DARK ENERGY
SURVEY

DES Calibrations: Remaining Loose Ends for Year 1

(Update: 17 April 2012)

Douglas L. Tucker

Current Thoughts on DES Year 1 Survey Strategy

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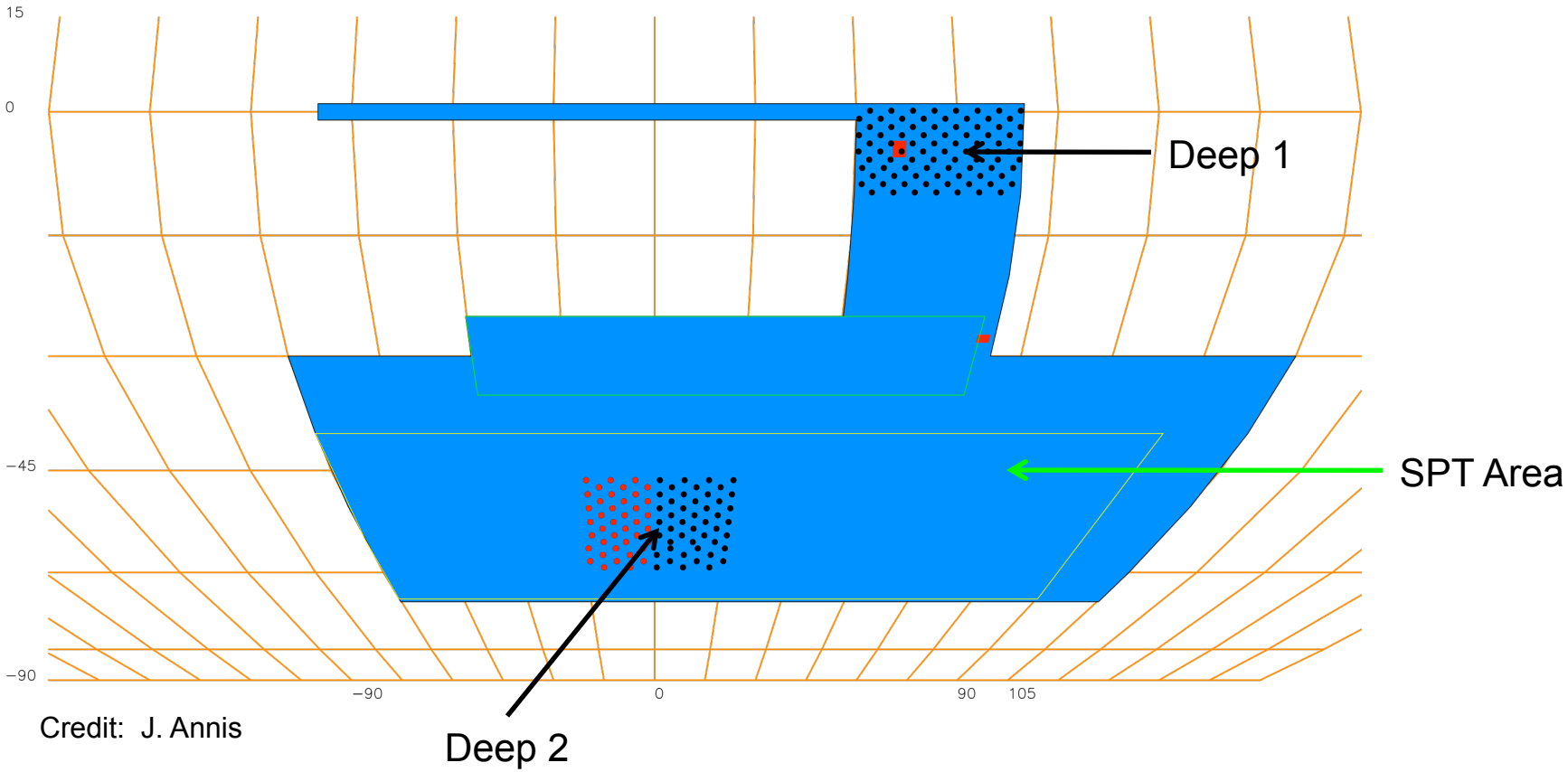

- Deep 1 & 2: c. 500 sq deg to full 5-year DES depth (10 tilings) in each filter
- SPT Area: 2 tilings in each filter, probably only the eastern parts (say, RA>0, if starting in September).

Current Thoughts on DES Year 1 Survey Strategy (3 April 2012)

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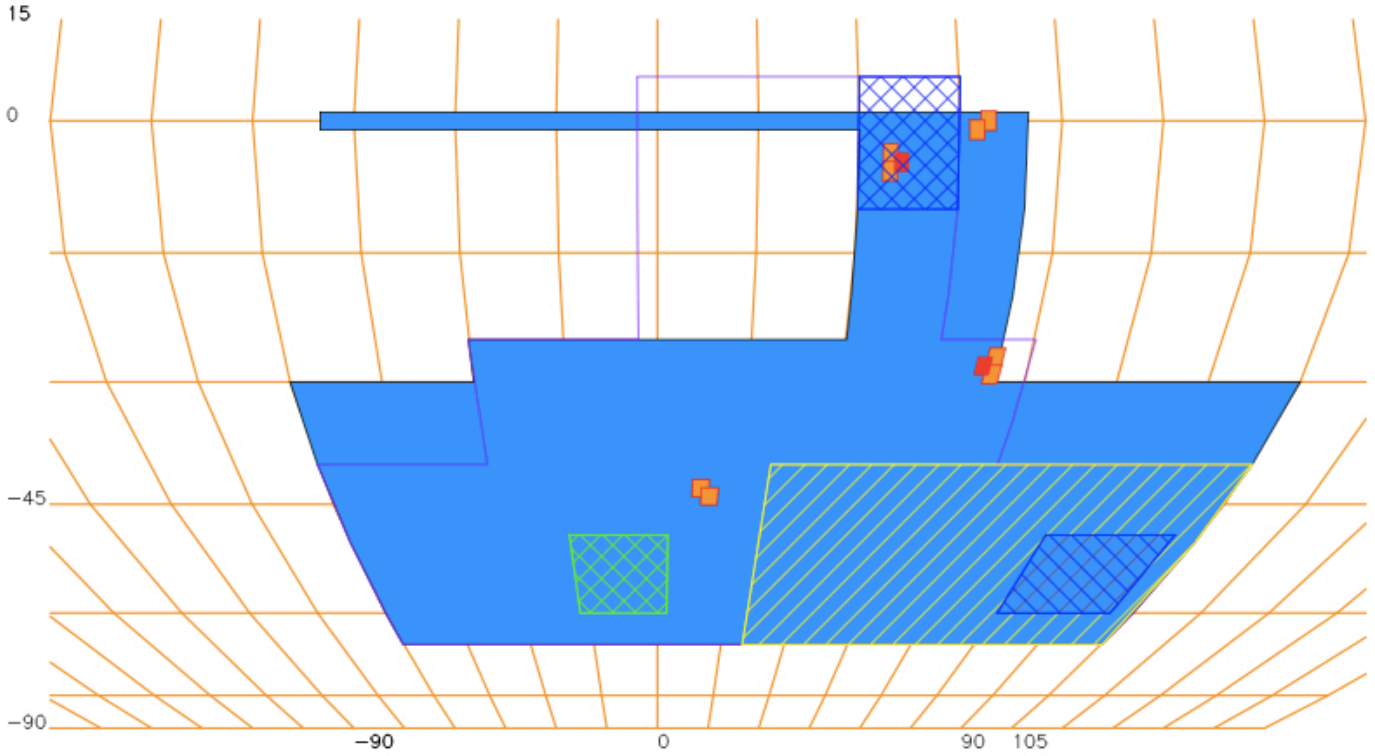

Figure 1: DES 5-year (blue) and first-season (hatched) footprints in a Putnins IV equal area projection. RA increases to the right. Cross-hatched regions show full 10-tiling depth areas of the "mini-survey"; single-hatched: 2-tiling area; red/orange squares: SN fields. The purple line outlines a modified 5-year footprint under consideration (the fiducial 5-year footprint will be finalized this April).

Current Thoughts on DES Year 1 Survey Strategy (3 April 2012)

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Target Table for Wide Area Survey in First Season

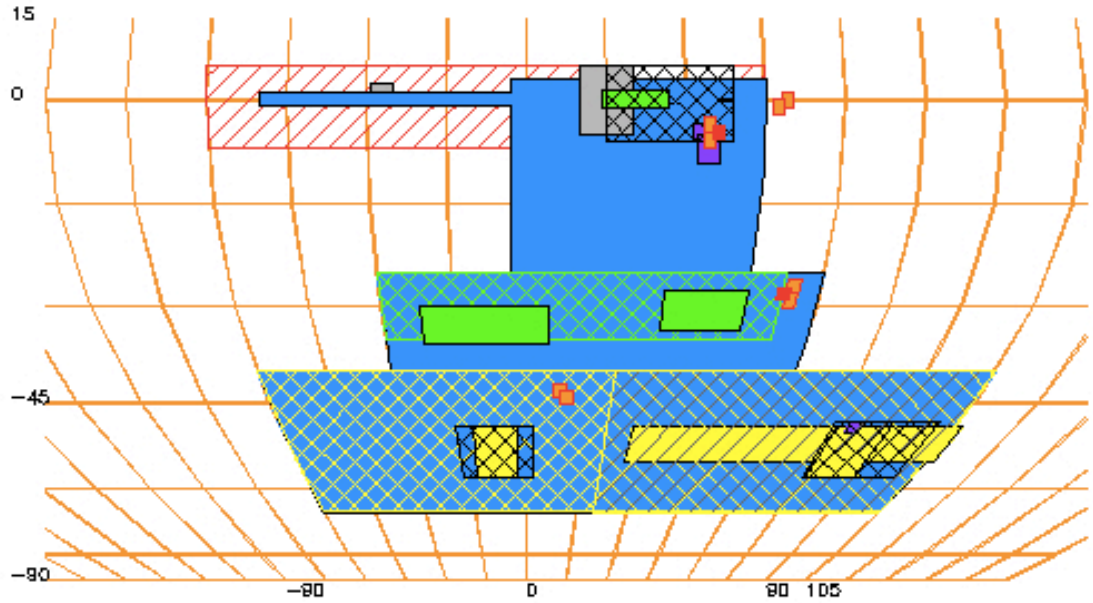
area	ra (degrees)	dec (degrees)	filters	exp (s)	# tilings/filter
SPT Deep	$-17 \leq$ra≤ 2	$-60 \leq$dec≤ -49	grizY	80,80,100,100,50	10
VVDS Deep	$30 \leq$ra≤ 45	$-10 \leq$dec≤ 5	grizY	80,80,100,100,50	10
MaxVis	$80 \leq$ra≤ 105	$-60 \leq$dec≤ -49	grizY	80,80,100,100,50	10
SPT Broad	$20 \leq$ra≤ 105	$-65 \leq$dec≤ -40	grizY	80,80,100,100,50	2

Target Table for Supernova Fields

Obj ID	Object	α	δ	Epoch	Mag.	Filter	Exp. time	# of exp.	Lunar days	Sky	Seeing	Comment
100	E1	7.8356	-42.9860	J2000		g,r,i,z	88,25,100,100	2,2,2,5				E1 Shallow SN field
101	E2	9.5000	-43.9980	J2000		g,r,i,z	88,25,100,100	2,2,2,5				E2 Shallow SN field
102	S1	49.1000	0.0000	J2000		g,r,i,z	88,25,100,100	2,2,2,5				S1 Shallow SN field
103	S2	47.4356	-1.0120	J2000		g,r,i,z	88,25,100,100	2,2,2,5				S2 Shallow SN field
104	C1	54.2644	-27.0880	J2000		g,r,i,z	88,25,100,100	2,2,2,5				C1 Shallow SN field
105	C2	54.2644	-29.1120	J2000		g,r,i,z	88,25,100,100	2,2,2,5				C2 Shallow SN field
106	X1	34.6356	-3.6880	J2000		g,r,i,z	88,25,100,100	2,2,2,5				X1 Shallow SN field
107	X2	34.6356	-5.7120	J2000		g,r,i,z	88,25,100,100	2,2,2,5				X2 Shallow SN field
108	X3	36.3000	-4.7000	J2000		g,r,i,z	100,300,300,300	3,4,6,13				X3 Deep SN field
109	C3	52.6000	-28.1000	J2000		g,r,i,z	100,300,300,300	3,4,6,13				C3 Deep SN field

Current Thoughts on 5-Year DES Survey Strategy (10 April 2012)

The Landscape of Round82



Under discussion by Science Committee.

80% chance of going with Round82?

Final decision by the May collaboration meeting?

- The current plot: blue solid is round82-hybrid.
- Black hatched and cross hatched are year 1 2-tiling and 10-tiling areas.
- Red are deep SN fields, orange are shallow SN fields
- CMB measurements in yellow: cross hatch is SPT, two upright rectangles are SPT deep, long rectangle is ACT.
- IR measurements in green: two rectangles at dec=-30 are Herschel-Atlas, the one at dec=0 is Shela, the crosshatch is Viking
- Spectroscopy measurements in Gray: equatorial and above stripe 82 is Vipers, the large gray rectangle is a WiggleZ field (there are others) and the small gray at the edge of the equatorial year 1 field is DEEP2. VVDS deep is under the red SN symbol. A second Vipers field is under the purple area just south of VVDS.
- High quality deep imaging is in purple: near VVDS is a DEEPLens field and a CFHTLS field (which covers Vipers). In the South there is a second DEEPLens field

Clearly this is unfortunately placed for VIPERS.

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Overview

1. Standard Stars

2. DESDM Software

3. DECal

4. Final Plans for On-Sky Commissioning

5. Contacts with other Surveys

Standard Stars: HST CalSpec Standards

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1. Re-calculate synthetic DES grizY mags using most current version of DES filter response curves (python code by Holly Batchelor). (Done – See following slides & DES-doc#6203)

2. Finish processing and analysis of data from July 2010 CTIO-1m run that used a DECam 2kx2k CCD + DES filters (these data include observations of some of these HST CalSpec Standards). (In progress-nearly finished w/ astrom.)

3. Identify any HST CalSpec standards in the PreCam fields (→ absolute calibration of PreCam data). (Done – See following slides)

4. BD+17 4708 is important for DES on-sky commissioning. (Observed by CTIO1m in July 2010 and by PreCam on 2010 November 21-24).

Standard Stars: HST CalSpec Standards

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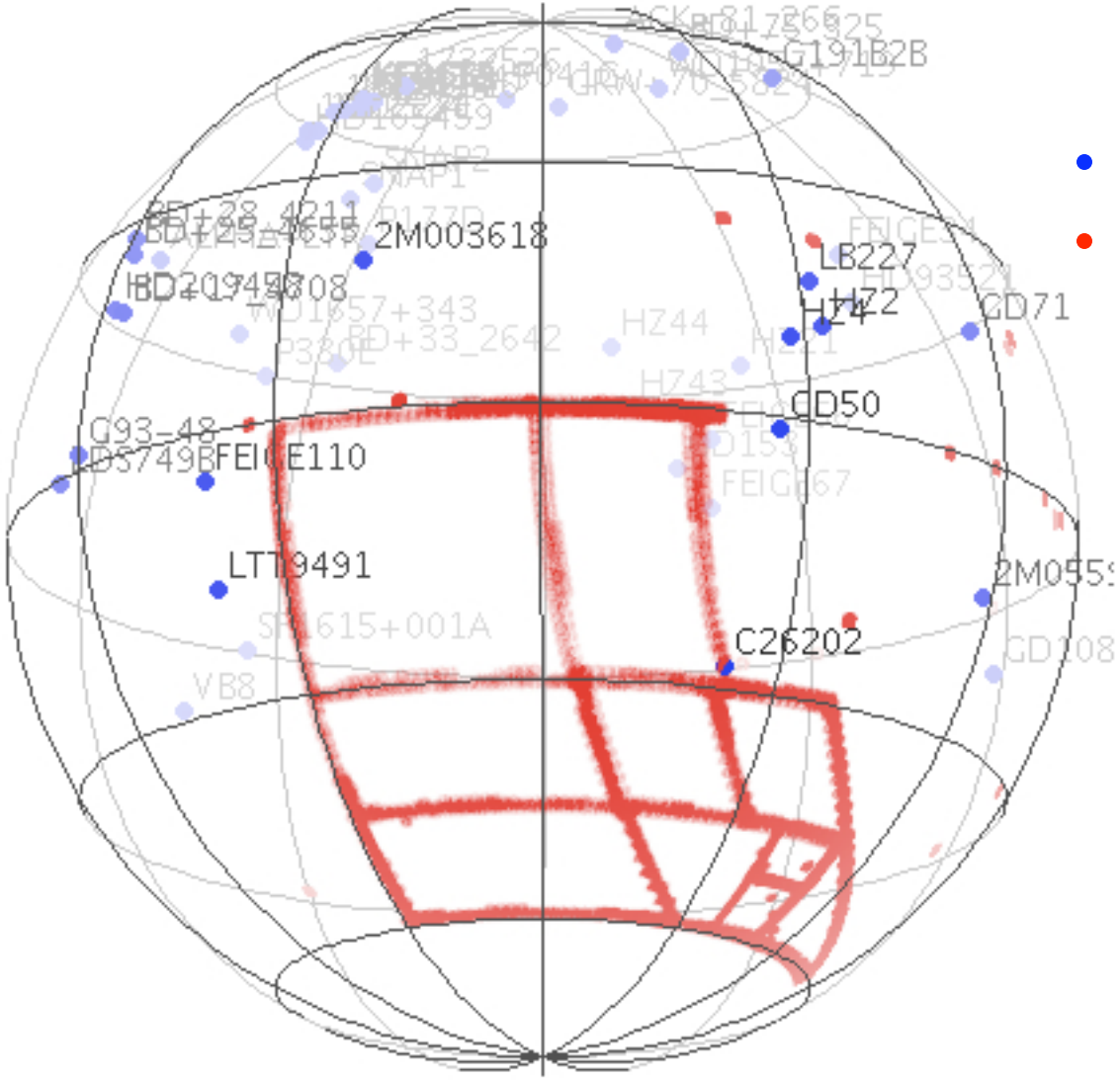

- HST CalSpec Standards
- PreCam FNALv4 i-band data

C26202 seems to be the only HST CalSpec Standard in the main PreCam footprint.

Standard Stars: HST CalSpec Standards

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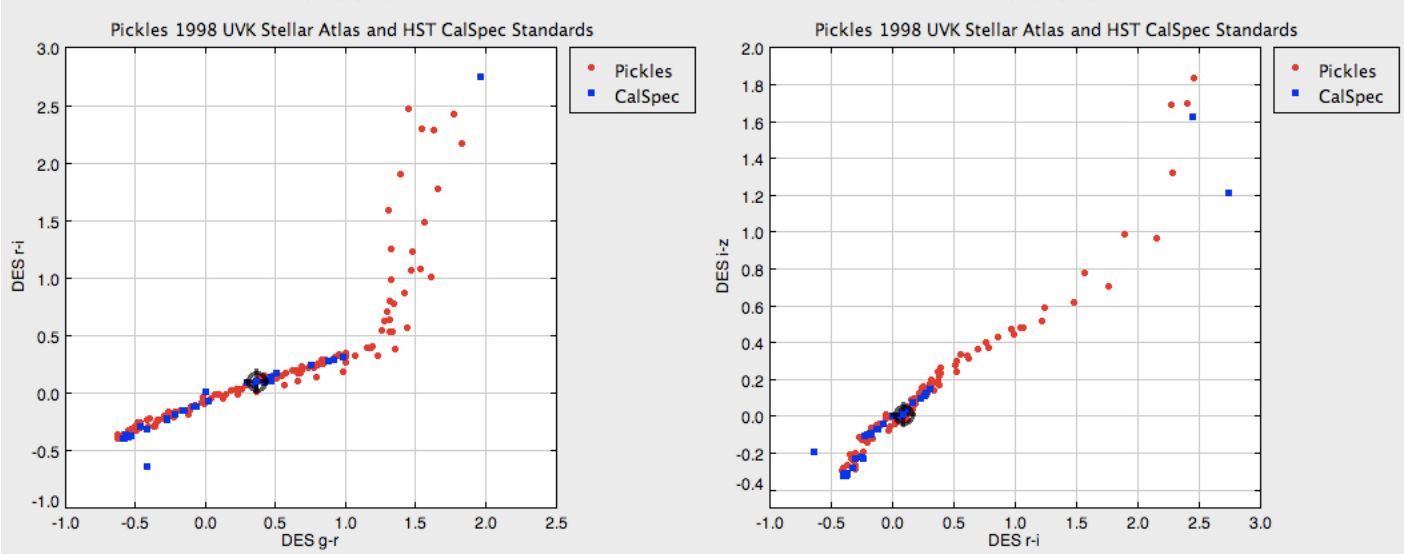

= C26202

DES grizY vs SDSS griz + UKIDSS Yab

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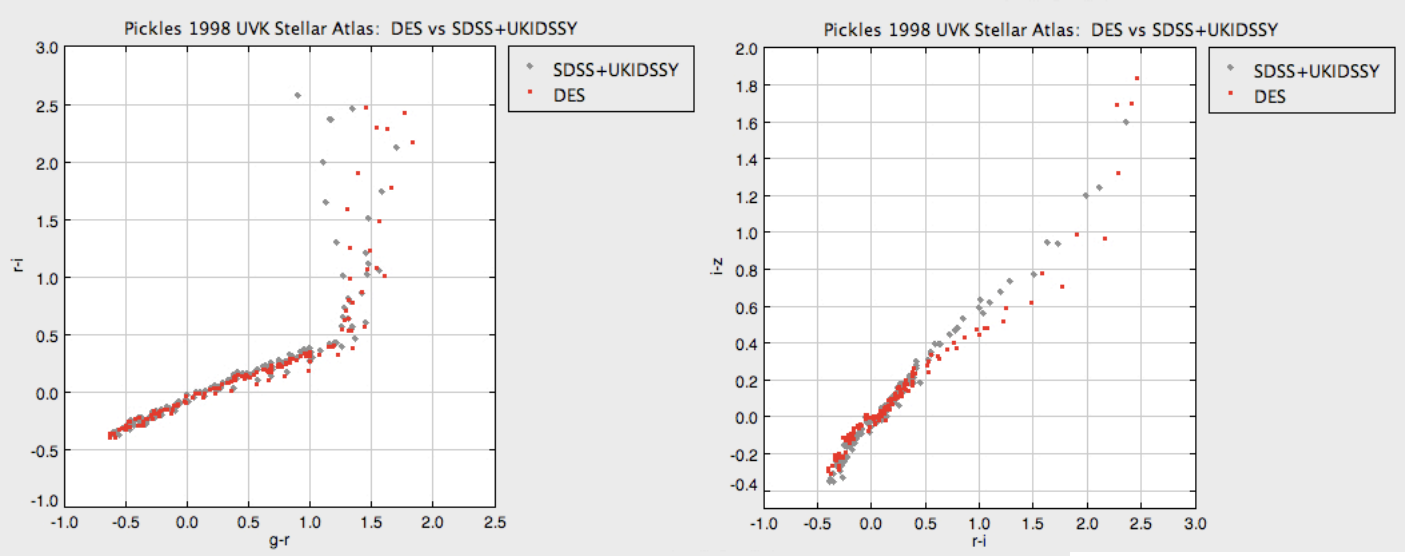
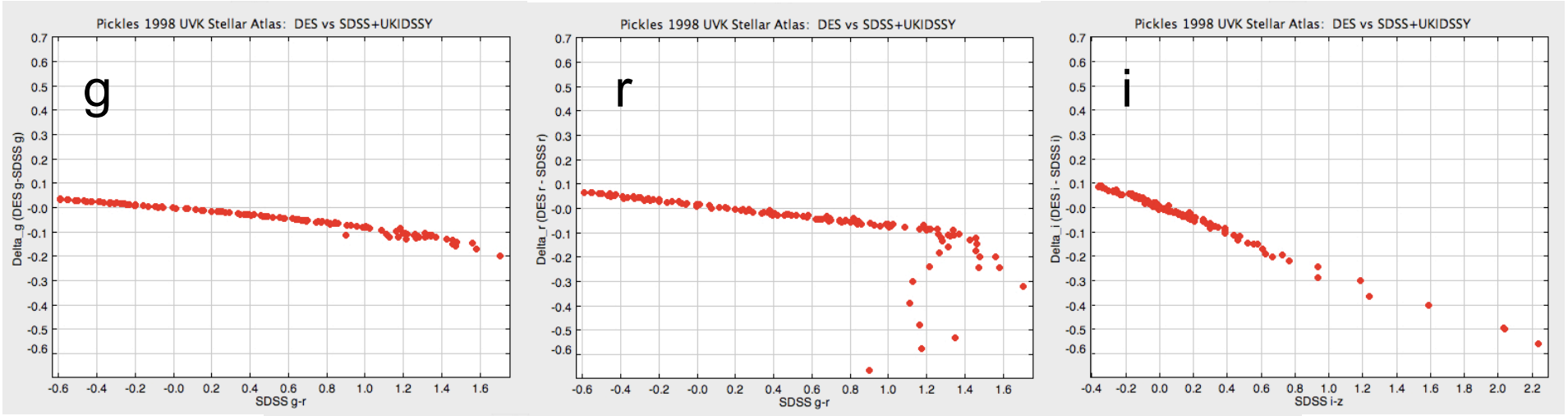
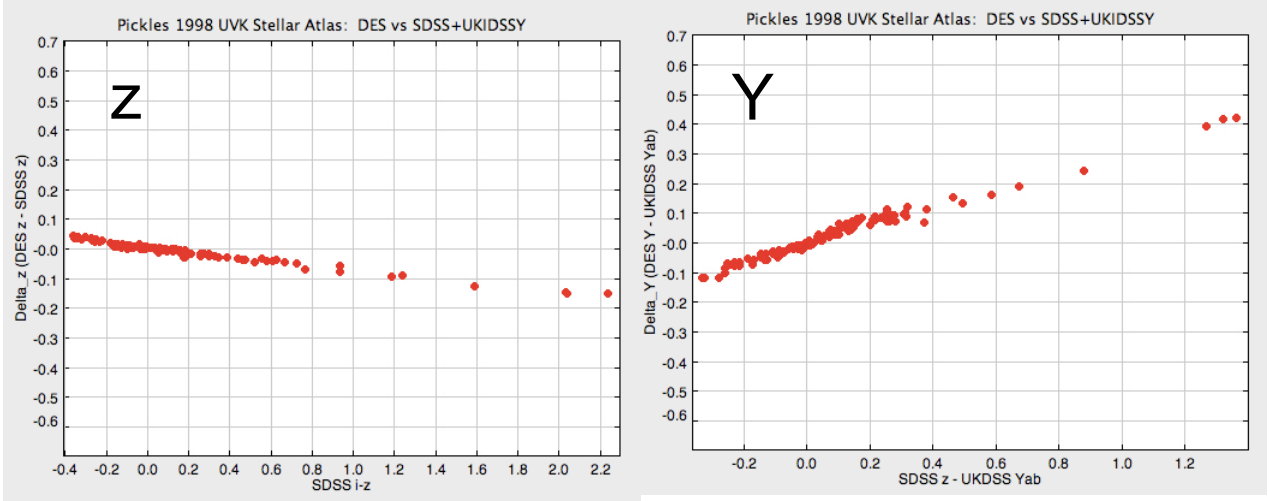


DES grizY vs SDSS griz + UKIDSS Yab

DARK ENERGY SURVEY





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SDSS/UKIDSS → PreCam DES grizY Transformation Equations (g-r < 0.8)

- SDSS g → PreCam DES g:

$$g_{precam} = g_{sdss} - 0.0055 - 0.0659x(g-r)_{sdss} - 0.0115x(g-r)_{sdss}^{2}$$

- SDSS r → PreCam DES r:

$$r_{precam} = r_{sdss} + 0.0102 - 0.0876x(g-r)_{sdss}$$

- SDSS i → PreCam DES i:

$$i_{precam} = i_{sdss} - 0.0009 - 0.2522x(i-z)_{sdss}$$

- SDSS z → PreCam DES z:

$$z_{precam} = z_{sdss} - 0.0011 - 0.0893x(i-z)_{sdss}$$

- UKIDSS Yab → PreCam DES Y:

$$Y_{precam} = Y_{ab,ukidss} - 0.0046 + 0.3428x(z_{sdss} - Y_{ab,ukidss})$$

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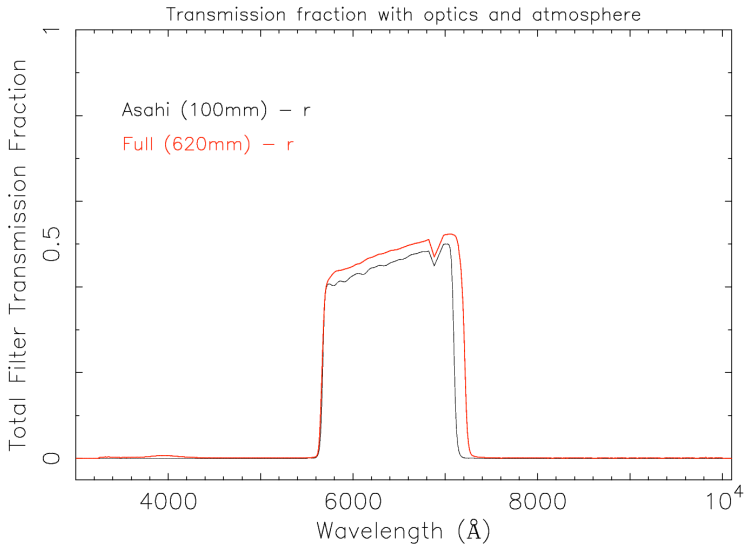
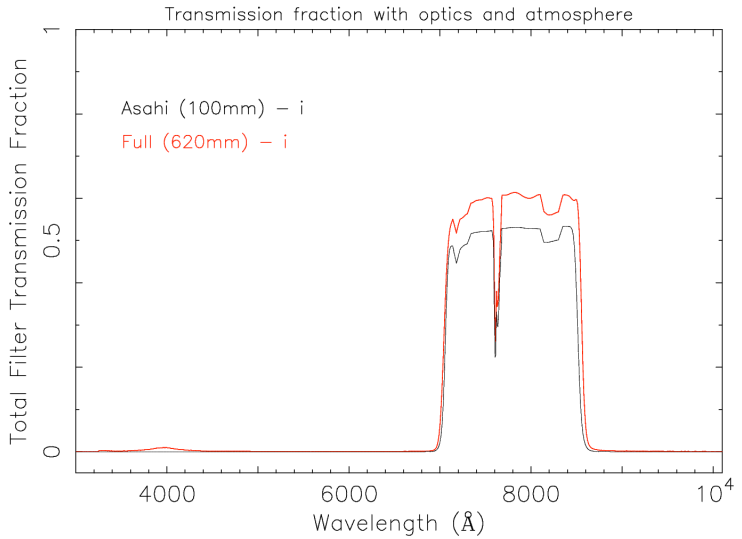
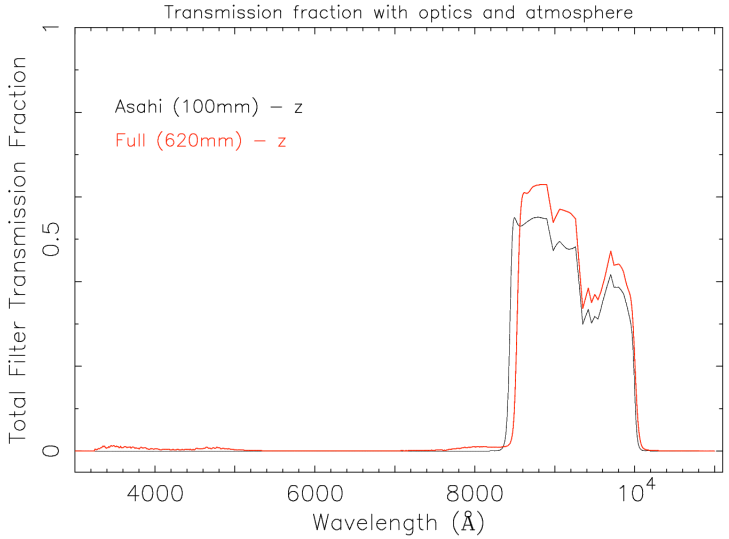
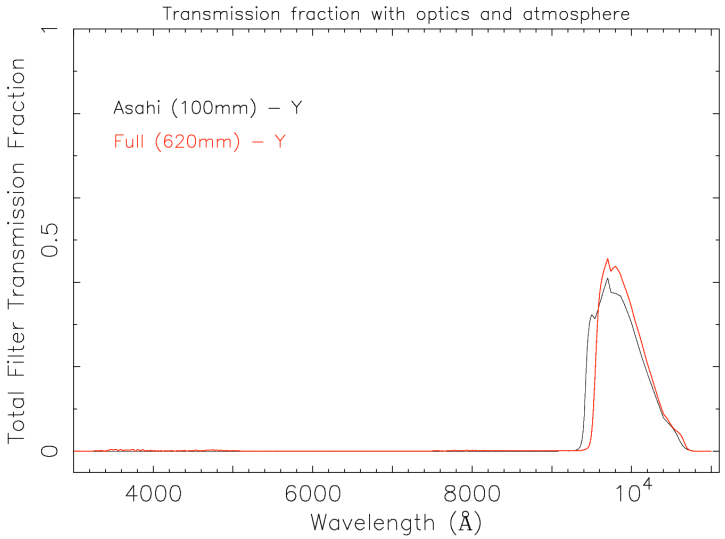
Updated Filter Curves
(David James, DES-doc#6229)









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Standard Stars: WD “Bronze” Sample

1. Calculate synthetic DES griz(Y) mags of all identified DA WDs with SDSS spectroscopy or equivalent (e.g., from the ARC3.5m program) that lie within the DES footprint.
   a) Particularly within the Year 1 footprint.
   b) Variation of Batchelor python code.

2. Identify any Bronze Sample DA WDs in the PreCam fields (→ absolute color calibration of PreCam data).

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Standard Stars: PreCam

1. Finish Global Relative Calibration (including tests).

2. Use any HST CalSpec Standards and Bronze Sample DA WDs in the PreCam footprint to refine Global Absolute Calibration of PreCam photometry.

3. Refine PreCam astrometry.

4. Combine multiple observations for each star to produce a set of standard stars.

5. Finalize/refine SDSS-DES griz and UKIDSS-DES Y transformation equations using PreCam photometry in Stripe 82.

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Standard Stars: SDSS Stripe 82

1. Re-generate Stripe 82 standard stars using DR8 coadd data?

2. Use PreCam-generated SDSS → DES griz transformation equations to transform SDSS Stripe 82 standards into the DES photometric system.

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Standard Stars: Southern u'g'r'i'z'

(http://www-star.fnal.gov/Southern_ugriz/index.html)

1. Brighter than Stripe 82 standards (typically r < 17).

2. Use newest version of Southern u'g'r'i'z' catalog. (Also USNO v3 u'g'r'i'z; catalog?)

3. Use USNO u'g'r'i'z' → SDSS ugriz and PreCam-generated SDSS → DES griz transformation equations to transform Southern u'g'r'i'z' standards into the DES photometric system.

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Standard Stars: BCS Fields

(http://cosmology.uiuc.edu/BCS/)

1. Lower grade than Stripe 82, but probably good enough for DES Year 1.

2. Two 50-sq-deg fields within the DES SPT area in SDSS griz and centered at:
   a) RA = 23^h00^m, DEC = -55°12’
   b) RA = 05^h30^m, DEC = -52°47’

3. Use PreCam-generated SDSS → DES griz transformation equations to transform BCS standards into the DES photometric system.

Standard Stars: UKIDSS LAS Fields

(http://www.ukidss.org/)

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1. UKIDSS Y-band in SDSS Stripe 82.
   a) UKIDSS Y is in the Vega mag system
   b) To transform to the AB mag system: $Y_{AB} = Y_{Vega} + 0.634$.
   c) Not the highest grade standards, but OK for DES Year 1

2. Use PreCam-generated UKIDSS → DES Y transformation equations to transform UKIDSS standards into the DES photometric system.
   a) Large transformation coefficient between UKIDSS Y_{AB} and DES Y.

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Standard Stars: Interface with DESDM

1. Create a new table in the DESDM database with the same schema as STANDARD_STARS (current table, which contains untransformed SDSS Stripe 82 and Southern u'g'r'i'z' standards). Call it STANDARD_STARS_YEAR1?

2. Incorporate the full set of standards from the previous slides into STANDARD_STARS_YEAR1.

3. Might need a trimmed version for quick matching for nightly photometric solutions.

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DESDM Software: Photometric Standards Module

1. This is the module that performs the nightly solutions.

2. It is mature code, in use since Data Challenge 1.

3. Some minor updates have been requested.

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DESDM Software: Global (Relative) Calibrations Module

1. This module uses stars in the overlaps between images to calculate relative zeropoints offsets. (There is also coadd_calczp.)

2. Speeding up the matching algorithm is the main problem at the moment.
   a) Oracle Spatial Functions (Todd Tomashek).
   b) Mangle Mask
   c) STILTS (for flat files)

3. Other improvements would be good, but perhaps not critical for DES Year 1.

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DESDM Software: Star Flat Solver

1. A version of the Photometric Standards Module does a simplistic solution for the star flat. It requires a field of known standards (e.g., SDSS Stripe 82)

2. Another version of the code, incorporating the Manfroid (1995, 1996) algorithm would be very useful for on-sky commissioning. This could be pretty easily written in python.

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DESDM Software: Stellar Locus/ “Zhed Point” QA

1. We need a QA test based on the Stellar Locus or “Zhed Point”.

2. Bob Armstrong did work in the area a couple years ago, but more along the lines of implementing a Stellar Locus Regression calibration tool.

3. A python-based script to do quick-and-dirty stellar locus or “Zhed point” QA (much simpler than an SLR calibration tool) should be fairly quick and easy to implement.

DESDM Software: Stellar Locus Regression

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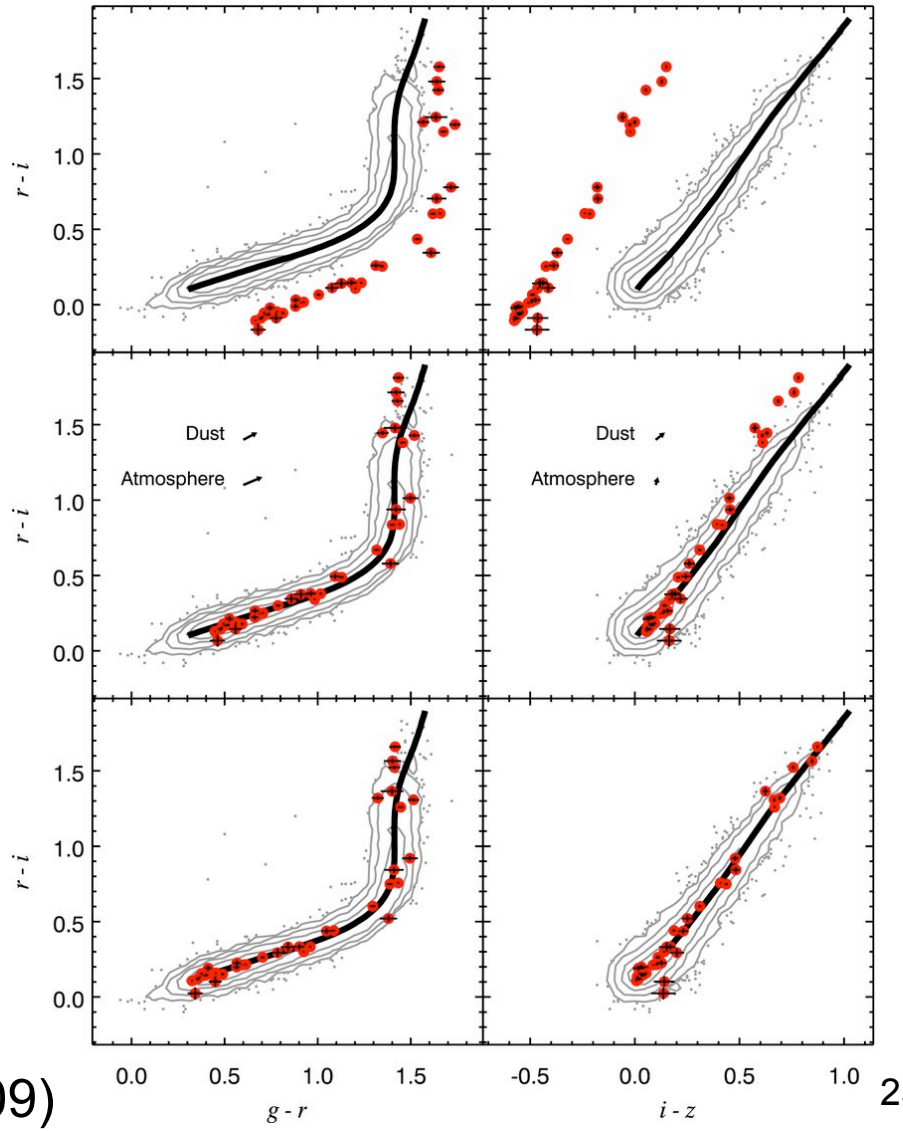
1. Use as a primary calibration strategy for DES First Year in conjunction with Global Zeropoint Calibrations.

2. Demote calibration using nightly standards.



High et al. (2009)

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DECal

1. This is mostly in hand.

2. Some work by SISPI, TAMU, William Wester, & Marcelle Soares-Santos to transfer data and create response curves.

3. See talk by William and Marcelle (DES-doc#6160).

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Final Plans for On-Sky Commissioning

1. See Alistair's "DECam Commissioning Plan (DES-doc#3734-v13), in particular Sections 6.9 ("Night Time Commissioning – Photometry and Astrometry) and star flats.

2. Alistair will be at Fermilab the week of April 16-20 for the Calibration Conference and this will be a good time to iterate on final plans for on-sky calibrations commissioning.

3. Need to define set of twilight standard star fields for ObsTac.

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Contacts with Other Surveys

1. There are several other imaging surveys, both ongoing and upcoming, that use similar filters and and overlap the DES.

2. It would be useful to make contact with these other surveys for cross-comparisons of each other's calibrations.

3. This is one of the purposes behind the April 16-19 Calibrations Conference at Fermilab:

   https://indico.fnal.gov/conferenceDisplay.py?confId=4958.

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Extra Slides