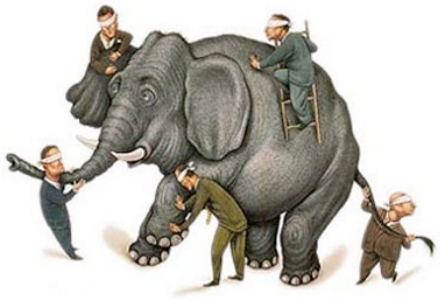
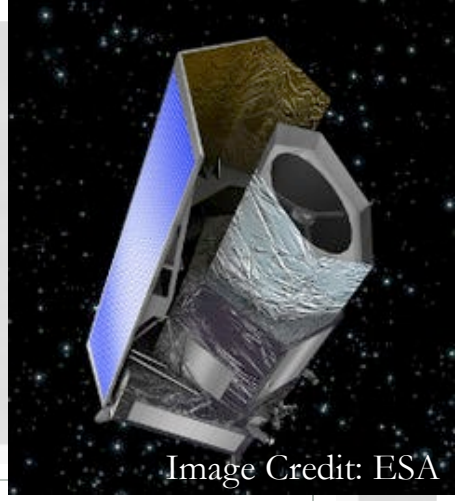


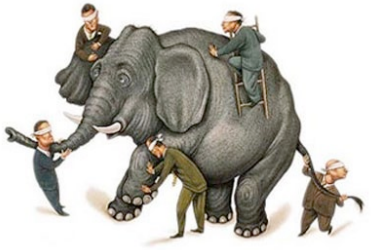


PHYSPAG JANUARY 2015
DARK ENERGY UPDATE

RACHEL BEAN (CORNELL UNIVERSITY)

Image Credit: NASA/GSFC

A single survey can't give the full dark energy picture



- Trade offs in
  - Techniques (SN1a, BAO,RSD, WL, Clusters + lensing, peculiar motions, positions)
  - Photometric speed vs. spectroscopic precision
  - Angular and spectral resolution
  - Astrophysical tracers used (LRGs, ELGs, Lya/QSOs, clusters)
  - Epochs, scales and environs being studied (cluster vs dwarf galaxies)

- Much more than a DETF FoM:
  - Astrophysical & instrumental systematic control mitigation not so easily summarized.
  - Readiness vs technological innovation
  - Survey area vs depth - repeat imaging, dithering, cadence and survey area overlap/config.

- WFIRST and Euclid are distinct and highly complementary, with each other and with
  - ground based LSS surveys (LSST, DESI and others)
  - Planck and ground-based CMB gravitational lensing measurements

Summary

Now & near term: e.g. DES, HSC; BOSS, eBOSS, PFS; J-PAS, JWST; Planck, ACT+, Spider, SPT+

Next generation	Euclid	WFIRST-AFTA	DESI	LSST
Starts, duration	2020 Q2, 7 yr	~2023, 5-6 yr	~2018, 5 yr	2020, 10 yr
Area (deg^2)	15,000 (N + S)	2,400 (S)*	14,000 (N)	20,000 (S)
FoV (deg^2)	0.54	0.281	7.9	10
Diameter	1.3	2.4	4 (less 1.8+)	6.7
Spec. res. $\Delta\lambda/\lambda$	250 (slitless)	550-800 (slitless)	3-4000 (N_{fib}=5000)	
Spec. range	1.1-2 μm	1.35-1.95 μm	360-980 nm	
BAO/RSD	~20-50M Hα ELGs z~0.7-2.1	20m Hα ELGs z = 1–2, 2m [OIII] ELGS z = 2–3	20-30m LRGs/[OII] ELGs 0.6 < z < 1.7, 1m QSOs/Lya 1.9<z<4	
pixel (arcsec)	0.13	0.12		0.7
Imaging/ weak lensing (0<z<2.)	30-35 gal/$arcmin^2$ 1 broad vis. band 550– 900 nm	68 gal/$arcmin^2$ 3 bands 927-2000nm		15-30 gal/$arcmin^2$ 5 bands 320-1080 nm
SN1a		2700 SN1a z = 0.1–1.7 IFU spectroscopy		10^4-10^5 SN1a/yr z = 0.–0.7 photometric

WFIRST: update

- AFTA SDT final report due this month
- Flexible observing strategy being considered
  - Deep in first 4 months on LSST deep drilling fields
    - To understand systematics in lensing and photometric redshifts
  - Cover 2200 sq deg to robustly tackle systematics, or 10000 sq deg H-band only and rely on LSST photo-zs, to aim for higher FoM but less control of systematics
  - Advantages of a big telescope can go in either direction
- Aim is 2023 launch, 2024-2028 observing

WFIRST: WFIRS2014 conference

- 210 registrants interested in broad science using WFIRST
  - Dark Energy
  - Exoplanetary
  - Milky Way + Local Group
  - Beyond the Local Group

- Lessons from current missions
  - Spitzer, Kepler, Hubble, Planck, WISE & Herschel

- Synergies with
  - Euclid, LSST, Gaia, JWST, VLASS, HSC, and others

WFIRST: ROSES WFIRST Preparatory Science

- Covered all areas of WFIRST science
  - including supernovae, galaxy redshift surveys, weak lensing, exoplanet microlensing, coronagraphy, and other surveys & GO science.
- Supporting development of WFIRST-centered simulations and models.
- 53 Proposals received on July 11 2014
- Selections have been made. Expectation (in November) was ~12 proposals to be funded, total $1.8M in first year.

WFIRST: funding/support status

- FY14 appropriation ($56M) and FY15 request ($50M) supports technology development for detectors and coronagraph, and Agency/ Administration decision for formulation to begin FY 2017, should funding be available.

- Funds will also support assessment of the 2.4m telescopes, mission design trades, payload accommodation studies, and observatory performance simulations.

- NASA decision not expected on new start before early 2016

Euclid: NASA Science Center at IPAC

- NASA has established the Euclid NASA Science Center at IPAC (ENSCI) to support US-based investigations using Euclid data.

- ENSCI will
  - Participate in the Euclid Consortium's Science Ground Segment to "learn by doing"
  - Support the US research community by providing expert insight into the Euclid surveys, data processes, calibration, and products.
  - Host an archive of detector characterization data

For more details, see http://euclid.caltech.edu

Euclid: instrument and US team updates

- Both instruments VIS (visible) and NISP (Near Infrared Spectrometer and Photometer) had successful reviews in the past year.
- Yun Wang is Deputy Lead for the Galaxy Clustering Work Group.
- Number of US Euclid team members now leading key work packages.
- Euclid scheduled for 2020 launch.

Some ground based updates

- DES:
  - analyzing year 1 data
- DESI:
  - P5 report supports, "Build DESI as a major step forward in dark energy science, if funding permits"
  - Passed DoE CD-1 in September
- HSC:
  - taking data with 0.6 arcsec seeing.
- LSST:
  - August 1, NSF authorized construction with $27.5M in FY14 and a budget plan through 2022 within a $473M overall budget cap.
  - highly ranked DoE P5
  - Dark Energy Science Collabor[n]

WFIRST and Euclid play critical roles in the advancement of our understanding of dark energy

- Theory has advanced, don't presume a strong theoretical prior a-priori
  - Data will be good enough to test beyond w=-1 or w0-wa
  - Investigate growth and expansion history, in a more general way

- Search for a diverse array of signatures:
  - Geometry and inhomogeneity across multiple epochs
  - Multiple tracers sampling distinct gravitational environments
  - Probe non-linear regimes (more modes + gravitational screening)

- Recognizes importance of complementarity
  - to maximize cosmological discovery and systematic control in realizing survey potential