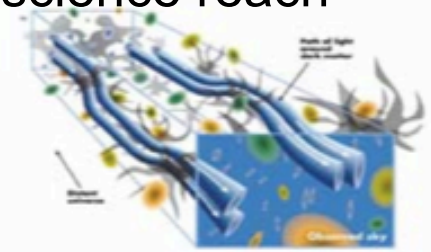
Probes of Dark Energy

Multiple techniques complementary in systematics and in science reach

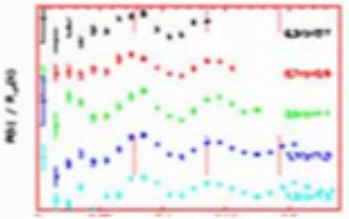
Cosmic Shear
WL

Evolution of dark matter perturbations
Angular diameter distance
Growth rate of structure



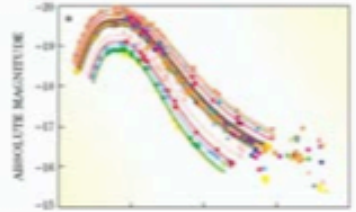
Baryon Wiggles
BAO

Standard ruler
Angular diameter distance



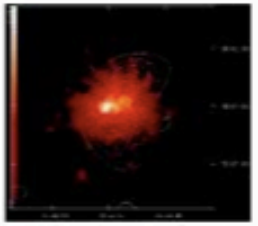
Supernovae

Standard candle
Luminosity distance



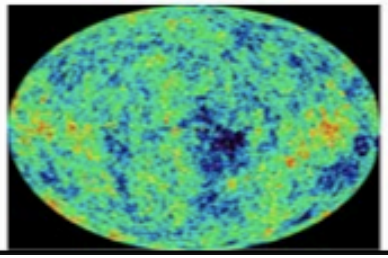
Cluster counts

Evolution of dark matter perturbations
Angular diameter distance
Growth rate of structure



CMB

Snapshot at ~400,000 yr, viewed from z=0
Angular diameter distance to z~1000



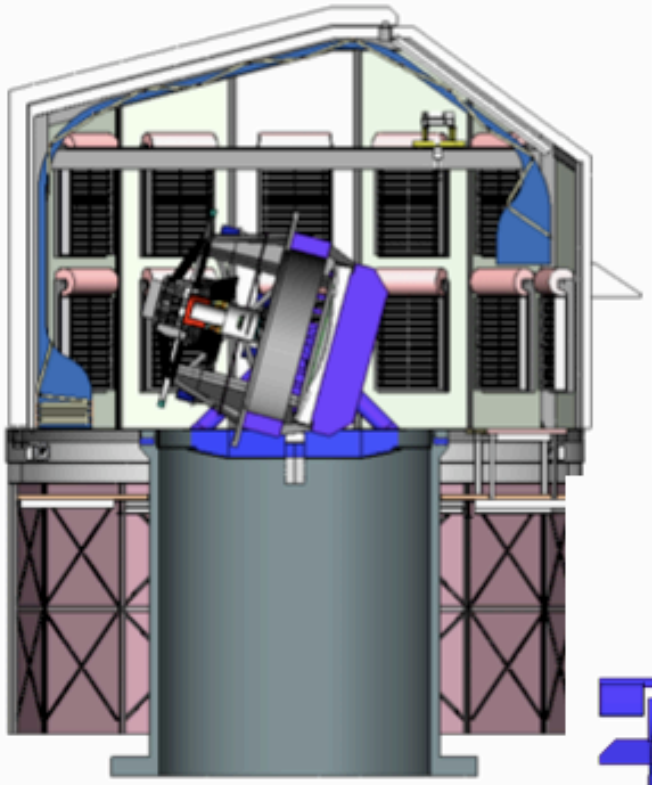
Center for Particle Astrophysics

Proposed Project Landscape circa 2008

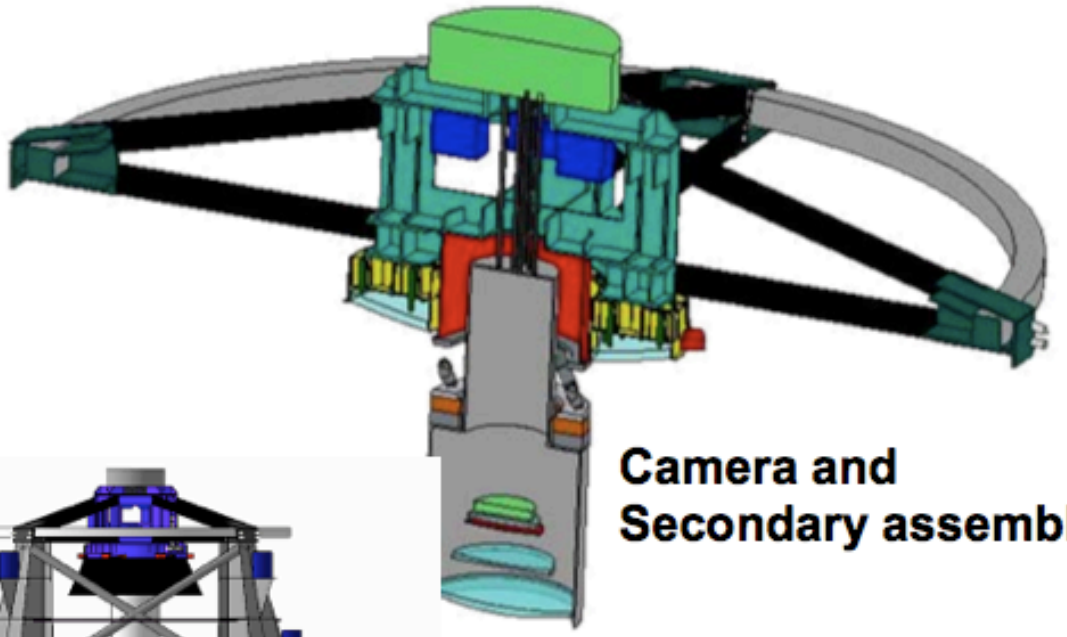
Table 3: Dark energy projects proposed or under construction. Stage refers to the DETF time-scale classification.

Survey	Description	Probes	Stage
Ground-based:			
ACT	SZ, 6-meter	CL	II
SPT	SZ, 10-m	CL	II
VST	Optical imaging, 2.6-m	BAO,CL,WL	II
Pan-STARRS 1(4)	Optical imaging, 1.8-m(×4)	All	II(III)
DES	Optical imaging, 4-m	All	III
Hyper Suprime-Cam	Optical imaging, 8-m	WL,CL,BAO	III
ALPACA	Optical imaging, 8-m	SN, BAO, CL	III
LSST	Optical imaging, 6.8-m	All	IV
AAT WiggleZ	Spectroscopy, 4-m	BAO	II
SDSS BOSS BigBoss	Spectroscopy, 2.5-m	BAO	III
HETDEX	Spectroscopy, 9.2-m	BAO	III
WFMOS	Spectroscopy, 8-m	BAO	III
SKA 21 cm	km^2 radio telescope	BAO, WL	IV
Space-based:			
JDEM Candidates			
ADEPT	Spectroscopy	BAO, SN	IV
SNAP	Optical+NIR+spectro	SN, WL	IV
DESTINY	Grism spectrophotometry	SN	IV
Proposed ESA Missions			
DUNE Euclid	Optical imaging	WL	
SPACE	Spectroscopy	BAO	
eROSITA	X-ray	CL	
Beyond Einstein Probe			
Constellation-X IXO	X-ray	CL	IV

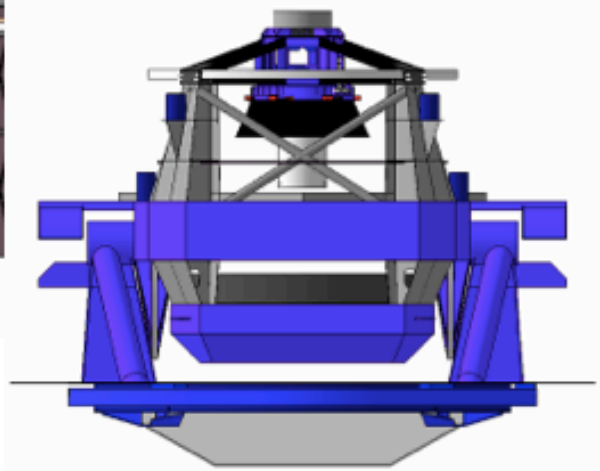
The Telescope, Mount, and Dome



Carrousel dome

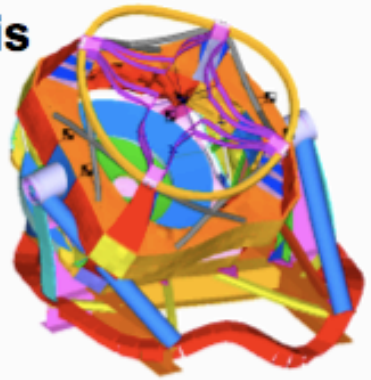


Camera and
Secondary assembly



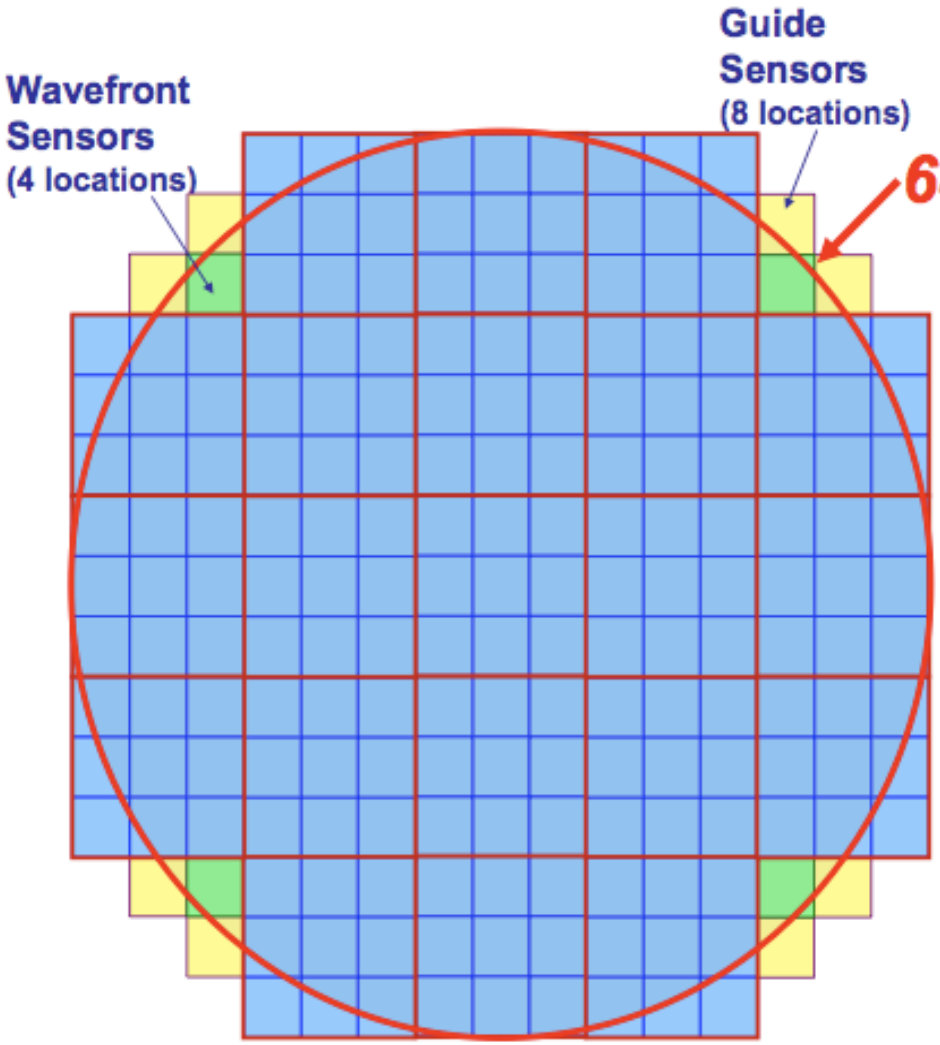
Altitude over azimuth configuration

Finite element
analysis



The LSST Focal Plane

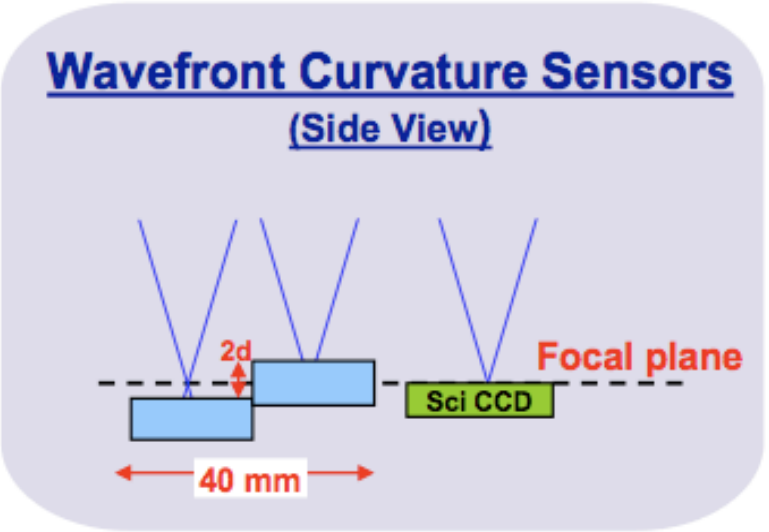
Large Synoptic Survey Telescope



64.3 cm diameter

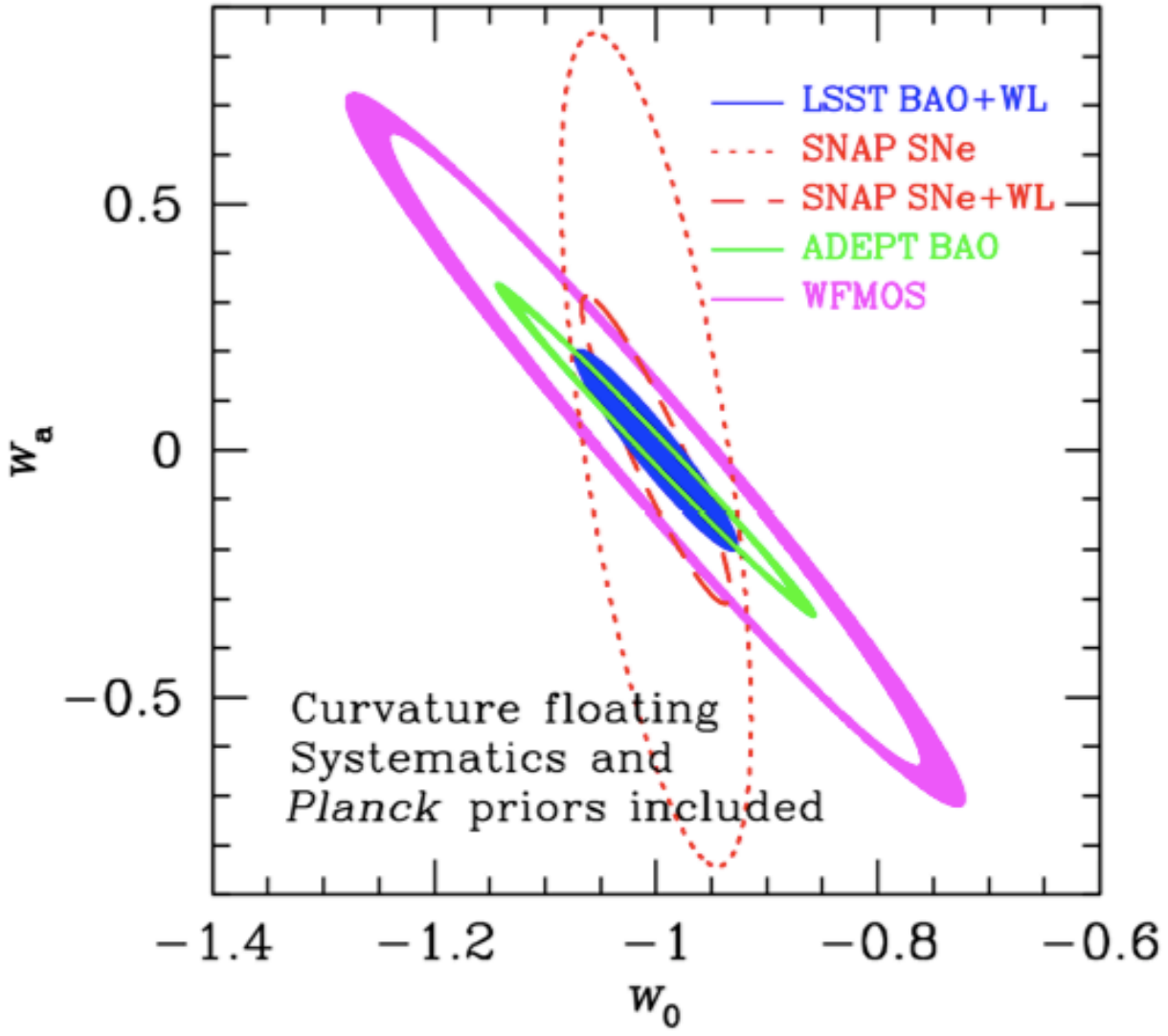
➔ **3.5 degree field of view**

➔ **9.6 square degrees/image**



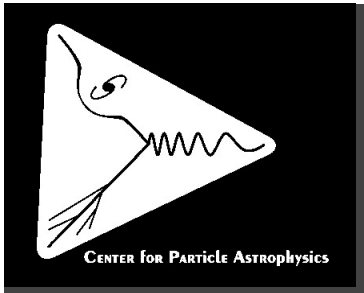
Looks a lot like DECam focal plane

Comparison of Stage-IV facilities for DE

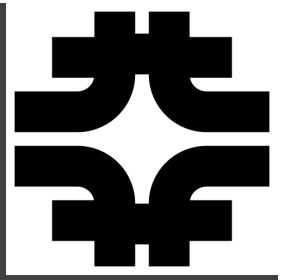


Control of systematics will be key: ground vs space

Zhan 2007



Questions & Issues



- How do we position our future efforts in an evolving geopolitical landscape?
  - Astro2010 report in August; Europe: EUCLID
  - New DOE resources in Particle Astro are limited:
    - Base program ~55M/yr; expected commitments to LSST, JDEM, TeV Gammas, Dark Matter, CMB?
- What is appropriate FNAL role/scale of effort in JDEM?
- What is the path forward for 21-cm?
- What role if any in BigBOSS? Competitive w/ or complementary to 21 cm?
- What role if any in LSST? Technical vs. scientific
- Distributed efforts in a number of projects vs. leading efforts in 1 or 2; scale of DE effort vs other Cosmic Frontier efforts