

DESpec: Science Goals & UK Perspective



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The Landscape of Surveys 2011-2020

(some under construction, some proposed)

Photometric surveys: DES, VISTA, Pan-STARRS, HSC, Skymapper, PAU, LSST, ...

Spectroscopic surveys: WiggleZ, BOSS, e-BOSS, BigBOSS, DESpec, HETDEX, Subaru/Sumire, 4MOST(VISTA), SKA, ...

Space Missions: Euclid vs. WFIRST

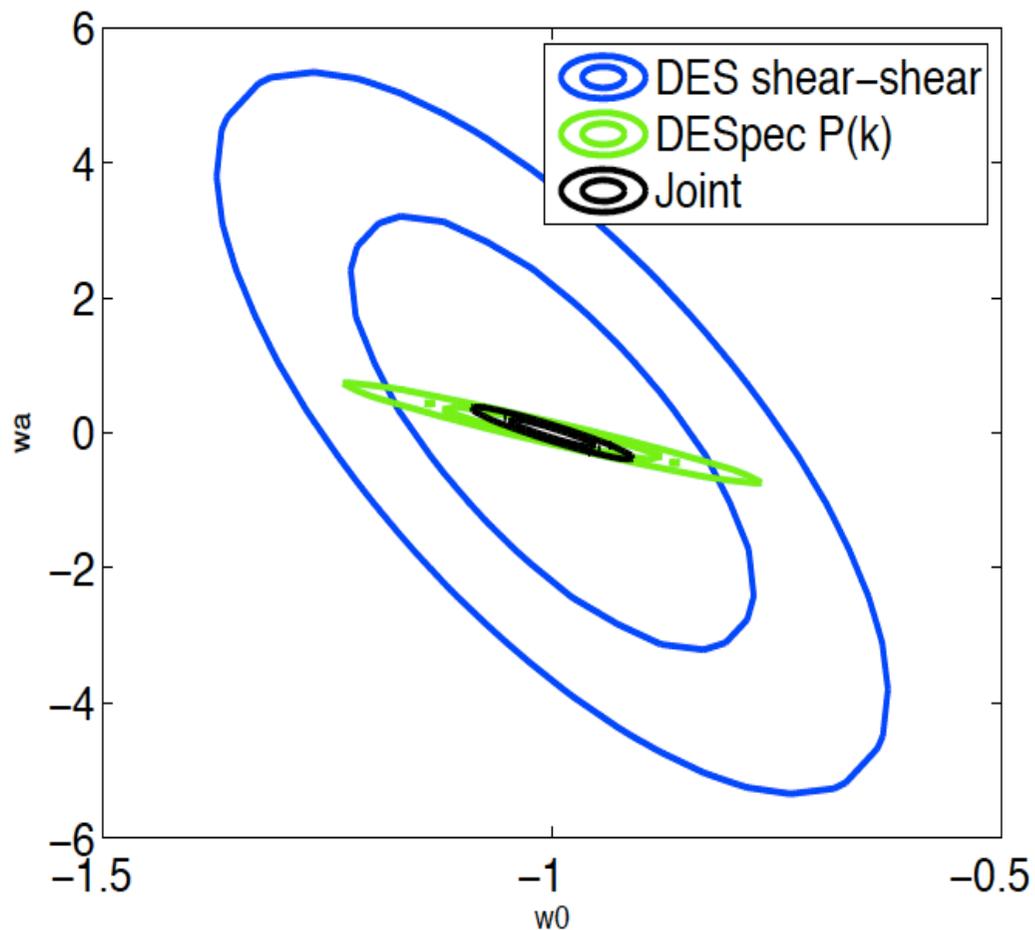
DESPEC: Spectroscopic follow up of DES

- Proposed Dark Energy Spectrometer (DESPEC)
- 4000–fibre \$40M instrument for the 4m Blanco telescope in Chile, using DES optics and spare CCDs
- 10 million galaxy spectra, target list from DES, powerful synergy of imaging and spectroscopy, starting 2017-18
- Spectral range approx 550 to 1000nm, $R=3500$
- DES+DESPEC can improve DE FoM by 3-6, making it DETF Stage IV experiment
- DES+DESPEC can distinguish DE from ModGrav
- Participants: current international DES collaboration
+ new teams

DESPEC: benefits per probe

- **Photo-z/spec TF:** better photo-z calibration
- **LSS:** RSD and radial BAO, FoM improved by several (3-6)
- **Clusters:** better redshifts and velocity dispersions, FoM up by several
- **WL:** little improvement for FoM (as projected mass, but may help with IA)
- **WL+LSS:** offers a lot for both DE and for ModGrav
- **SN Ia:** spectra of host galaxies and for photo-z training, improving FoM by 2
- **Galaxy Evolution:** galaxy properties and star-formation history
- **Strong Lensing:** improved cluster mass models

DES(WL) + DESpec(LSS)



10 million spectra
with uniform
density over
 $0.2 < z < 1.7$

Note these are
sensitive to
assumed priors

DESPEC activities in the UK



- UCL hosted a meeting on 7-8 March 2011
- Portsmouth is hosting one on 27 June 2011
- Ongoing design studies for both science and instrumentation
- Contribution to DESPEC White Paper (in preparation)

Funding Request from STFC

Sol and presentation to PPAN, April 2011

- £1.5M total to cover:
- C5+C6 (material+polishing+coating):300k
- ADC: 800k
- Mounting: 200k
- Contingency: 200k
- Timeline years 1-4: 300k, 700k, 300k, 200k

- Participating UK universities: UCL, Portsmouth, Cambridge, Edinburgh, Sussex and Nottingham + more
- Cf. £1.76M awarded by STFC for DES Optical Corrector

Ongoing R&D studies for DESPEC+DES

- Standard DE FoM with careful attention to k-range, systematics and to priors, including Planck
- Modified Gravity vs. DE (new metrics needed) and neutrino mass (possible detection if ~ 0.1 eV)
- Impact of spectral range and resolution on the probes
- Optimal survey strategy
- Quantify the benefits of same sky (phase correlations) for DES and DESPEC: control galaxy biasing and cosmic variance
- Design of optics, spectrograph and fibre positioner
- Impact of DESPEC on future surveys (e.g. LSST and Euclid)

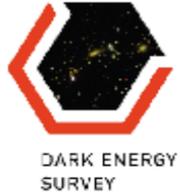
DESpec and BigBOSS

- In an ideal world, both should be built, esp covering north and south (cf. benefits of parallel projects - 2dF and SDSS, or the two SNIa teams).
- They have comparable area+depth per unit time; DESpec with higher fibre density, BigBOSS with larger FoV and larger optics.
- Both subject to NSF review (by 2012) of NOAO portfolio (incl telescopes), and to the DOE process (cf. DES).
- Shared R&D process is beneficial (e.g. UCL is involved in optics studies for both) – cooperation rather than competition.

DESpec – Summary

- DESpec – natural extension to DES
- DES+VHS and later LSST will provide the target list
- DESpec inter-changeable with DECam
- Imaging and Spectroscopy on same part of the sky - great science benefits
- DESpec is 'cheap' (\$40M) relative to others
- Request from STFC is modest (£1.5M)
- DES Science and Instrumentation teams already in place, and discussions eg with AAO, JPL/Caltech etc.

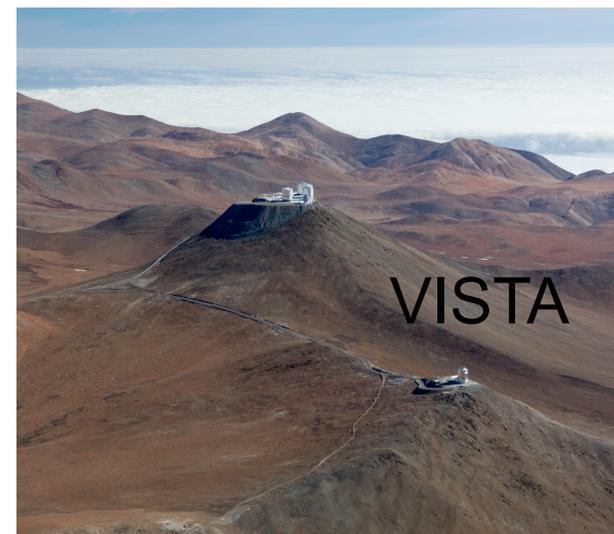
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The Dark Energy Survey

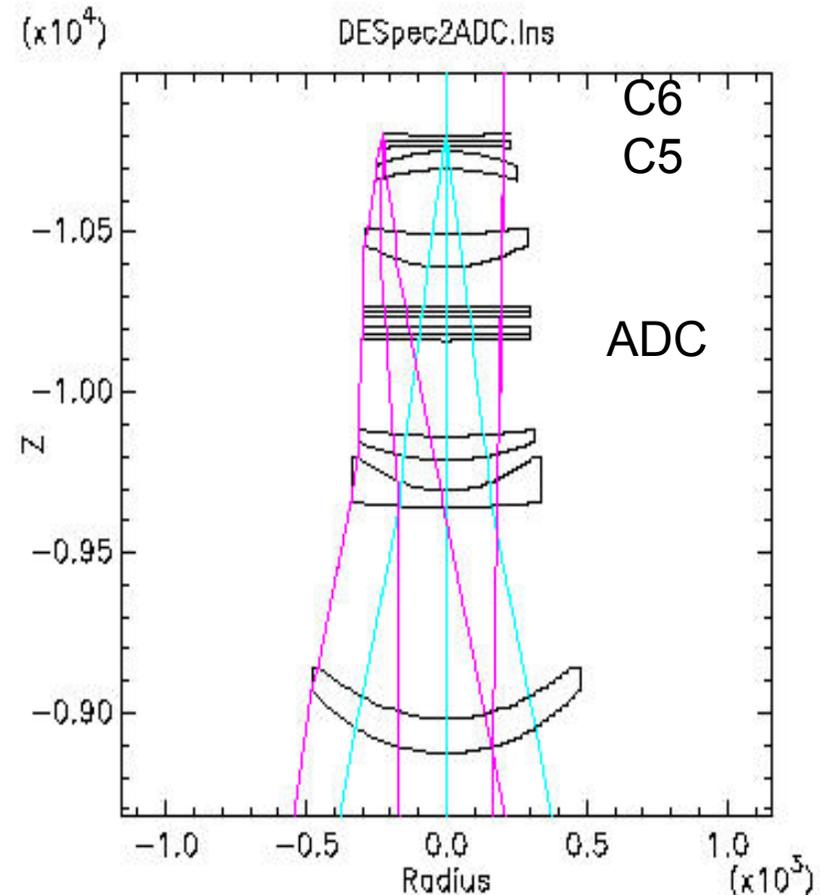
- 4 complementary techniques
 - Cluster Counts
 - Weak Lensing
 - Large Scale Structure
 - Supernovae Ia
- 8-band survey
 - 5000 deg² *grizY* + *JHK* from *VHS*
 - 300 million photometric redshifts
 - +SPT SZ clusters

Survey 2012-2017 (525 nights)



DESpec Instrumentation

- Build on DECam corrector
- 2 new lenses: C5 and C6
- Atmospheric Dispersion Corrector (ADC)
- 4000 fibres, FoV 3.8 sq deg
- Fibre positioners: e.g. JPL's Cobra or AAO's Echidna
- Spectrograph design based on Hetdex VIRUS
- Spare DECam CCDs at hand
- Most of the DESpec optics already exists from DECam
- Low cost, low risk experiment



Based on work by
T. Diehl and S. Kent

Total Neutrino Mass

DES+Planck vs. KATRIN

$M_\nu < 0.1 \text{ eV}$ $M_\nu < 0.6 \text{ eV}$



Lahav, Kiakotou, Abdalla and Blake (2010) 0910.4714

Expect DESpec+DES+Planck can reach the lower limit from Physics experiments (0.05 eV), i.e detection of neutrino mass