VISTA Hemisphere Survey (VHS)

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VISTA SCIENCE COMMITTEE
VSC-00-1

Scientific issues concerning VISTA site choice

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Abstract: This report aims to summarise and compare in a quantitative manner the *scientific* related issues that affect site choice. We include material that characterises the sites that are currently under consideration. Other issues relating to operational cost and logistics which can indirectly affect scientific output in a major manner are not considered.

Comparing the two sites under consideration, we find that:

- the seeing at the two sites is probably similar
- Paranal has 20% more photometric nights than Pachon
- Paranal is a warmer winter site and hence the K_s sky background may be brighter by ~0.25-0.34mag. If 50% of all time (think of it as bright + some grey time) is spent in K_s this would reduce Paranal's advantage in terms of the number of winter photometric nights by 6-8%, so it would be 12-14%.
- We conclude that either Pachon or Paranal would make an excellent site for VISTA.

VISTA site choice: Cerro Paranal (ESO) or Cerro Pachon (Gemini)

ESO VISTA Public Surveys

- >75% of VISTA time is for large scale Public Surveys
- March, 2006 Initial proposal
  - 16 proposals
  - 6 selected for next phase (incudes civil partnership of 4 within Ultra-VISTA)
  - VHS, VIKING, VIDEO, VMC, VVV, Ultra-VISTA

- Nov, 2006; Vista Hemisphere Survey (VHS) was highest scientifically ranked by ESO OPC.

- Nov, 2007 VHS Survey Management (SMP) plan accepted by ESO.
  - Survey management plan requested 3402 clear hours of observing time which assumes 65% observing efficiency
  - 380 clear 9hr nights of service mode observing over a 5 year period.
  - Dry Run observations started Nov 2009; Survey started Mar, 2010

VHS Science Goals

- The nearest and lowest mass stars
- Galactic structure; formation of the Milky Way
- Evolution of Large scale structure in the Universe; the nature and evolution of Dark Energy
- The physics and baryonic content of the Epoch of Reionization; the discovery of first z>7 quasars.

100 times volume of Universe compared with 2MASS

10 times the volume of the Universe compared UKIDSS

- Targets for the VLT, ALMA, ELT, JWST
- Support for ESA Survey Missions:
  - XMM-Newton, Herschel, Planck, GAIA

VHS Components

- VHS Galactic Plane (VHS-GP)
  - 5< |b| <30
  - 8200deg^2
  - J(60sec); K(60sec)

- VHS-ATLAS (VST-ATLAS PI: Shanks)
  - 5000deg^2
  - Y(60sec), J(60sec), H(60sec), K(60sec)

- VHS-Dark Energy Survey(VHS-DES)
  - 4500deg^2 (excludes 500deg^2 from VIKING footprint)
  - J (120sec), H(120sec), K(120sec)

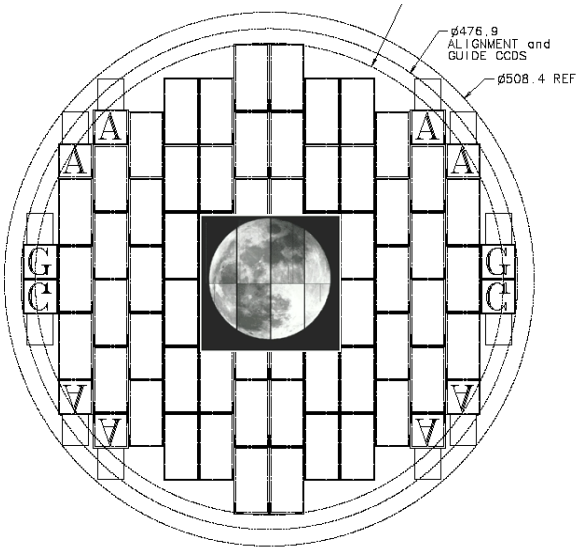
DARK ENERGY SURVEY

The Dark Energy Survey

(US, UK, Spain, Brasil collaboration)

- Telescope; upgraded CTIO 3.9m
- 525 nights over 5 years
- Starting late 2012
- Multiple pass survey so coverage of 5000deg^2 in first year.
- Field of view
  - 2.3deg diameter; 3.0deg^2
- Very red sensitive CCDs
  - QE; 90% at 900nm; 50% at 1μm
- g, r, i, z, Y wavebands

DECam Focal Plane

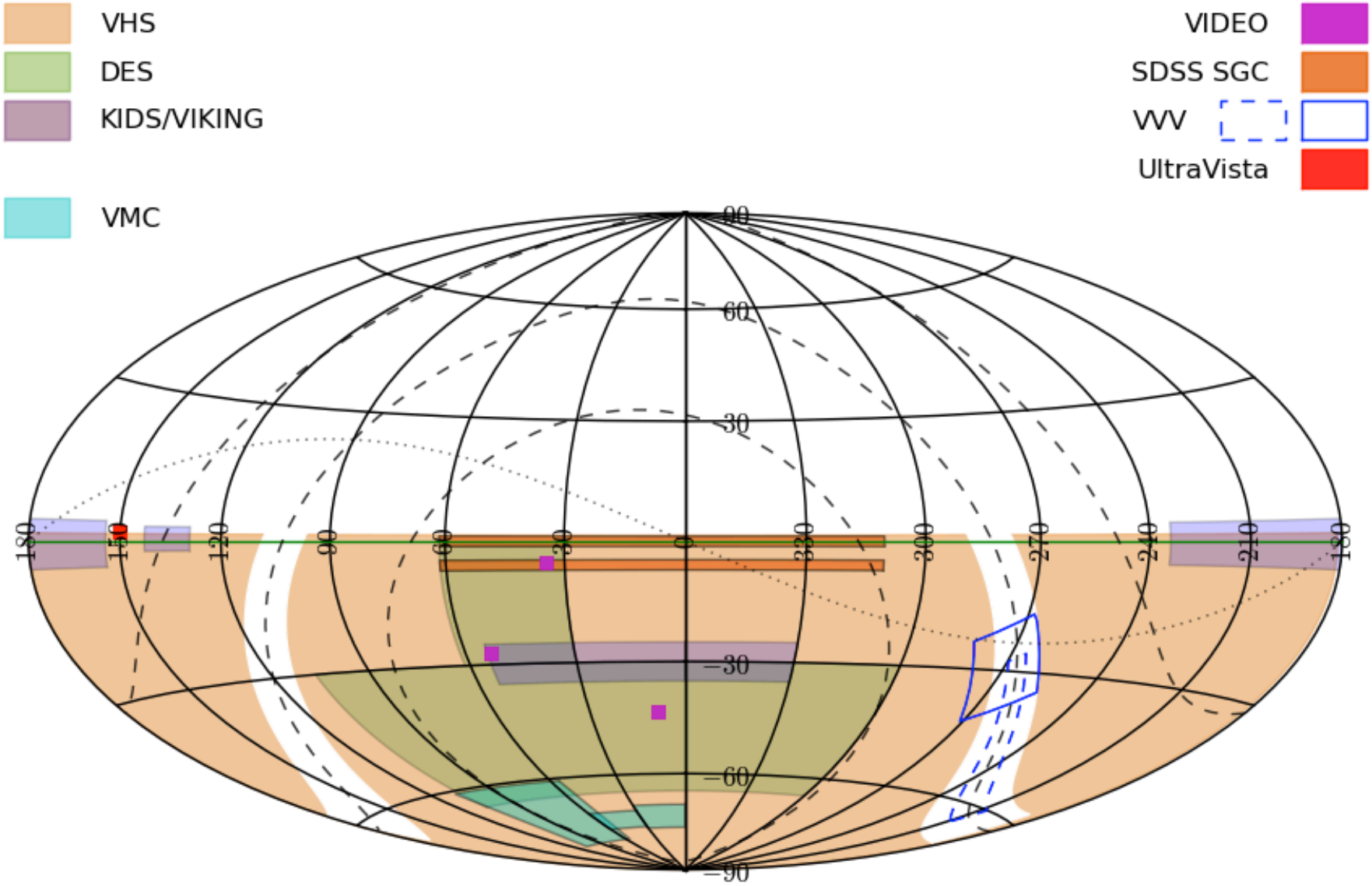


62 2kx4k Image CCDs: 520 MPix
8 2kx2k focus, alignment CCDs
4 2kx2k guide CCDs
0.27" per pixel

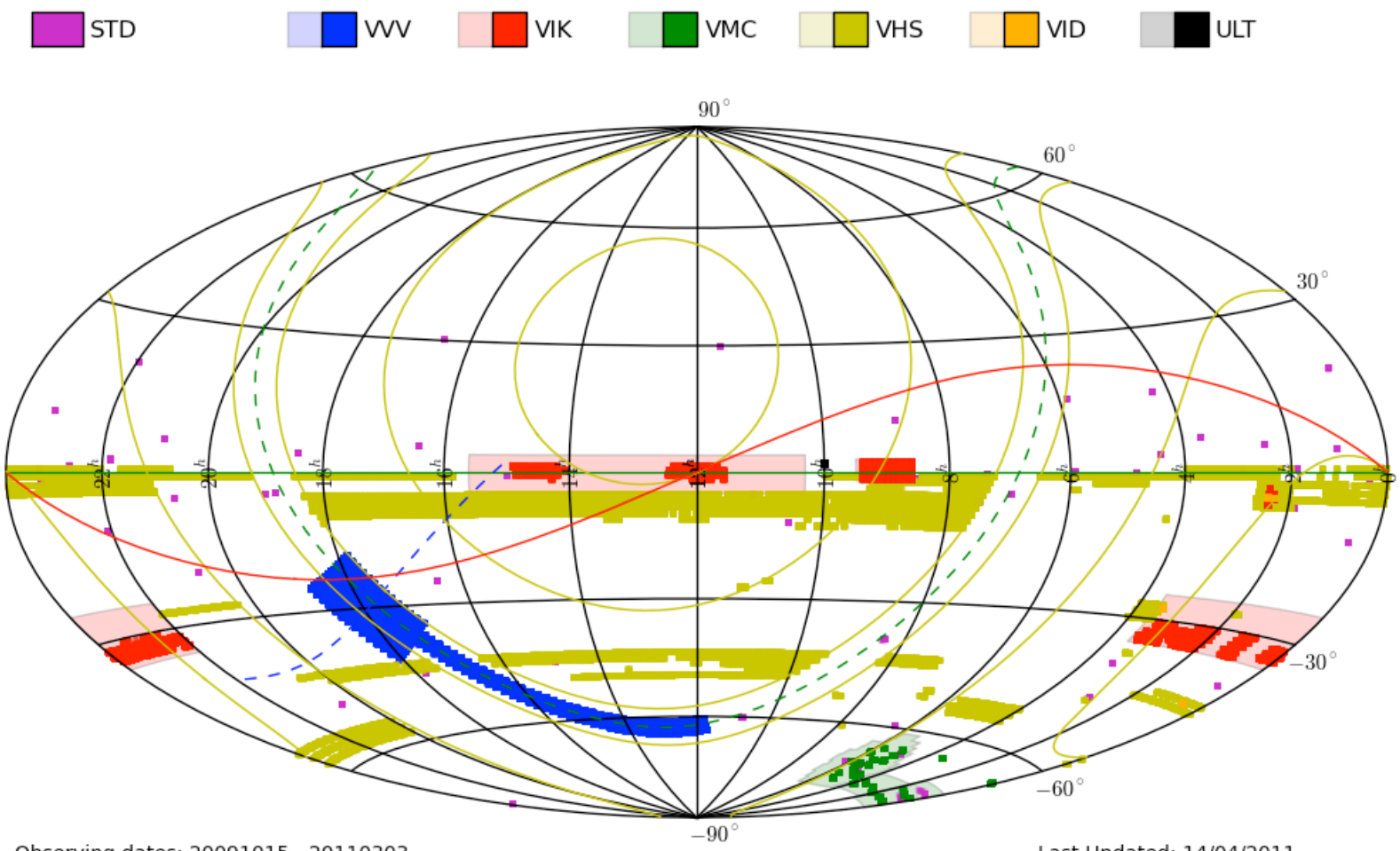
VISTA Surveys summary

Survey	Area (deg^2)	Depths Measure (mag)	Depth (mag)				
VHS	**18, 000**	**5σ, AB**		**J=21.2**		**Ks=20.0**	
1. VHS-DES	4500	5σ, AB		J=21.6	H=21.0	Ks=20.4	
2. VHS ATLAS	5000	5σ, AB	Y=21.2	J=21.2	H=20.6	Ks=20.0	
3. VHS-GPS	8000	5σ, AB		J=21.2		Ks=20.0	
VIKING	**1,500**	**5α, AB**	**Z=23.1**	**Y=22.3**	**J=22.1**	**H=21.5**	**K_s=21.2**
VVV	520	5σ, Vega	Z=21.9	Y=21.2	J=20.2	H=18.2	K_s=18.1
VMC	184	10σ, Vega		Y=21.9	J=21.4		Ks=20.3
VIDEO	15	5σ, AB	Z=25.7	Y=24.6	J=24.5	H=24.0	K_s=23.5
Ultra-VISTA	0.70	5σ, AB	NB=26.0	Y=26.7	J=26.6	H=26.1	K_s=25.6

VISTA Public Survey footprints

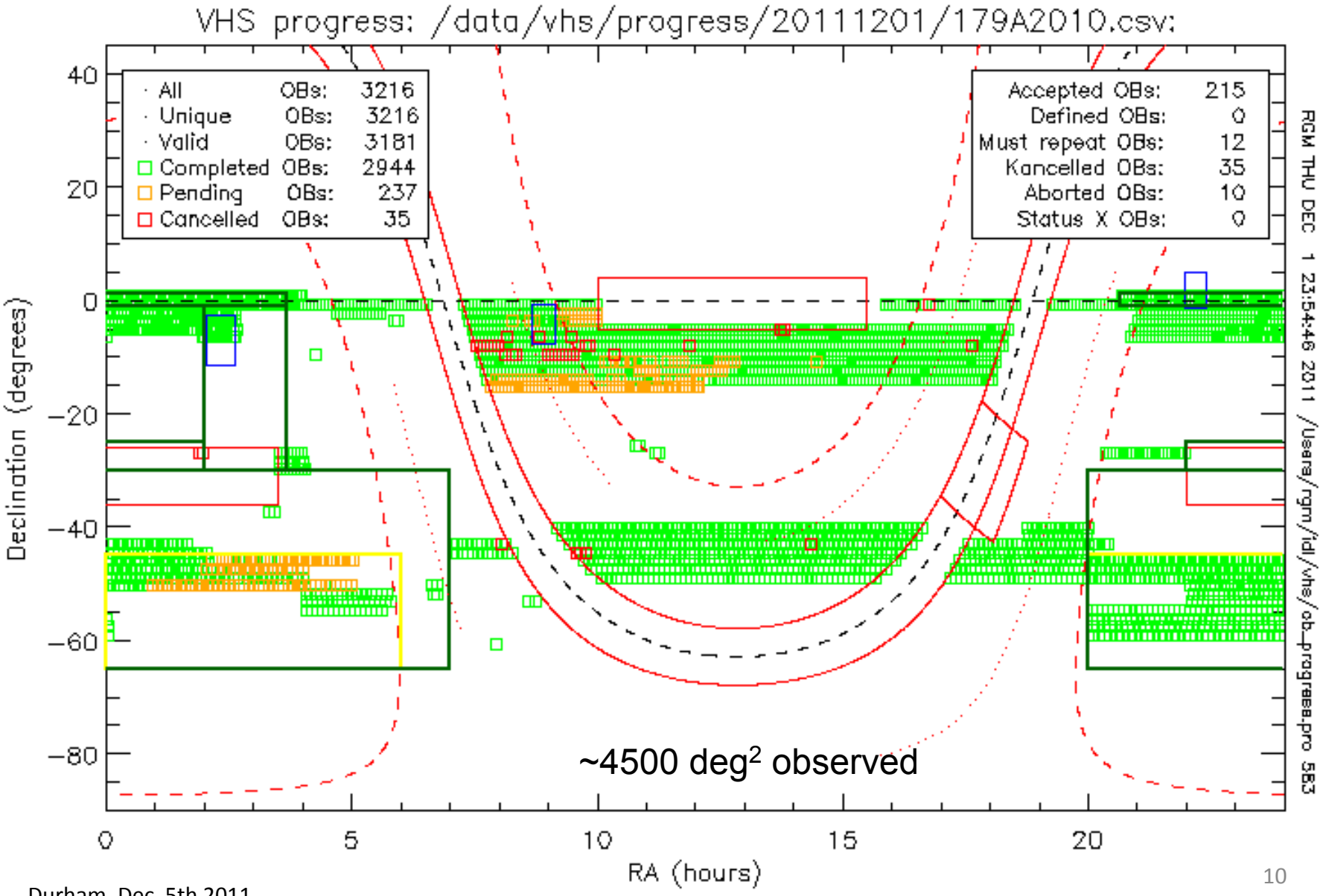


VISTA Surveys Status

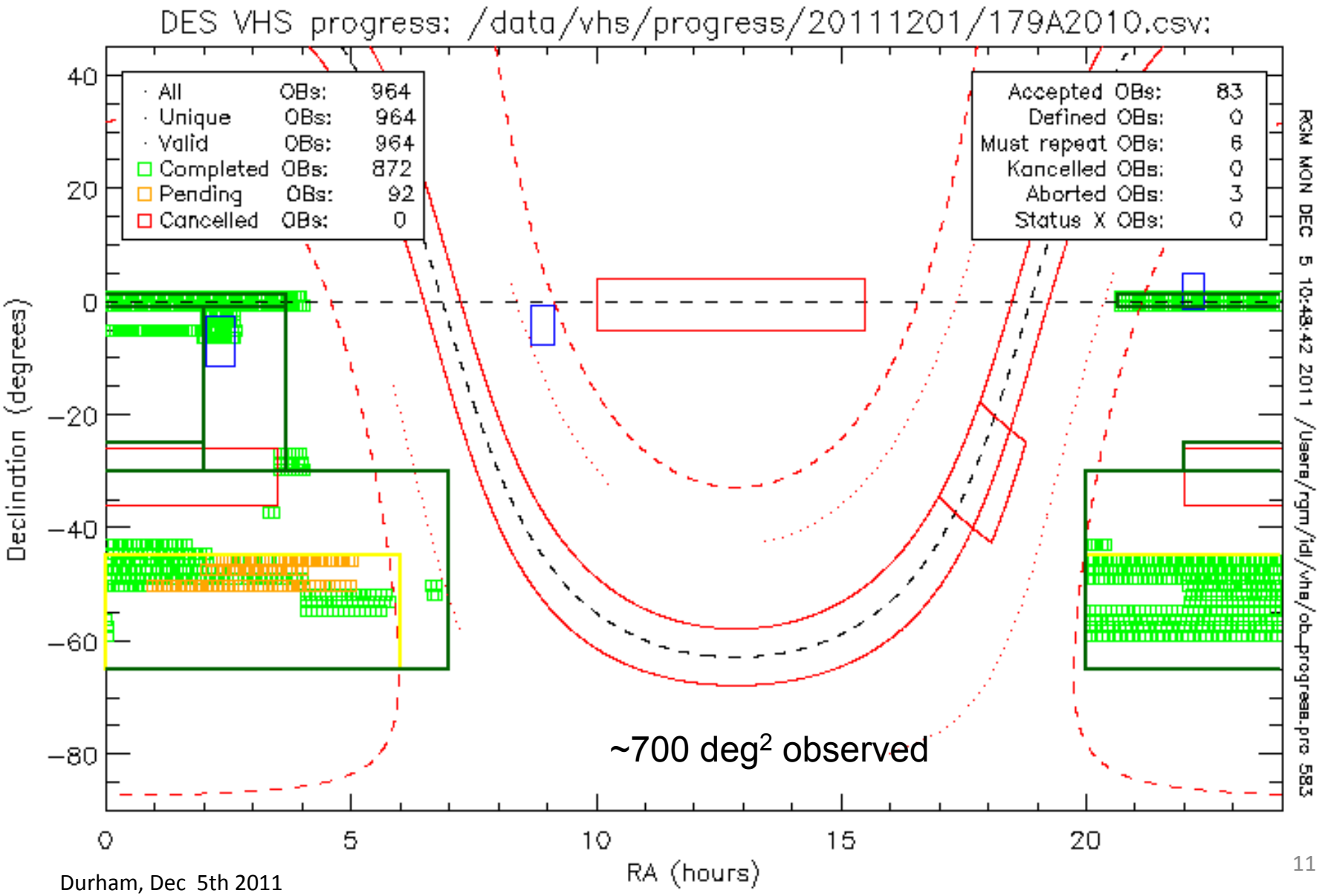


VHS observations status this week

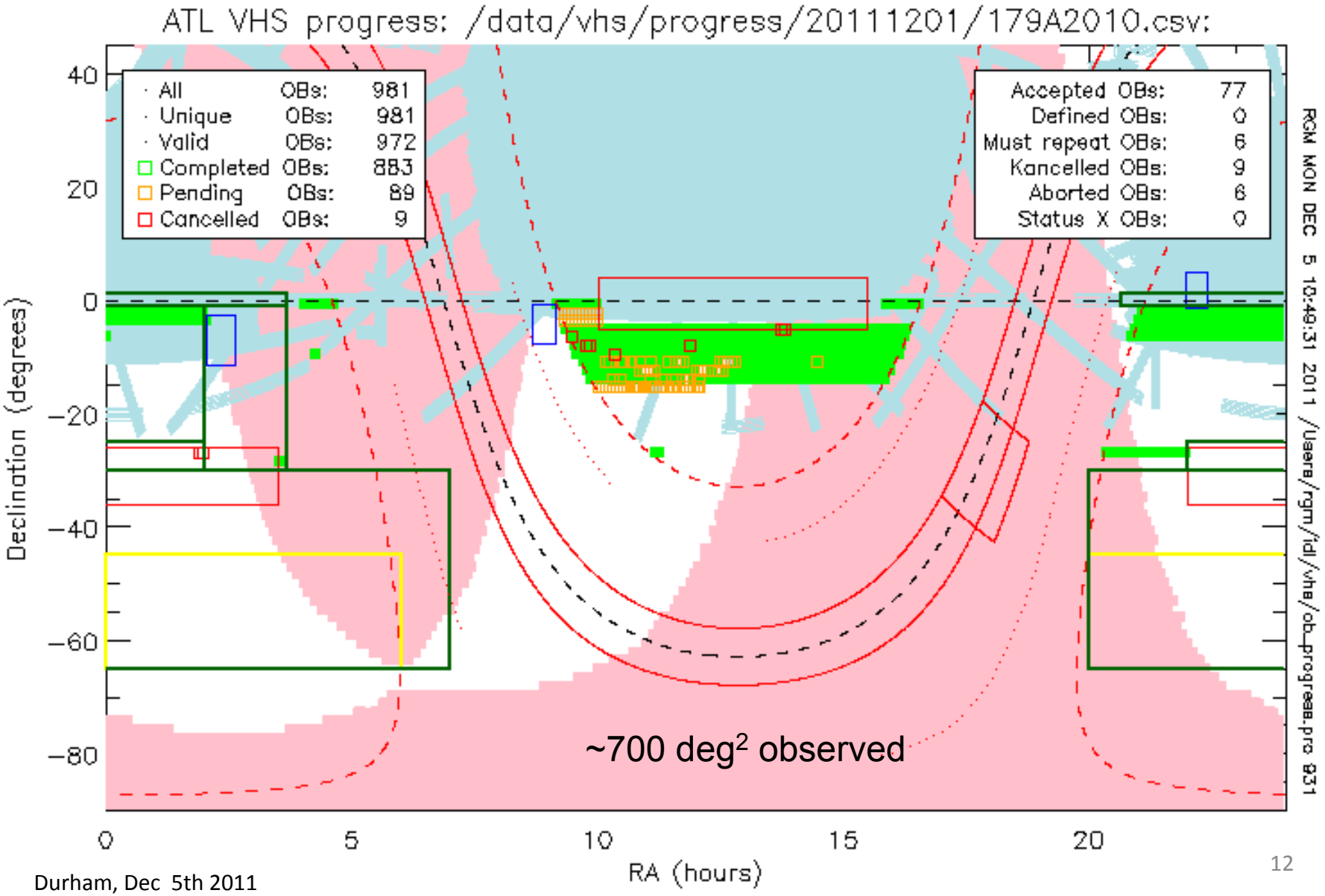
Each Observing Block(OB) = 1.5deg^2



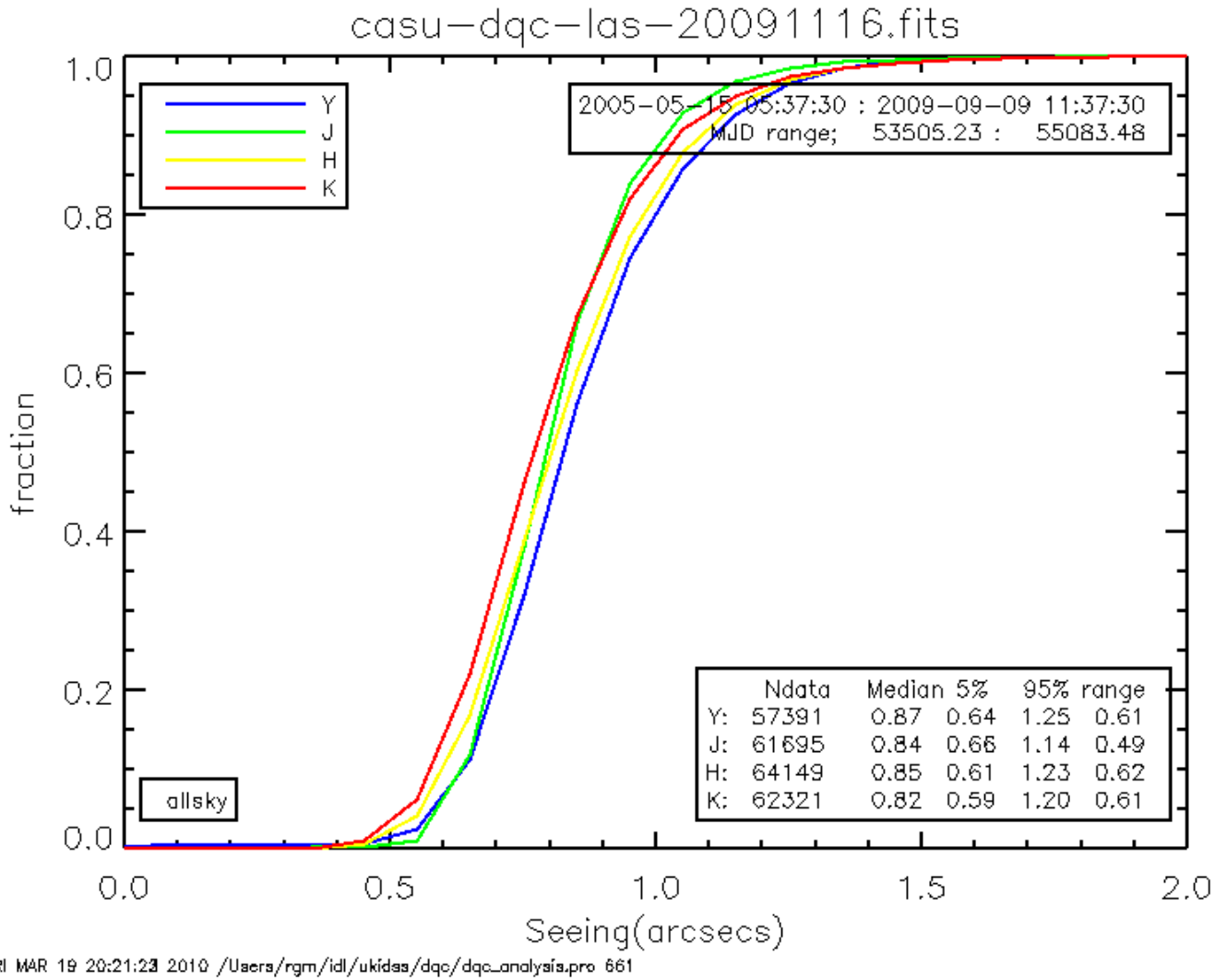
VHS-DES observations status this week



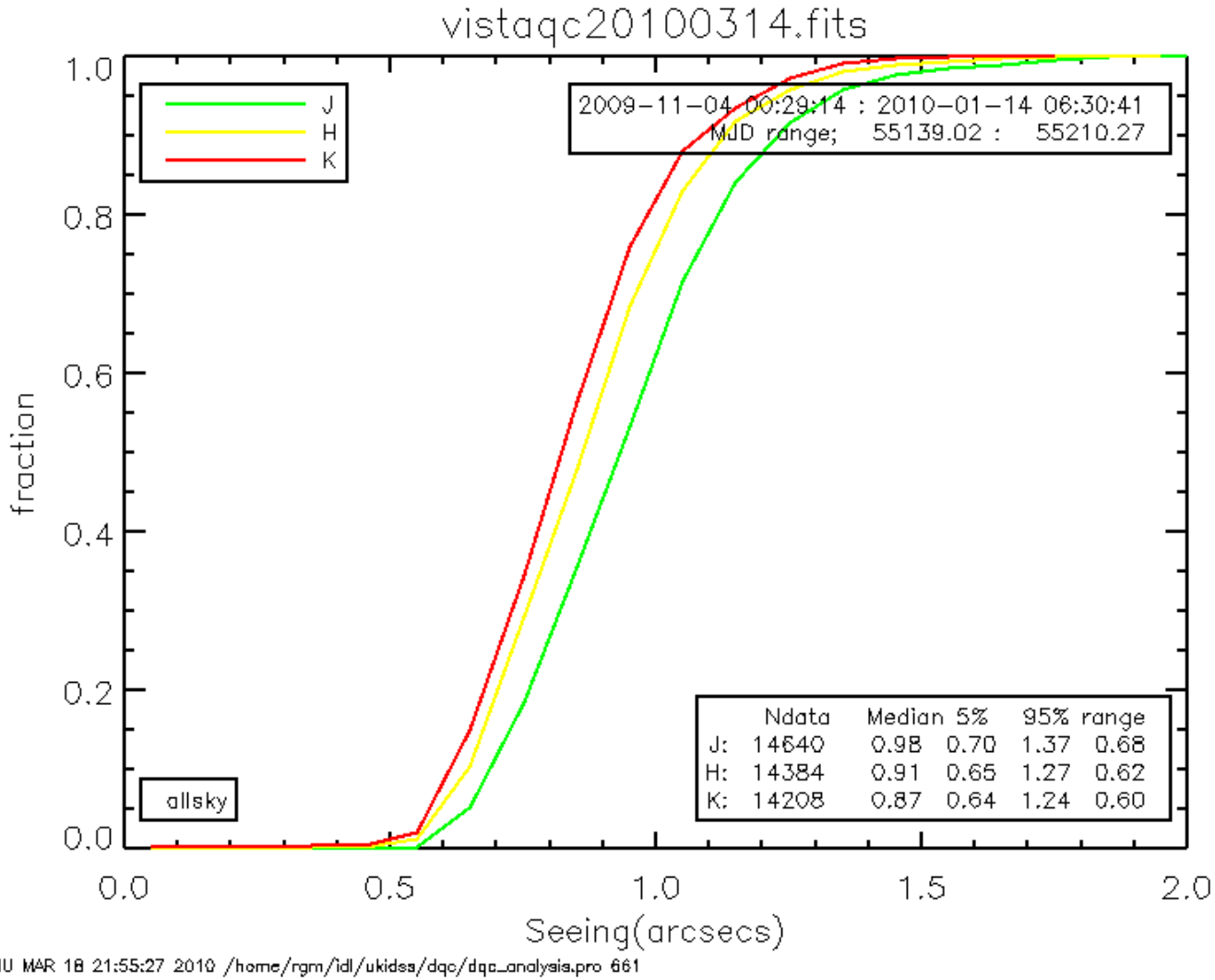
VHS-ATLAS observations status this week



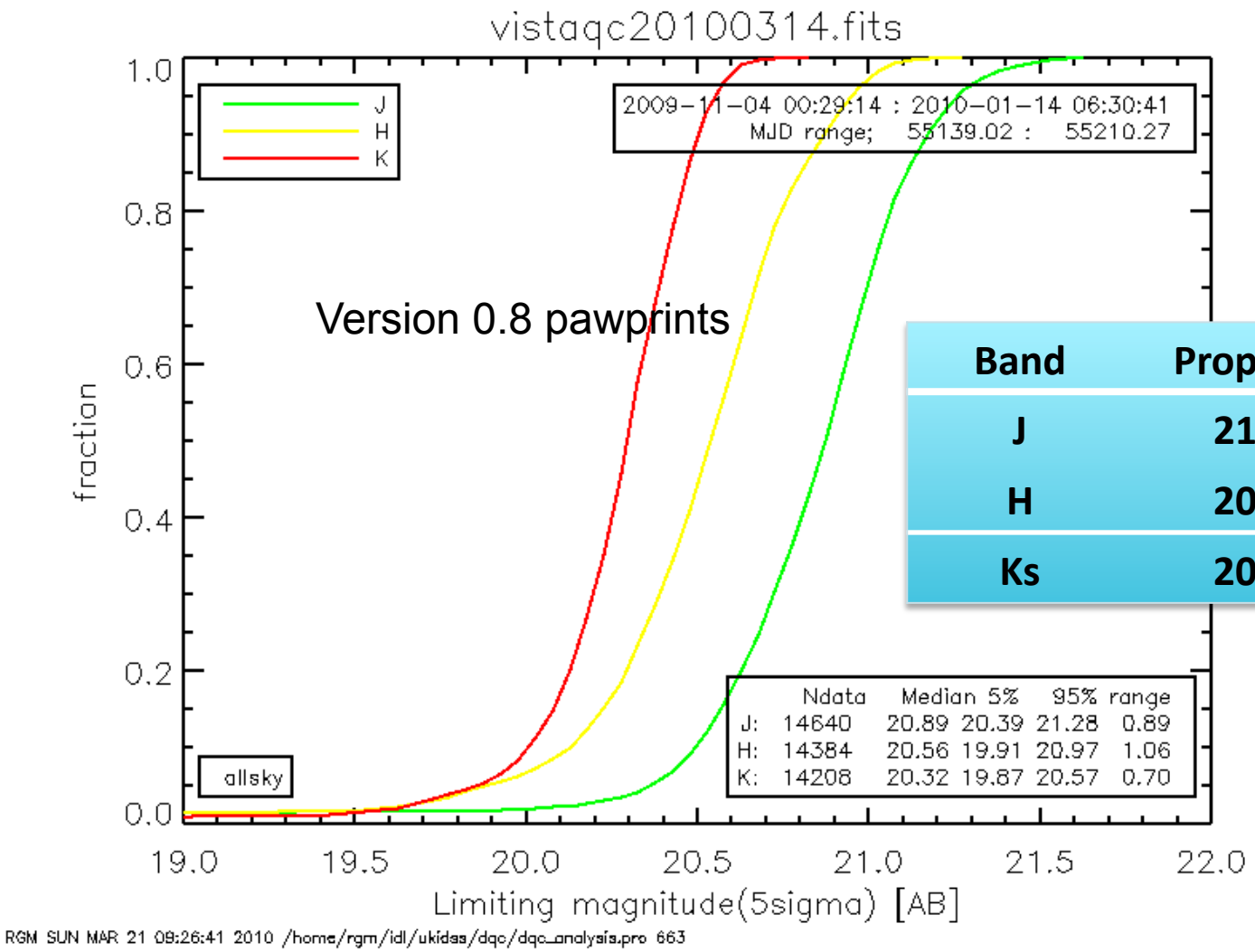
UKIDSS LAS Seeing Distribution



VHS Seeing distribution

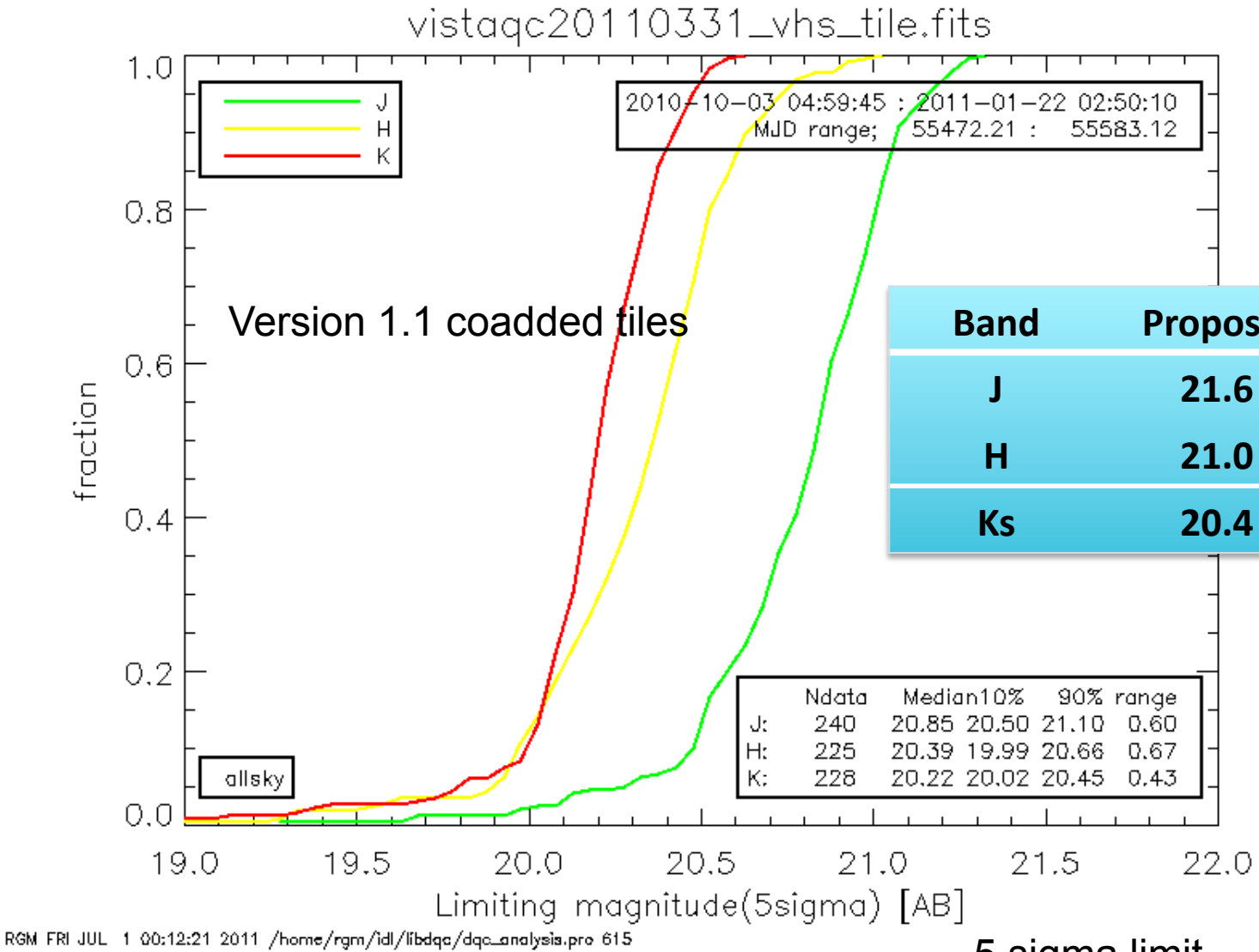


VHS-DES limiting magnitudes: 60second exposure



Band	Proposal	Measured
J	21.1	20.9
H	20.6	20.6
Ks	20.0	20.3

VHS-DES limiting magnitude 2010/2011 season



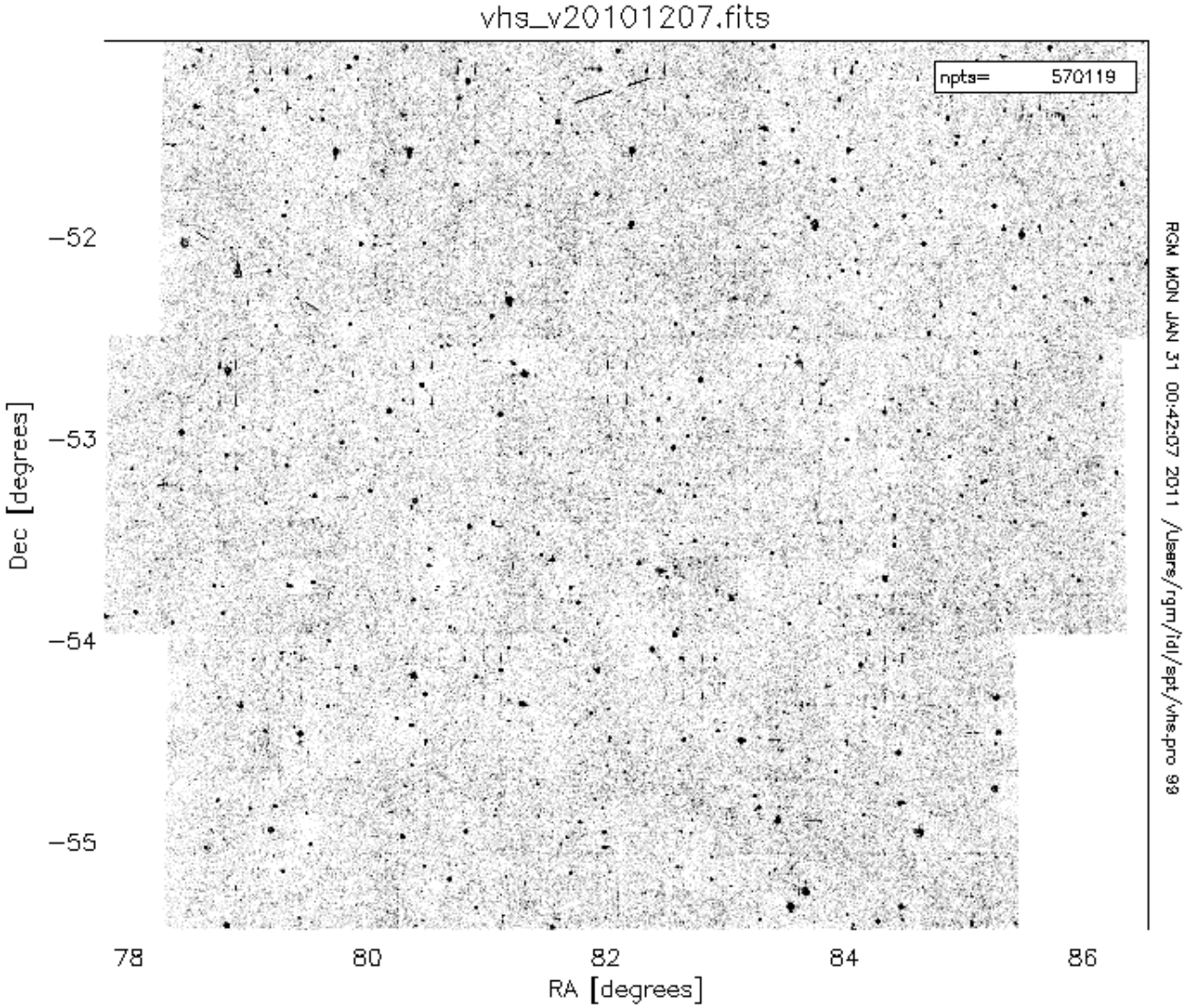
Band	Proposal	Measured
J	21.6	20.8
H	21.0	20.4
Ks	20.4	20.2

5 sigma limit
120 seconds per band

Some VHSish science verification examples

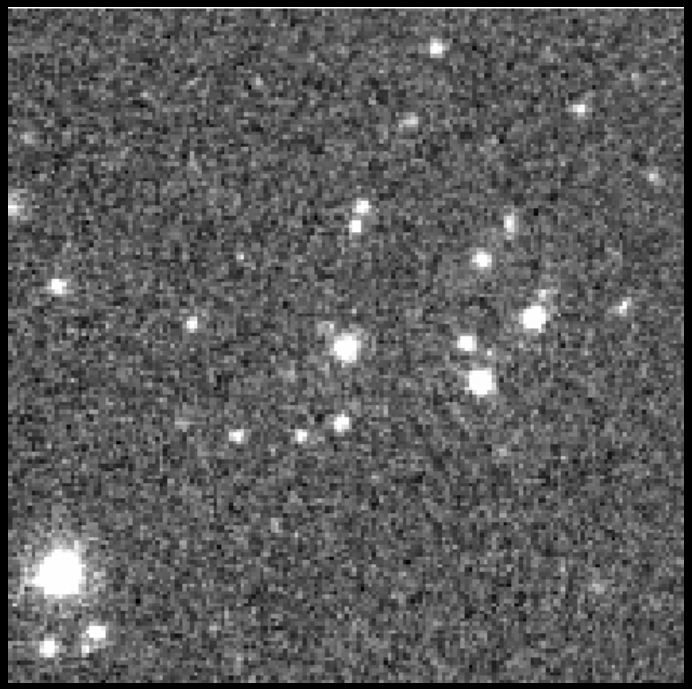
- SPT clusters at z=1 (Manda Banerji)
- Galactic Structure/Streams
  - GAIA-SPEC ESO Public Spectroscopic Survey target selection (Sergey Koposov)
- z>6.5 QSOs

5 deg x 5 deg patch:



SPT-CLJ0528
(z=0.76)

SPT-CLJ0546
(z=1.06)

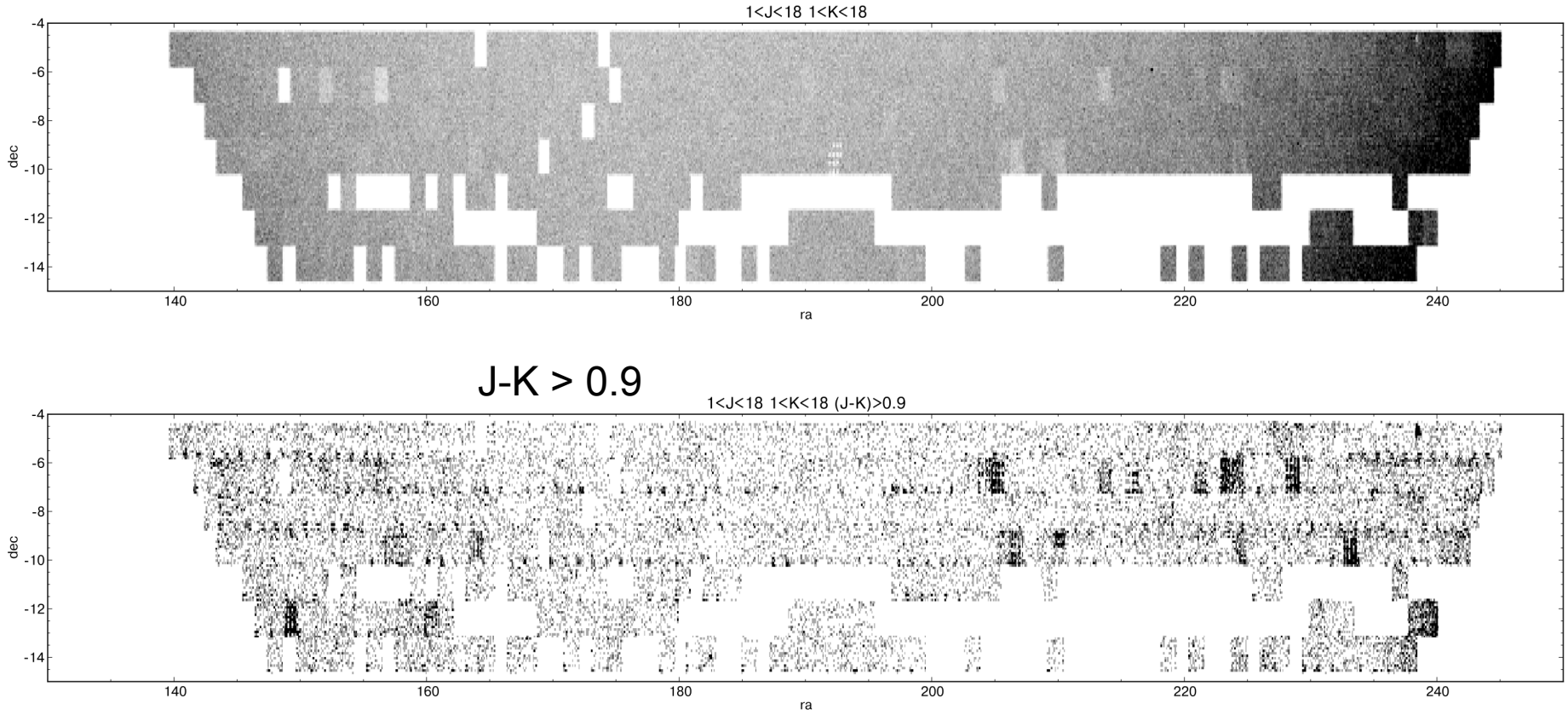


Ks~18.9 (10σ AB)

Ks~18.5 (10σ AB)

Stellar mass analysis currently ongoing for both clusters (*Banerji, Stroe, McMahon, Mohr et al.)*

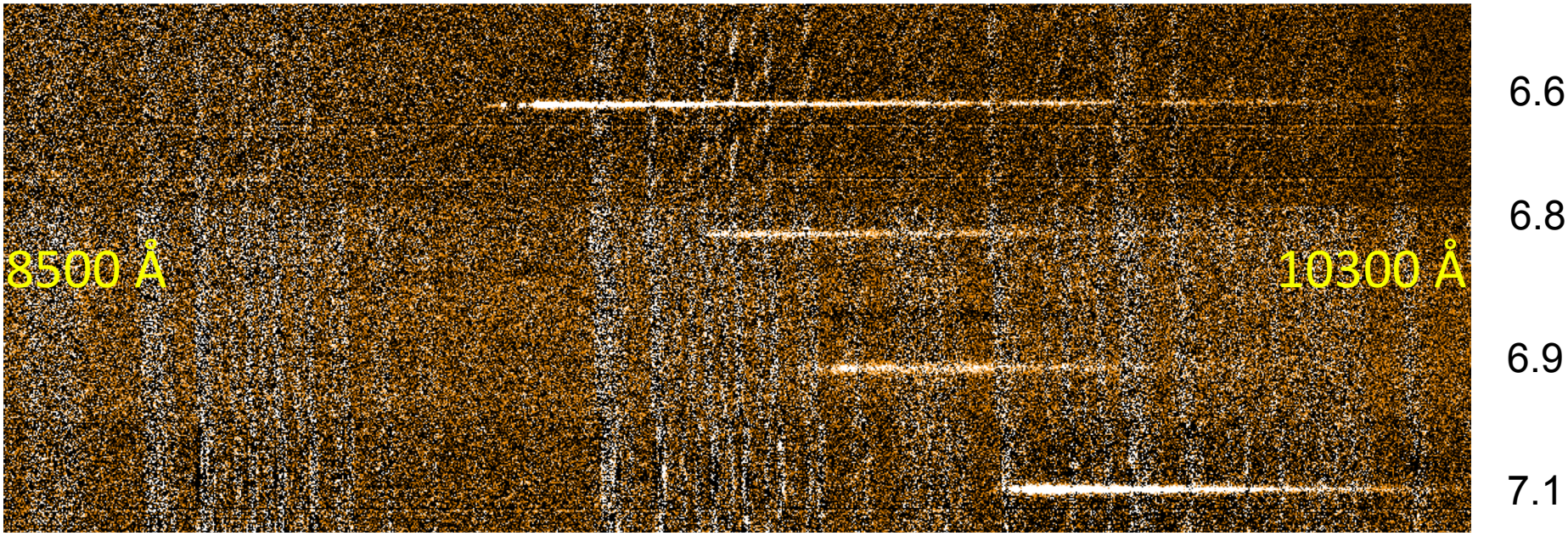
VHS-ATLAS NGP
Stellar density distribution



J-K > 0.9

Sergey Koposov, Eduardo Gonzalez

Example spectroscopic data for four z>6.5 quasars found in last 13 months from UKIDSS and VIKING



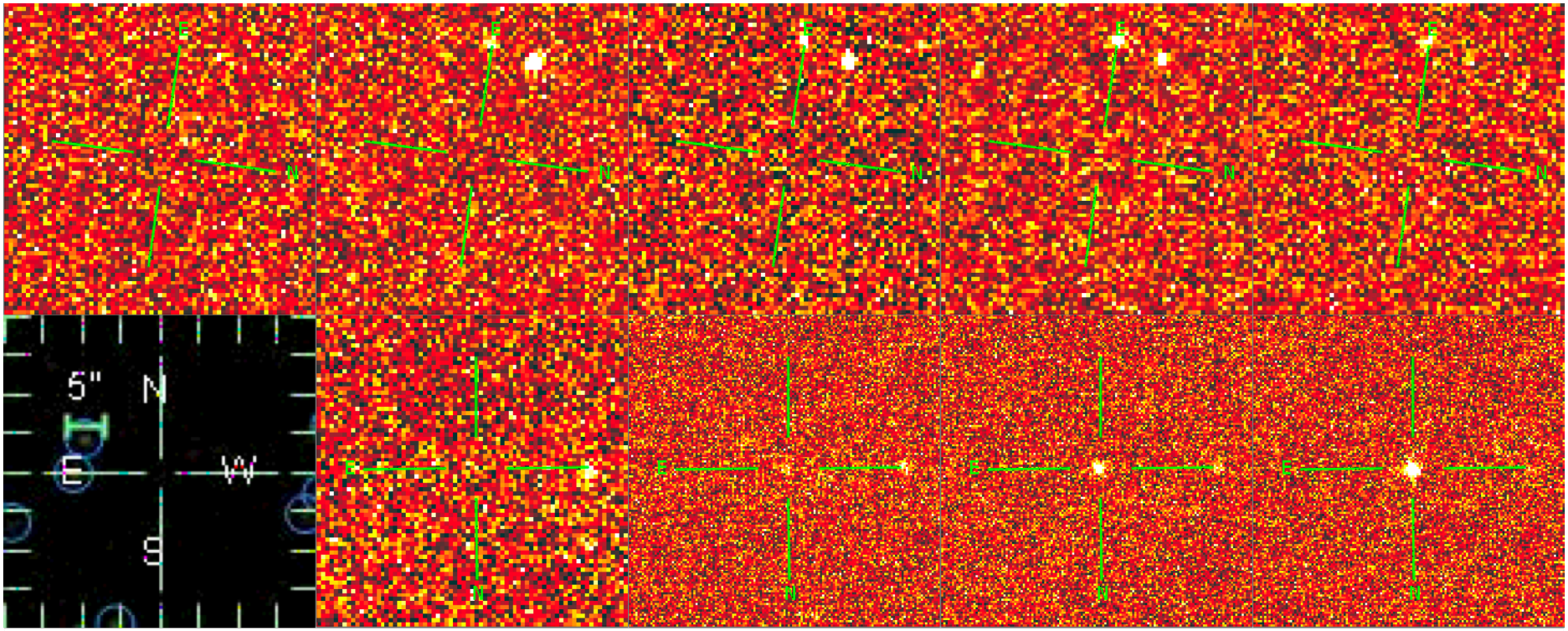
Mortlock et al, 2011, Venemans et al, in prep

Optical and IR photometry

yclass: -9999
j_1class: -9999
hclass: -1
kclass: -1

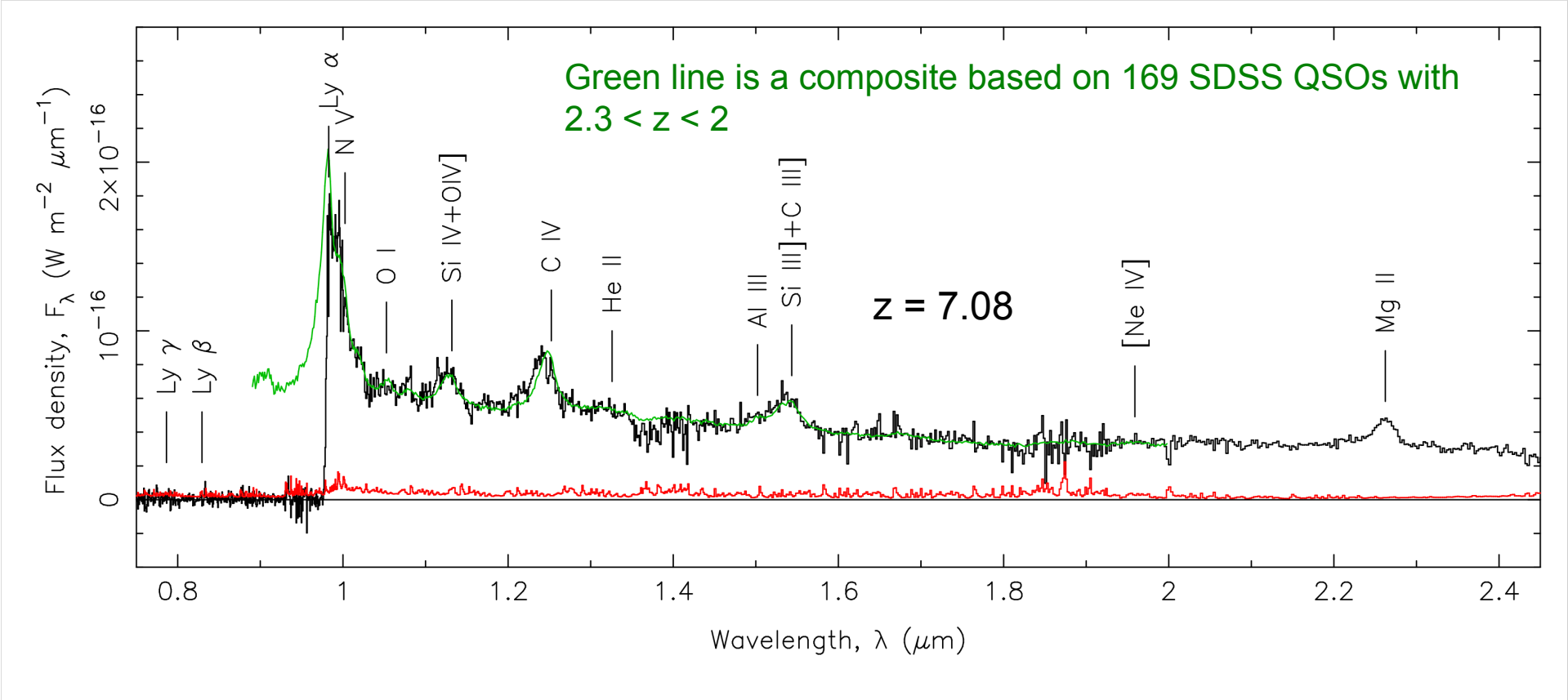
source id: 433792579688

run: 3909 rerun: 40 camcol: 3 field: 278 ra: 237.11543 dec: +5.8059765



umag > 23.43	gmag > 23.91	rmag > 23.60	imag > 23.16	zmag > 21.55
No: 2	ymag >******	jmag > 21.17	hmag = 19.34± 0.08	kmag = 18.37± 0.03
ra: 15 48 27.70	dec: +05 48 21.5	i-Y >******	z-J > 0.38	
Y-J = *****	z-Y >******	Y-K = *****	J-K = 2.79	J-H = 1.83

‘Example’ z=7 quasar: Combined optical and near IR spectrum



From Mortlock et al 2011, Nature

VHS Data Release 1(DR1) CASU(v1.1) processed tiles

Component	Unique OBs	Y	J	H	K	All
ATLAS	439	571	546	531	536	2184
DES	304		351	342	344	1037
GPS	543		677		662	1339
All	1286	571	1574	873	1542	4560

- Each OB contains all waveband observations needed for an tile
- Total number of stacked pawprints 27,596
  - Each stack is normally 2-3 dithers/jitters

THE END

EXTRA SLIDES