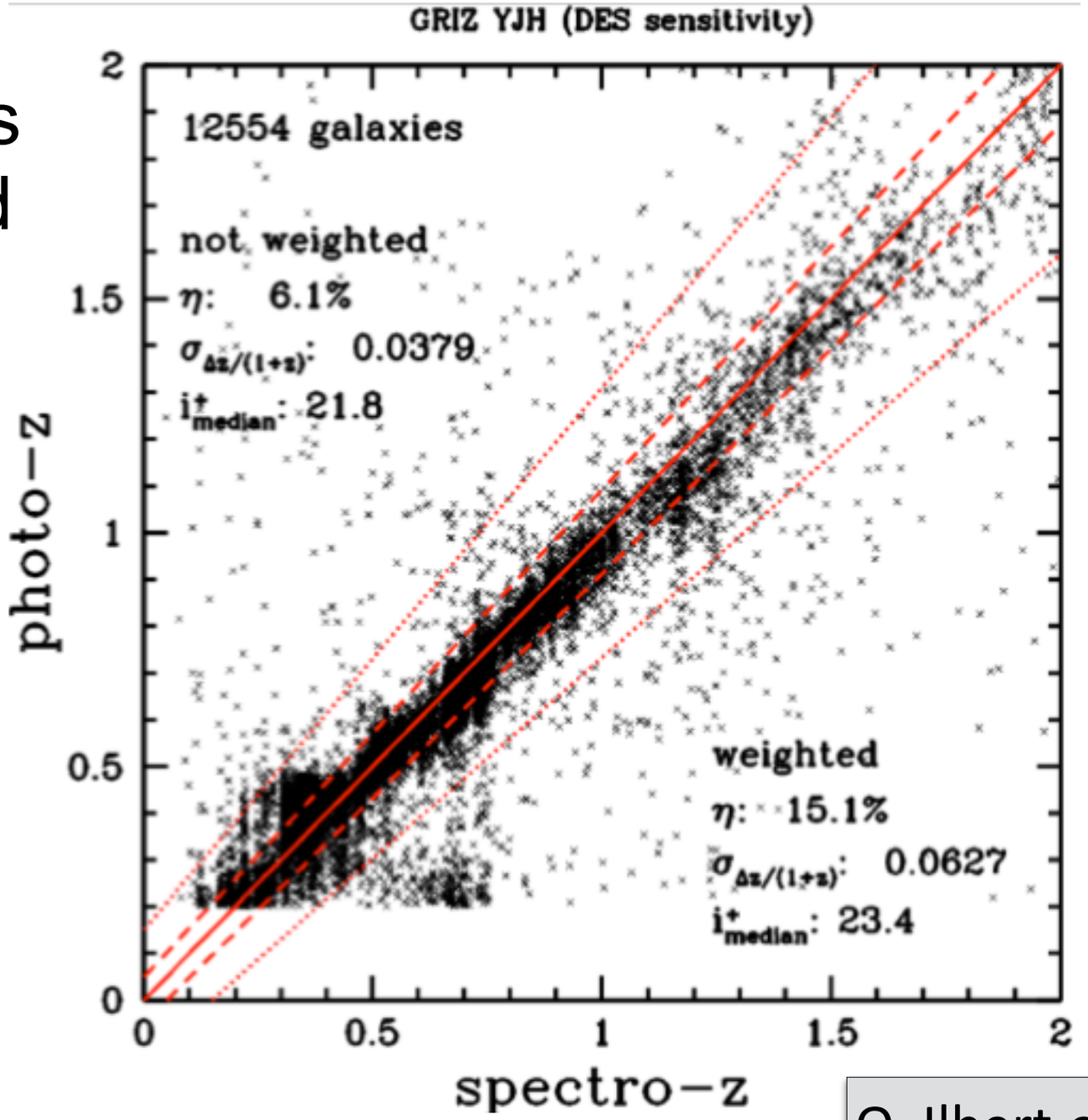
- Euclid: YJH~24AB
- VISTA reaches redder near-infrared bands than Euclid
- **What science gains could be made from addition of Ks data to LSST (and Euclid?)**



O. Ilbert *et al.*

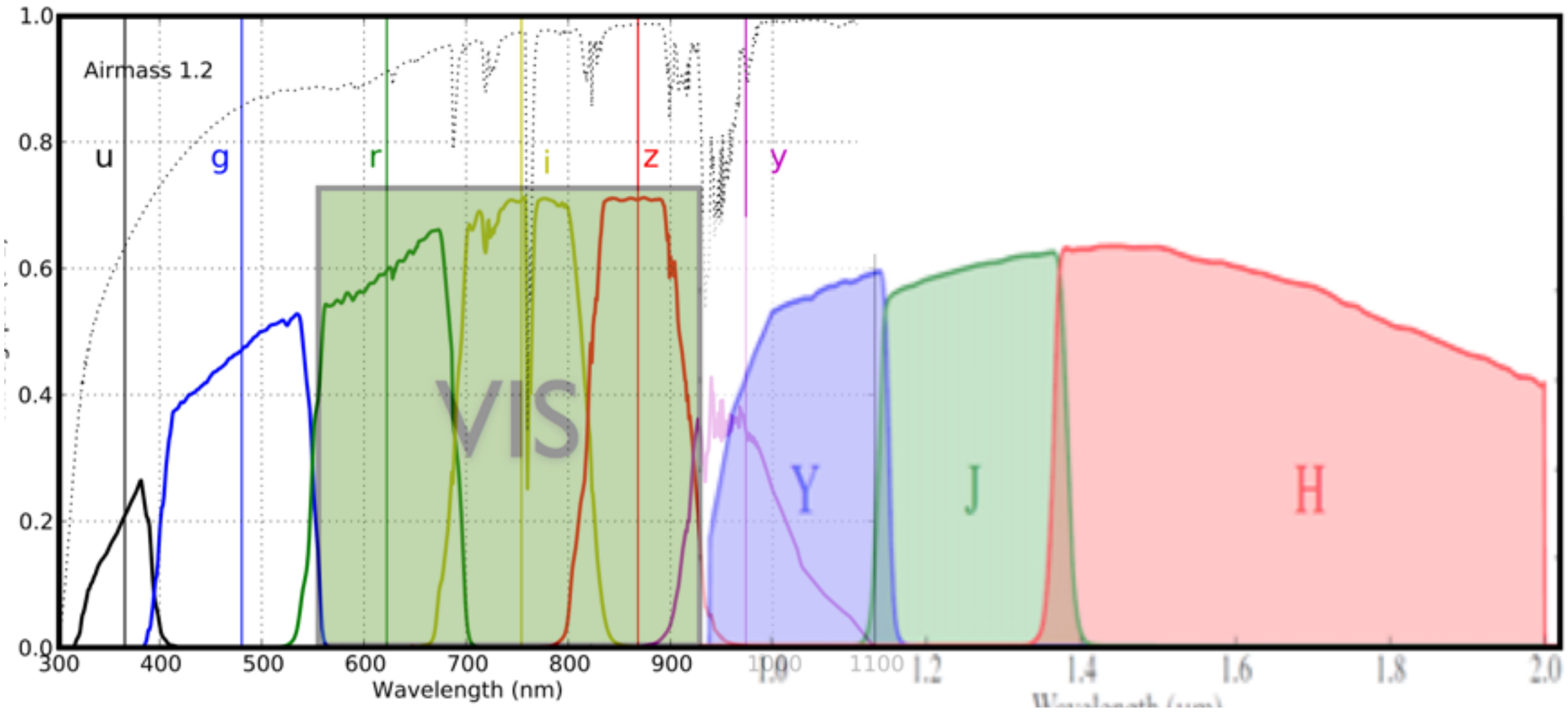
“Pure Euclid” photometric redshifts

- Most of the precision in Euclid phot-zeds comes from deep near-infrared bandpasses
- Ground based data in Euclid is relatively shallow (AB~24)
- **What could we gain with Euclid+LSST?**

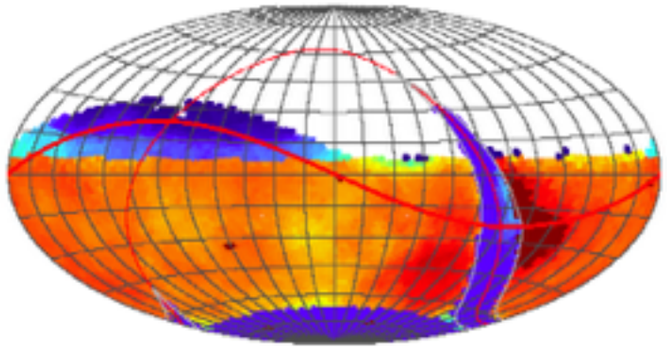


O. Ilbert *et al.*

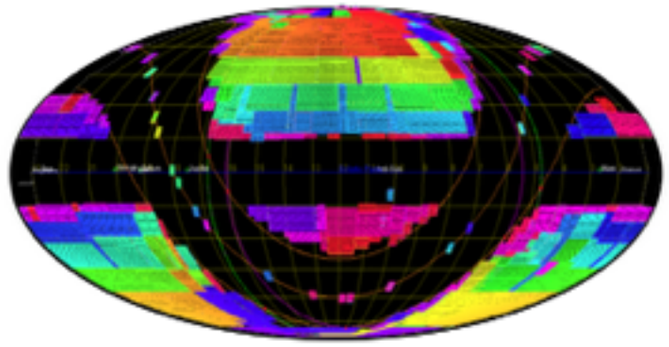
LSST / Euclid filter set



Euclid/LSST



LSST, Equatorial



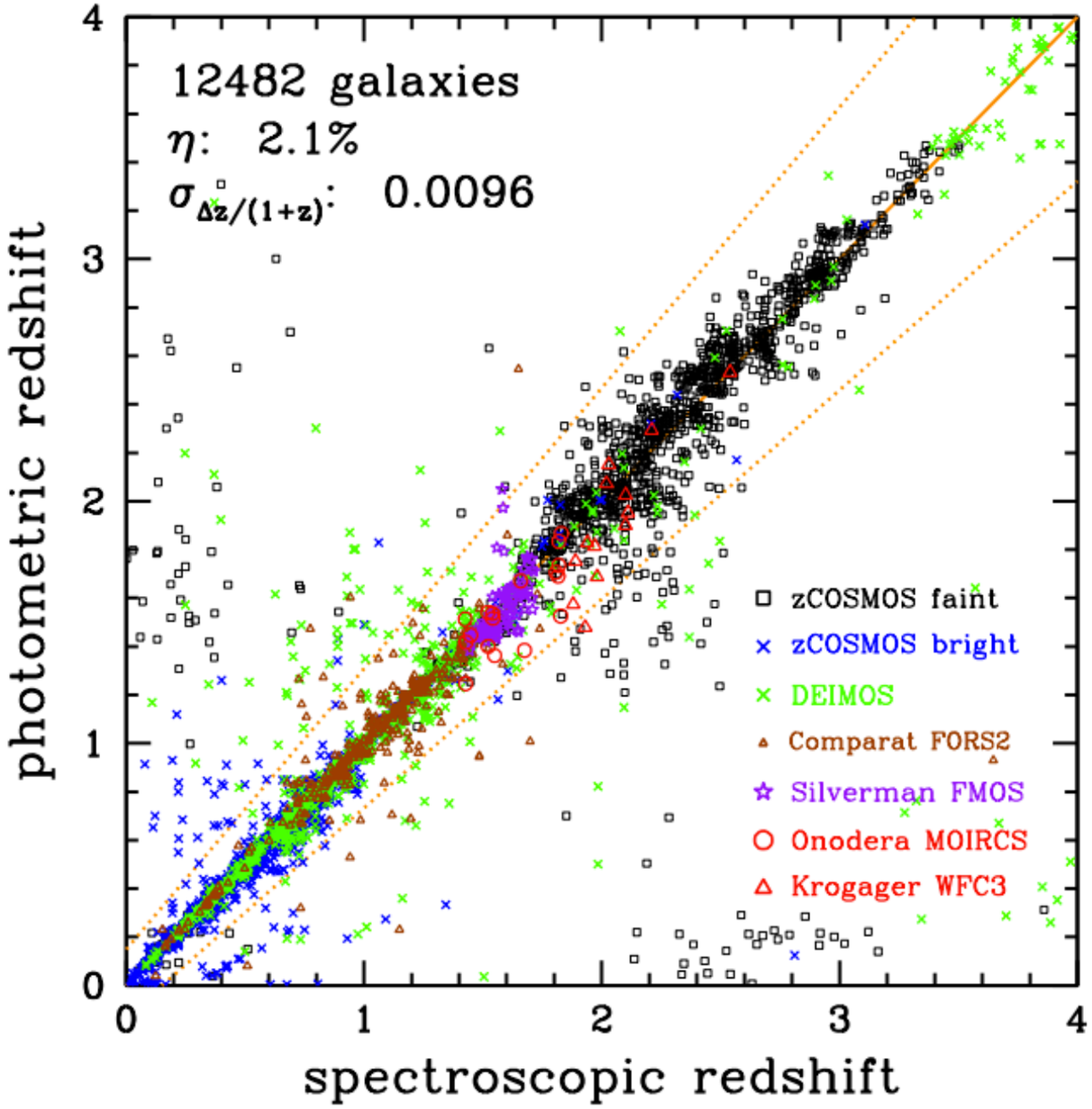
Euclid, Ecliptic

	LSST	Euclid	Overlap
Area (sqdeg)	18,000	15,000	5,000
z(median)	1.2	0.9	0.9
Volume (Mpc^3)	4437	3133	2181
n_{gal}	37	30	30
N / 10^9	2.4	1.6	0.5
Filters	ugrizy (r=27.5)	(RIZ)YHJ (24.5)	ugrizyYHJ
PSF	0.7”	0.18”	0.18”
N Spec	-	$5.2x10^7$	$1.7x10^7$

A. Taylor

Photometric redshifts and UltraVISTA

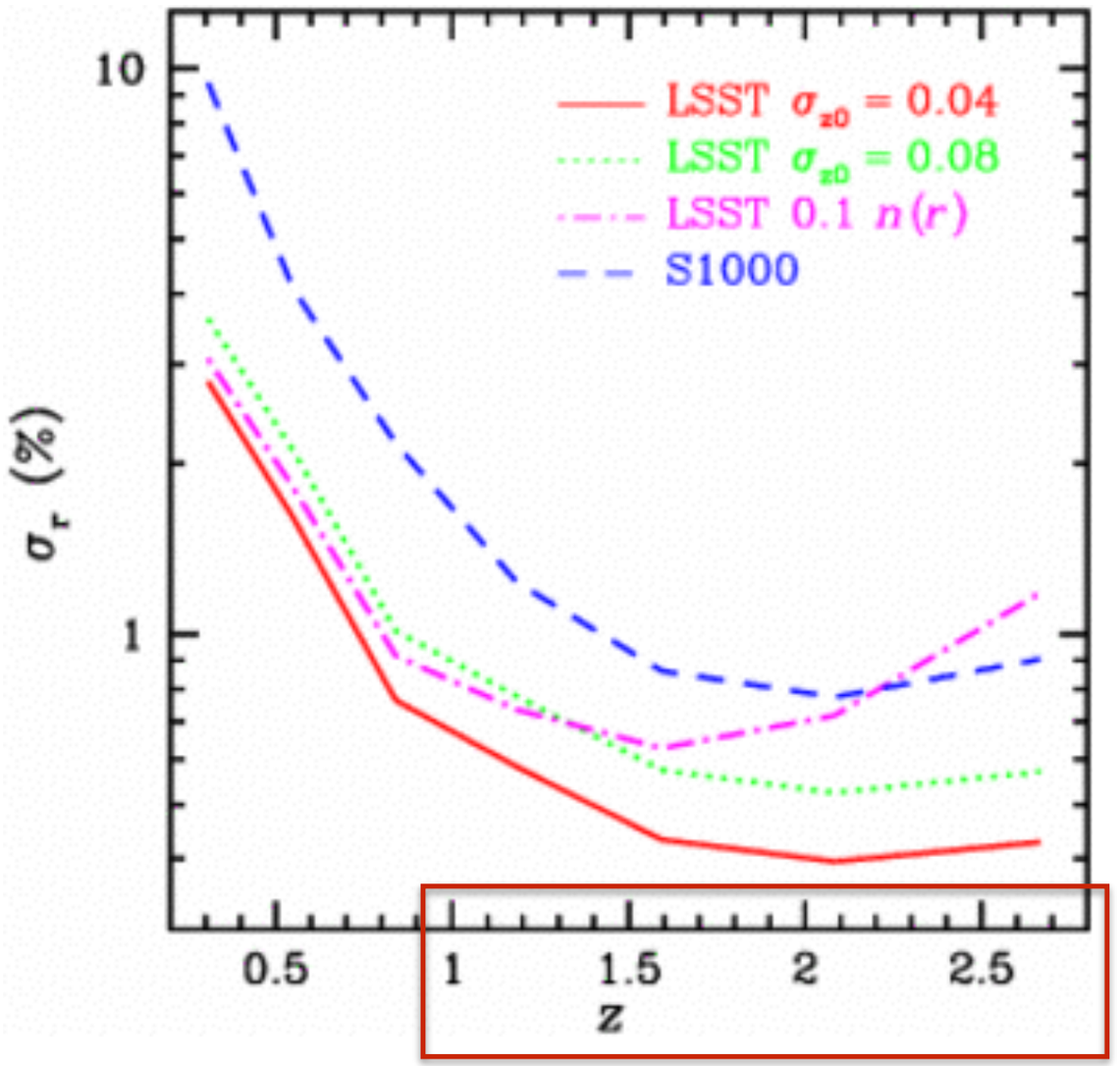
- UltraVISTA + COSMOS optical broad-data (AB~26) has enabled the best current photometric redshifts over the largest area (>2 deg)
- *YJHK* bands help reduce catastrophic errors at 1<z<2 and reduce systematics
- **Would expect LSST +Euclid to have similar performance**



Ilbert *et al.* 2013

BAO precision / volume

- Adding deep Ks band data would allow extending BAO measurement to higher redshifts (but only minimal increase in volume in this redshift range)
- Brown dwarf science?
- But … more useful: **could we fill in some of the southern sky with VISTA?**



LSST sci book

Bottom lines

- Photo-zed performances in science book probably overestimated (sorry).
- Only a small amount of the southern sky covered by Euclid: could VISTA be used to fill in the gaps?
- Clear science gains / FOM need to be calculated. “VIKING” like depths are probably not sufficient
- Window for start of extended southern survey is quite narrow and depends on arrival of 4MOST.