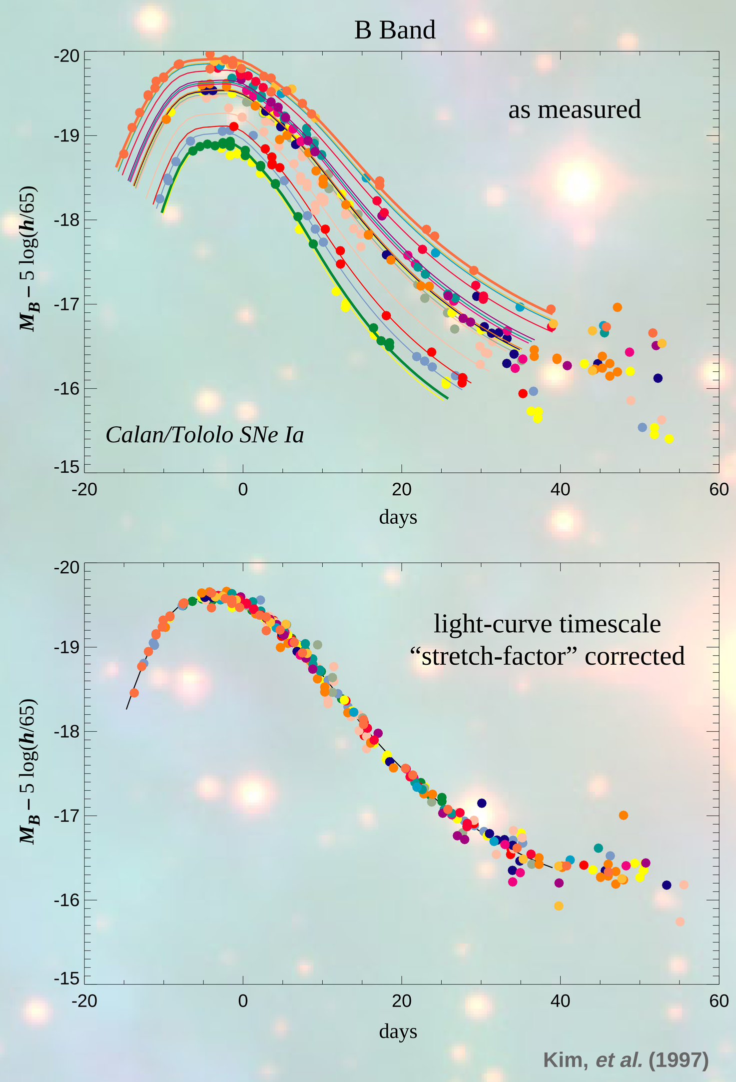
Supernova/Acceleration Probe: Cosmology With Type Ia Supernovae

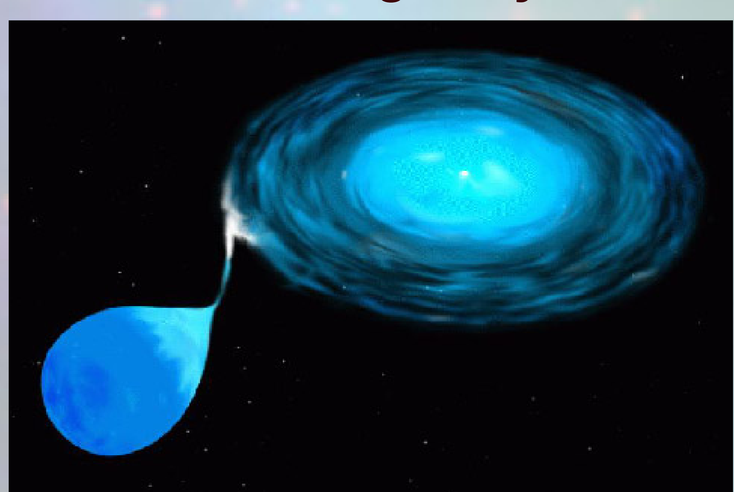
The SNAP Collaboration

http://snap.lbl.gov

Type Ia Supernovae: Bright and Homogeneous

Type Ia Supernovae (SNe Ia) are understood as being the thermonuclear explosion of a white dwarf that accretes mass from a binary companion. As the mass of the white dwarf reaches the Chandrasekhar limit, nuclear burning is triggered. The result is a standard bomb that gets as bright as the host galaxy.



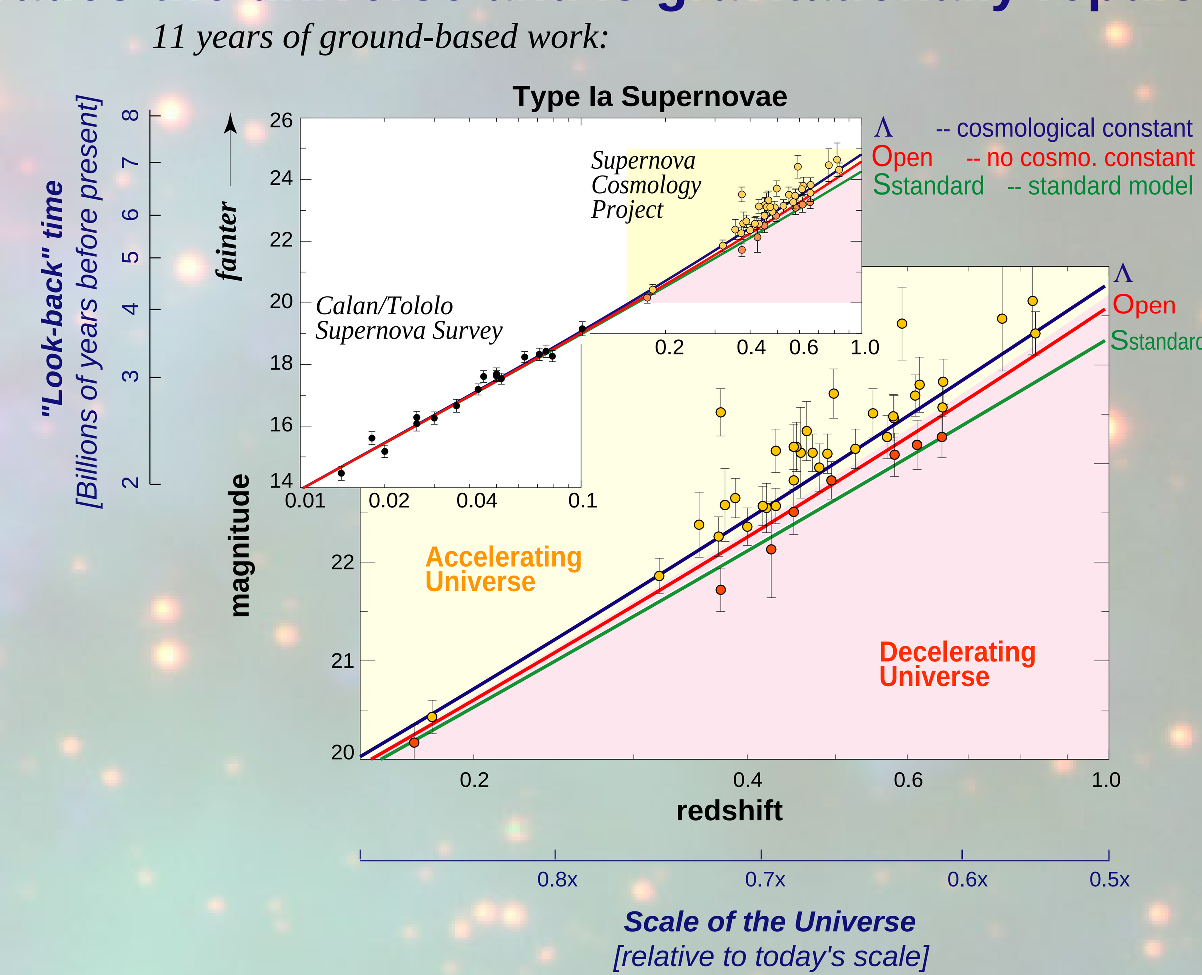


Spectra, light curves and peak magnitudes of SNe Ia are observationally homogeneous. Slight inhomogeneities correlate with peak magnitude and improve this "standard candle" to 7% in distance.

Current Results : The Accelerating Universe

The standard brightness of SNe Ia makes them ideal for measuring distances. Using SNe, the Supernova Cosmology Project and the Hi-z Team have made the startling discovery that the universe is accelerating. The conclusion is that there must be a strange form of energy - *dark energy* - that pervades the universe and is gravitationally repulsive.

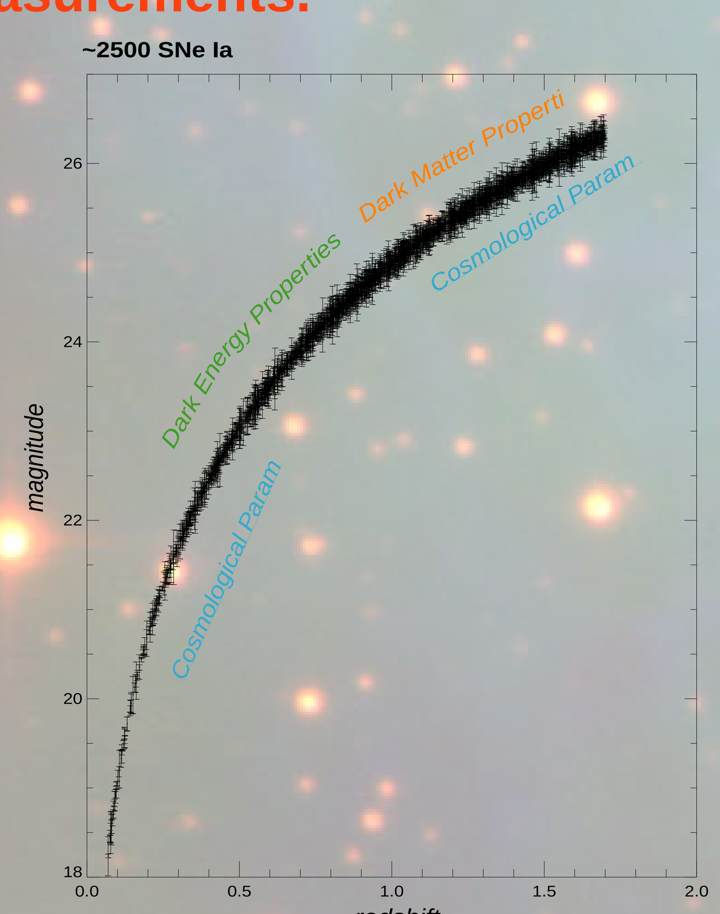
11 years of ground-based work:



Supernova Data from SNAP

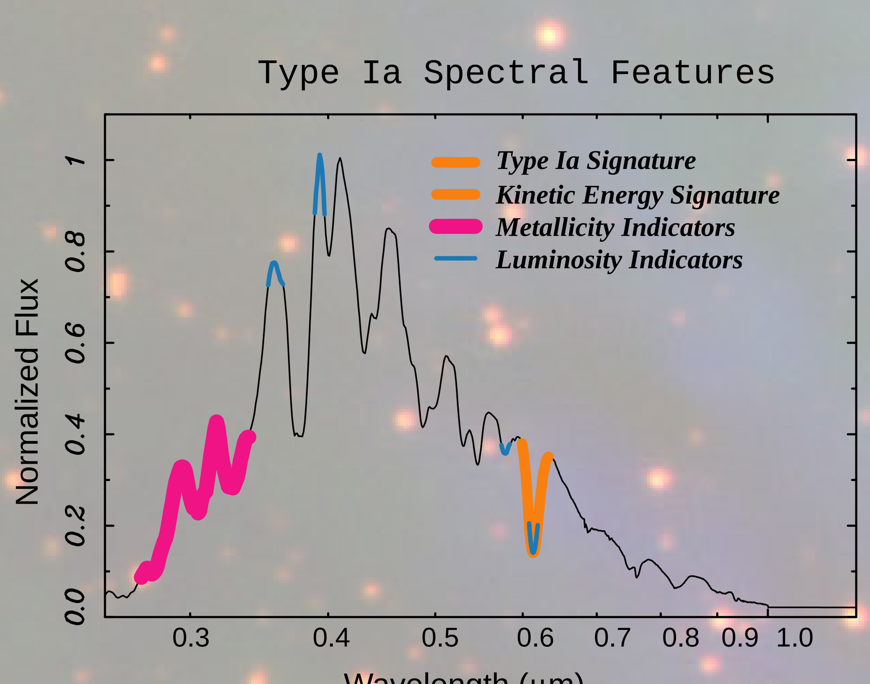
The scientific objectives of SNAP are to obtain precision measurements of the cosmological parameters and to study the properties of the mysterious dark energy.

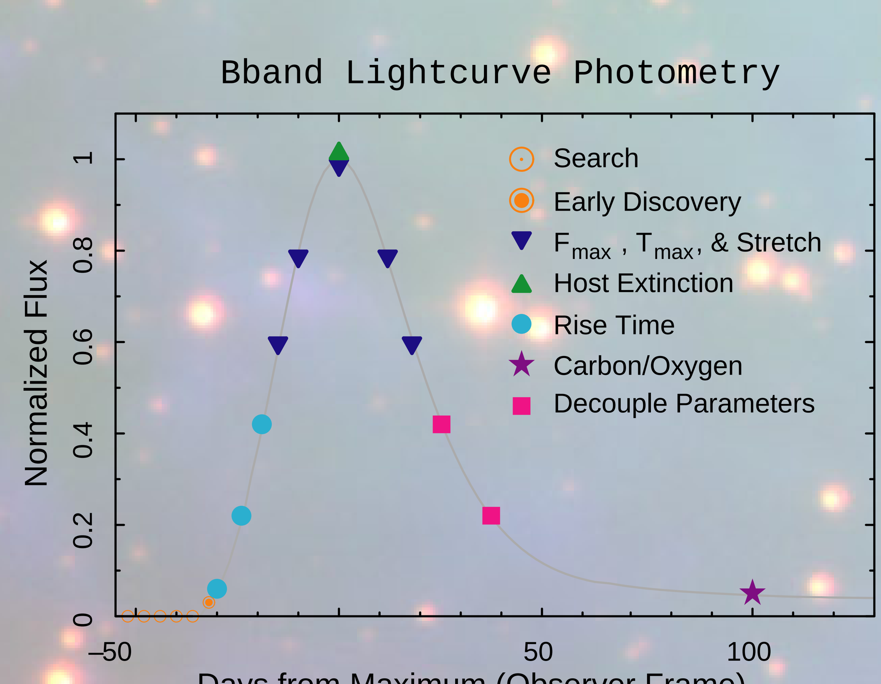
SNAP will provide:
Large numbers of supernovae with a large redshift range -- Statistical and systematic lever-arm for cosmological parameter measurements.



A one year baseline SNAP Hubble Diagram shows the expected distribution of 2500 Type Ia supernovae. Precision measurement of cosmological parameters are best determined between redshifts of 0.3 and 1.7.

High signal-to-noise spectra and lightcurves -- Probe systematic errors such as SN evolution and grey dust.



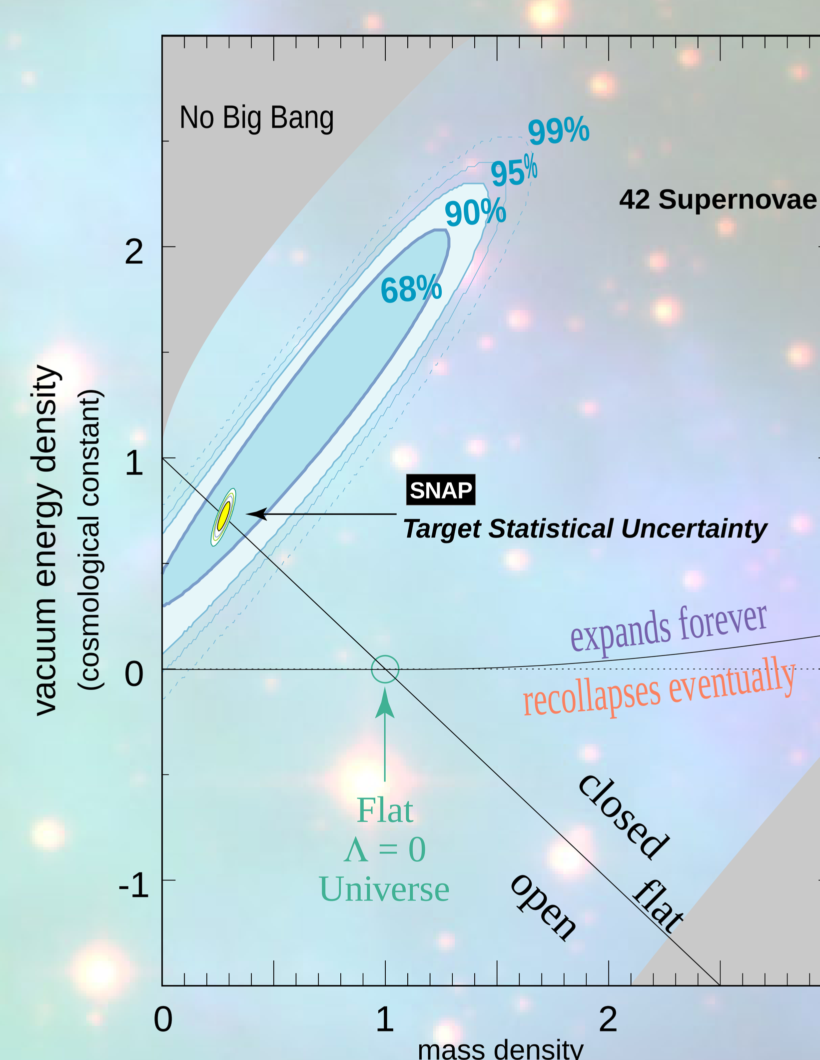


The left panel shows the SN Ia spectroscopic regions relevant for identification and systematic studies. The right panel shows the B-band light-curve sampling for a Type Ia supernova at z = 0.8, and the supernova physics addressed at different times from maximum brightness. SNAP will obtain high signal-to-noise data in these regions.

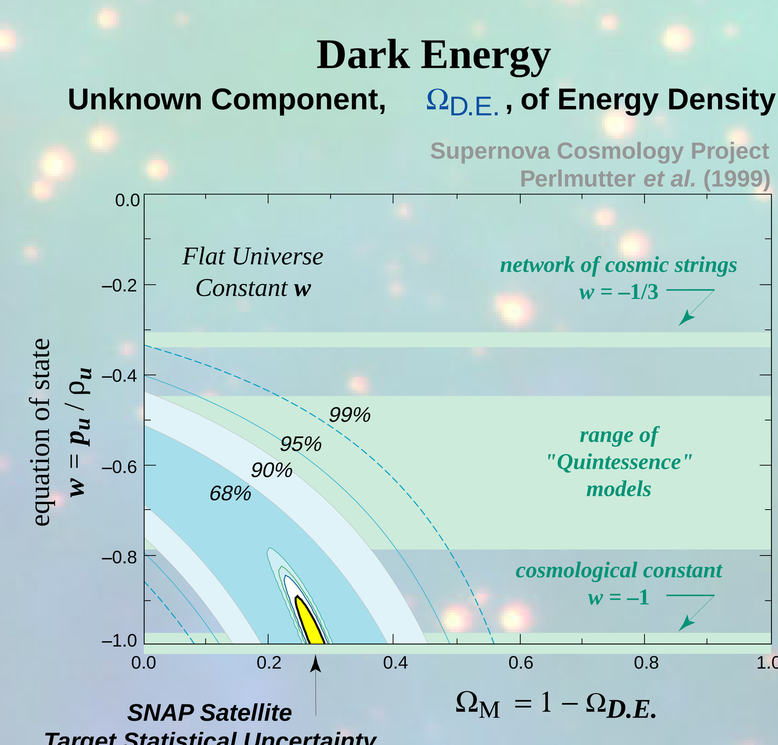
Cosmology with SNAP

High quality data will give cosmological parameter measurements limited by irreducible systematic errors.

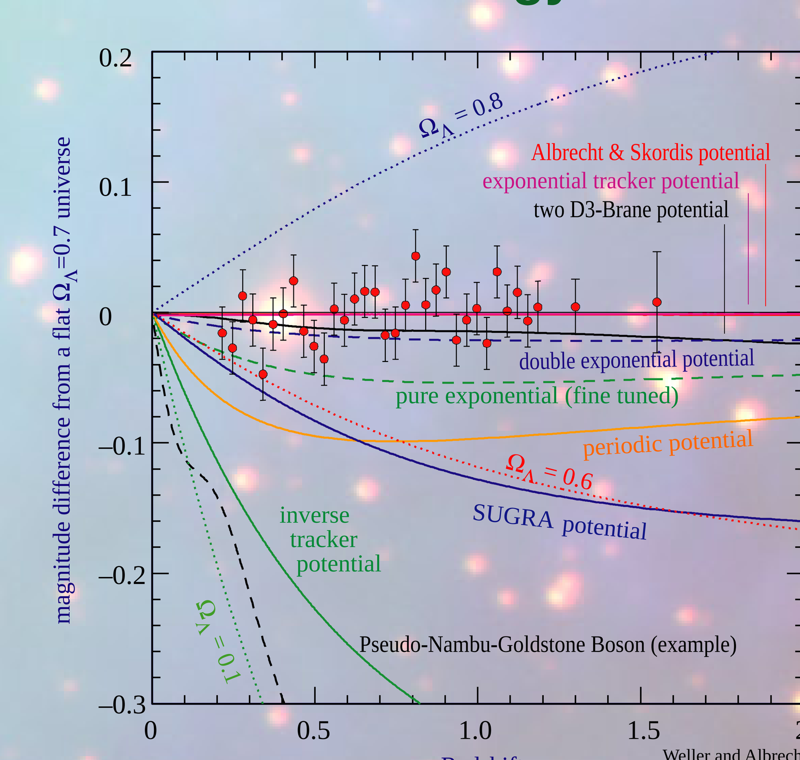
Confidence regions in the Ω_M-Ω_Λ plane from 42 distant SNe Ia. These results rule out a simple flat, [Ω_M=1, Ω_Λ=0] cosmology. They further show strong evidence (probability >99%) for Ω_Λ>0. Also shown is the expected confidence region from the SNAP satellite for an Ω_M=0.28 flat universe. (From the Supernova Cosmology Project, Perlmutter et al. 1999)



SNAP will constrain the nature and evolution of the dark energy.



Current and expected SNAP best-fit confidence regions in the Ω_M - w plane for an additional energy density component, Ω_w, characterized by an equation-of-state w=p/ρ. Einstein's cosmological constant, Λ, has w = p_Λ/ρ_Λ= –1.



SNAP constraints on dark-energy models in the magnitude-redshift plane. Each simulated SNAP point represents 50 supernovae. Theoretical curves correspond to a variety of dark energy models in the literature.

SNAP is supported by the US Department of Energy Office of Science, Division of High Energy Physics.

The Dumbell Nebula, taken with the LBNL CCD Image from NOAO/AURA/NSF