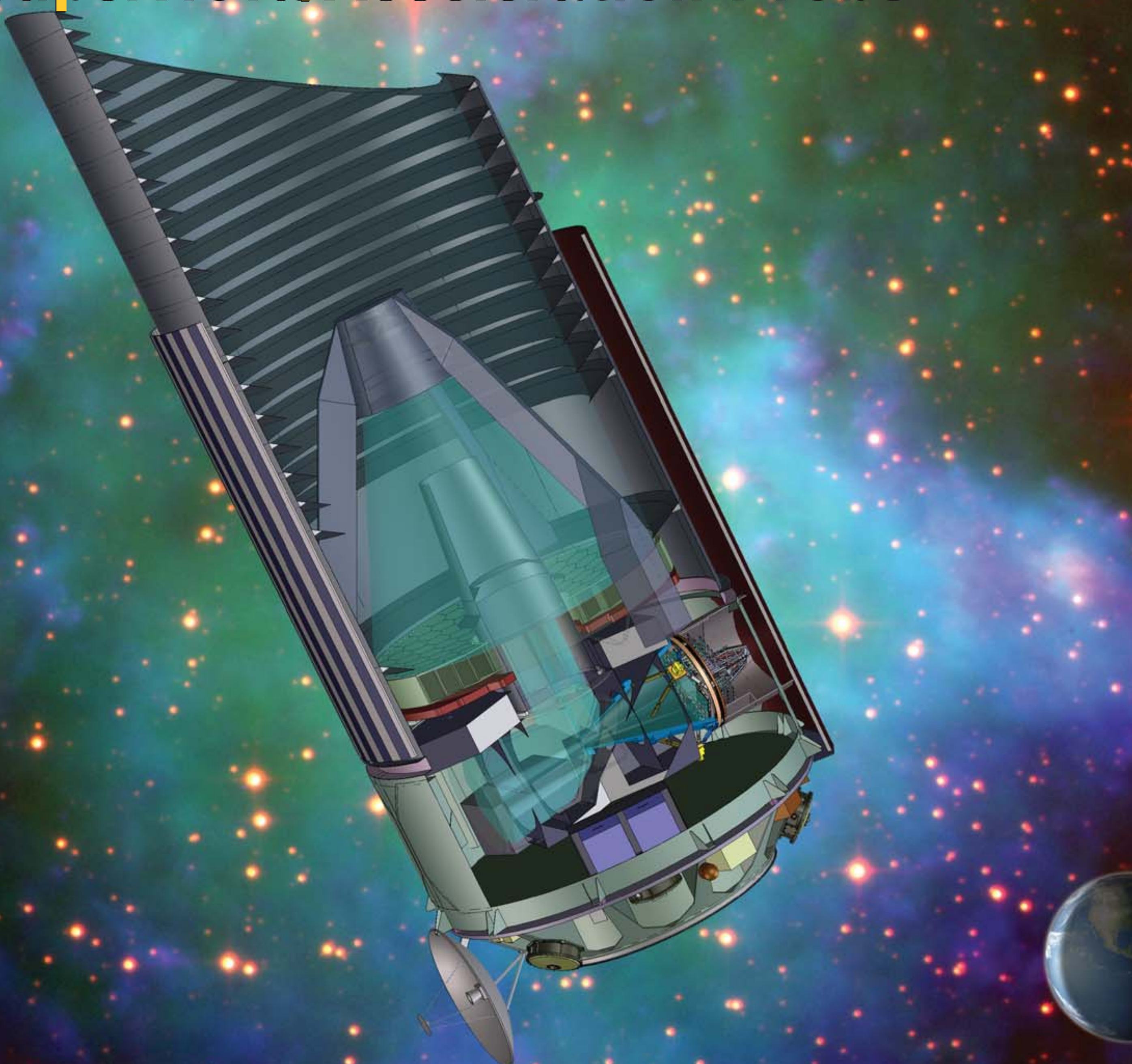
SNAP

SuperNova/Acceleration Probe



Dark Energy and the Accelerating Universe

DARK ENERGY WITH SUPERNOVAE

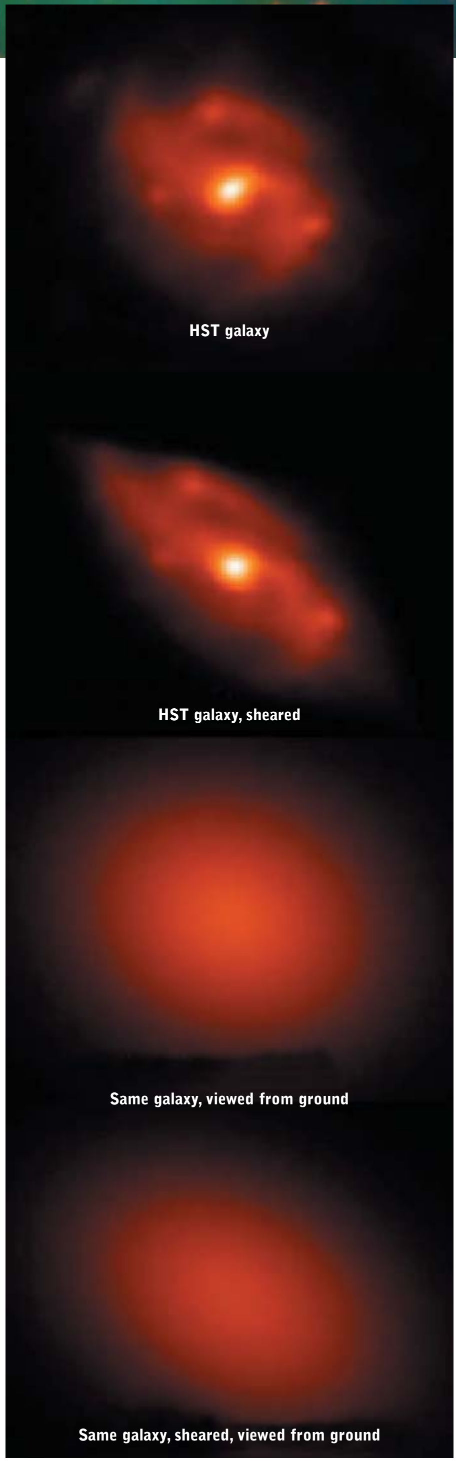
The recent discovery that the expansion of the universe is accelerating poses an exciting mystery – for if the universe were dominated by gravitational attraction alone, its rate of expansion would be slowing.

Acceleration requires a strange "dark energy" opposing this attraction. Is this Einstein's cosmological constant? Whatever the explanation, it will lead to new discoveries in astrophysics, particle physics, and gravitation.

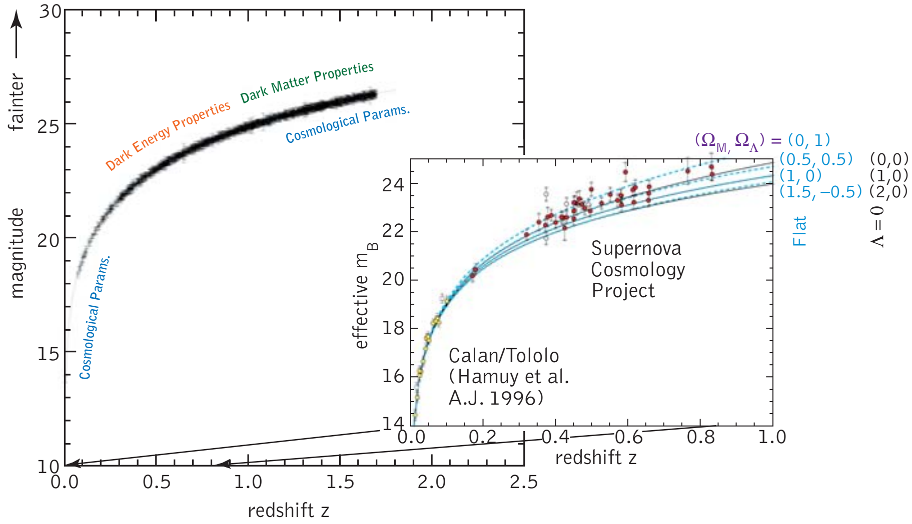
Observations of exploding stars called Type Ia supernovae, combined with other astrophysical measurements, imply that almost three-quarters of our universe must be this dark energy.

To uncover its nature, we need to find many more supernovae over a much wider range of distances, from nearby supernovae all the way out to very distant supernovae that exploded when our universe was less than 25 percent of its current age (at redshift $z \approx 2$). And we need better control over uncertainties, like intervening dust or the elemental composition of the stars that became supernovae.

Type Ia supernovae are so similar and so bright they can be calibrated to make excellent "standard candles" for measuring distance. Moreover, their energy spectra and changes in brightness over time are rich sources of information, allowing us to see small differences due to their local environments and to compare them, like to like, over the entire redshift range. Other cosmological probes, like maps of the matter distribution revealed by gravitational lensing, will combine with the supernova data to determine the precise nature of the mysterious dark energy.



▲ *A wide-field space telescope can observe galaxies with exquisite resolution over a large patch of sky. The subtle distortions in galaxy shapes — weak gravitational lensing — directly map both the visible and dark matter, as well as reveal the influence of the fundamental cosmological parameters. (Bacon, Ellis, Refreiger 2000)*



◀ *SNAP represents a third-generation experiment in supernova cosmology. The large supernova sample, broad redshift range, and high data quality will measure the cosmological parameters with unprecedented accuracy and systematic control.*

SNAP OBSERVATORY AND SCIENCE

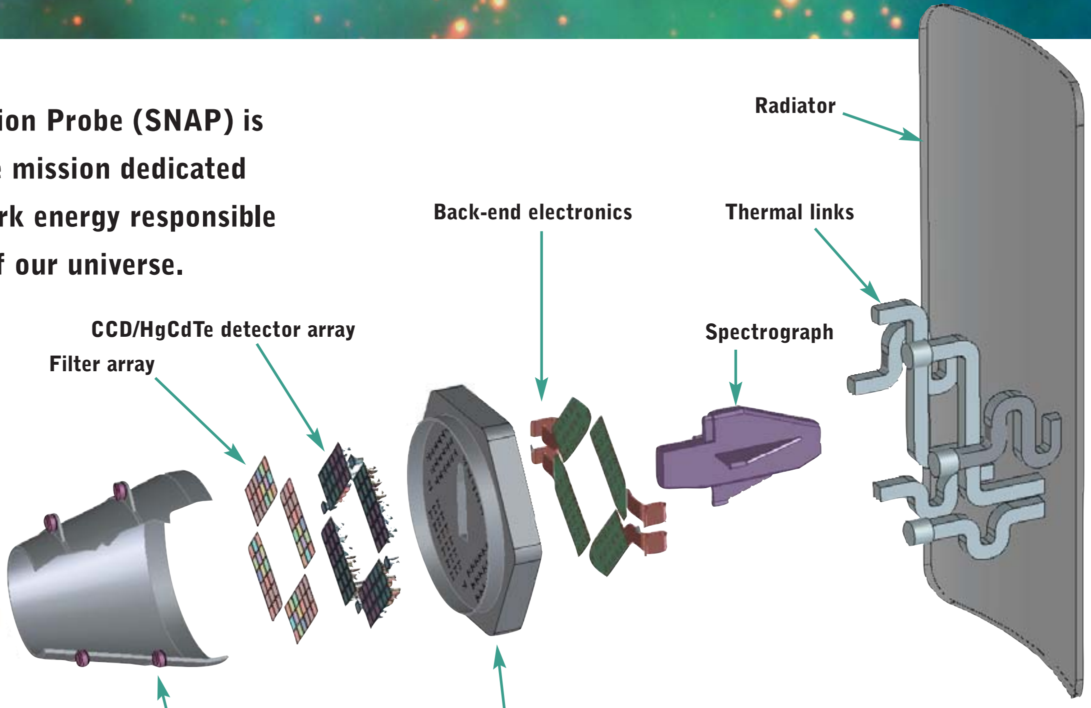
The SuperNova/Acceleration Probe (SNAP) is an international satellite mission dedicated to understanding the dark energy responsible for the accelerating expansion of our universe.

SNAP has a 2 meter telescope with a large field of view: 600 times the sky area of the Hubble Space Telescope's Wide Field Camera. By repeatedly imaging ~15 square degrees of the sky, SNAP will accurately measure the energy spectra and brightness over time for over 2,000 Type Ia supernovae, discovering them just after they explode.

In addition, the SNAP mission for precision cosmology includes an important complementary probe in a weak-lensing gravity survey. Gravitational lensing, the bending of light by massive objects, provides maps of the universe's total mass distribution, including its hidden dark matter.

Overall, SNAP will cover more of the sky, more deeply, more often, with more accuracy, and with wider wavelength coverage, than any other survey. Thus SNAP will revolutionize astronomy and uncover many surprises.

- **Multi-band, deep survey**
  - 15 sq.deg. field to *AB* magnitude ~ 30 coadded mag ~ 31, each scan ~ 28
  - 9,000 times the area of Hubble Deep Field, same resolution and ~ 1.5 magnitudes deeper
  - 1,000+ sq.deg. field to *AB* magnitude ~ 28
- **Time domain survey**
- **Synergy with James Webb Space Telescope**



▲ *A cutaway view of SNAP's image plane showing CCD and HgCdTe detector arrays, spectrograph, electronics and associated hardware. Sources sweep across each detector, providing high accuracy photometric measurements in each of nine wavelength bands. Spectroscopy near supernova peak brightness reveals supernova characteristics.*

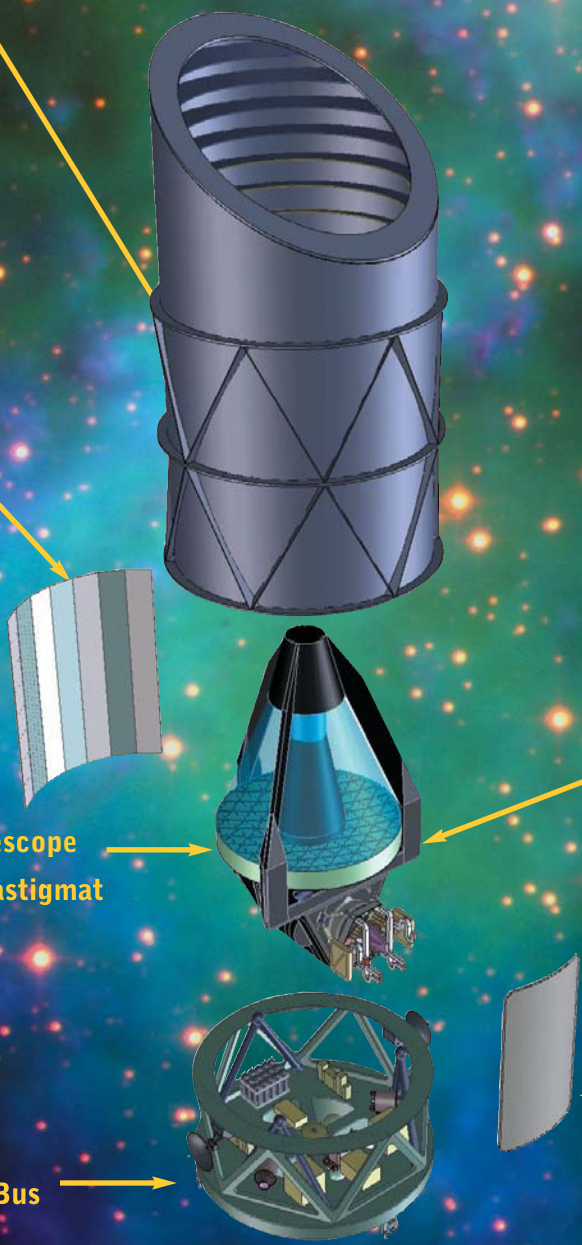
Further Science Resources with SNAP

- Galaxy structure, populations, and evolution
- Galaxy correlation function and evolution
- Rare, moving, or variable objects
- Multiply imaged sources
- Stellar distributions, populations, and evolution
- Star formation, starbursts, multicolor mapping
- Solar system studies
- Gamma ray burst afterglows
- Microlensing survey and extrasolar planet search
- Unexpected discoveries?

The SNAP project is an international collaboration headquartered at the Department of Energy's Lawrence Berkeley National Laboratory in Berkeley, California.

SNAP

The SNAP Observatory



SNAP SUMMARY

Telescope Aperture	2 meter
Optics	diffraction limited, f/10 0.1" pixel scale
Field of View	0.7 sq. degree instrumented equal CCD, NIR coverage
Wavelength Coverage	0.35–1.7 μm
Orbit	L2 halo orbit
Pointing Stability	within 0.02 arcsec, focal plane feedback

INSTRUMENTATION

Imaging Camera	half-billion pixel imager 9 fixed filters CCD detectors: high resistivity p-channel high QE from 0.35–1.0 μm low noise HgCdTe infrared devices: high QE from 0.9–1.7 μm low noise
Integral Field Spectrograph	0.35–1.7 μm low resolution R ~100

http://snap.lbl.gov

background image taken with LBNL CCD, courtesy NOAO

LBNL/PUB-938
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