(Note: This project is known to DOE through LBNL, which is the lead institution. The information below is thus not complete or necessarily accurate.)

1. NAME OF INITIATIVE: SNAP (SuperNova Acceleration Probe)

List of major collaborating institutions (including non-US partners).

- Lawrence Berkeley National Lab (Lead institution)
- UC Berkeley
- Caltech
- Fermilab
- Indiana University
- IN2P3 (France)
- LAM (France)
- University of Michigan
- University of Pennsylvania
- University of Stockholm
- SLAC/Stanford
- STScI
- Yale University

2. SCIENTIFIC JUSTIFICATION:

Physics goals. How does it fit into the global physics goals for the entire field.

Recent studies of Type Ia supernovas, including measurements by the Supernova Cosmology Group led by Saul Perlmutter at LBNL and the High Z-SN Search team led by Brian P. Schmidt, have produced significant evidence that over cosmological distances they appear dimmer than would be expected if the universe's rate of expansion was constant or slowing down. This was the first direct experimental evidence for an accelerating universe potentially driven by a positive Cosmological Constant. However, only about 80 supernovas accumulated over several years have been studied and other explanations have not been completely ruled out.

A space mission is now being designed that would increase the discovery rate for such supernovas to about 2,000 per year. Discovery of so many more supernova will help eliminate possible alternative explanations, give experimental measurements of several other cosmological parameters, and put strong constraints on possible cosmological models. The satellite called SNAP (Supernova / Acceleration Probe) will be a space based telescope with a one square degree field of view with 1 billion pixels. Such a satellite would also complement the results of proposed experiments to improve measurements of the cosmic microwave background.

The baseline proposed satellite experiment is based on a simple, dedicated combination of a 2.0-meter telescope, a 1-square-degree optical/infrared imager, and a two-channel UV-to-near-IR spectrograph. The 1-square-degree wide field is obtained with a modified three-mirror Paul-Baker design.

This instrumentation will be used with a simple, predetermined observing strategy designed to monitor a twenty-square-degree region of sky near the north or south ecliptic poles, discovering and following supernovae that explode in that region. Every field will be visited frequently enough with sufficiently long exposures that at any given redshift up to z = 1.7 every supernova will be discovered within, on average, two restframe days of explosion. Every supernova at z <1.2 will be followed as it brightens and fades, while at z >1.2 there will be sufficient numbers of supernovae that it will only be necessary (and possible) to follow a subsample to obtain comparable numbers of supernovae.

A wide field survey covering an area of 300 to 1000 square degrees in one pass will also be conducted. This survey will be used to measure dark energy using a technique known as weak lensing, where the images and shapes of distant galaxies are distorted by foreground galaxies, also giving a measure of the mass density in the universe. Weak lensing will have different dependencies and systematic errors from the supernova experiemnt, , allowing the measurement of dark energy to be validated and improved.

NASA and DOE have formed a partnership for a Joint Dark Energy Mission (JDEM). SNAP will be proposed as the dark energy experiment for JDEM.

3. VALIDATIONS FOR SCIENTIFIC JUSTIFICATION:

Examples of recommendations and supporting statements from the committees, panels, and the community at large.

DOE Review Committee report on SNAP R&D (2003):

The finding of Dark Energy is of central importance to High Energy Physics in its mission to explore the fundamental nature of matter, energy, space, and time. This mysterious Dark Energy does not fit into the current model of fundamental matter and energy. Further study of this dominant energy in the universe will address profound issues at the heart of both cosmology and High Energy Physics and will be of utmost importance to the understanding of the physical laws and contents of the universe.

From Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century, committee on Physics of the Universe, National Research Council 2003:

To get at the nature of the dark energy will require a new class of large, wide-field (greater than 1 square degree) telescopes, both in space and on the ground. A wide-field, space-based telescope with a 2-meter mirror (such as SNAP) would provide crystal-clear images of large patches of the universe, ideal for deep gravitational lensing studies and for the discovery and follow-up of large numbers of supernovae out to high redshift (z ~ 1.51.

4. DESIRED SCHEDULE:

List major milestones (month & year) such as design complete, construction start, construction complete, etc.

SNAP R&D:

- Dec 2004: Zero'th order design report
- Jan 2006: Concept design report

JDEM:

- Year -1 to 0: Pre-concept design planning (CD0)
  - Conduct mission concept study. Prepare AO
- Year 1: Announcement of Opportunity (CD1)
- Year 2-3: Phase B, Preliminary Design (CD2) Select prime contractor

Year 4-8: Final design (CD3) . Construction (CD4)
Year 9-11: Launch; dark energy phase
Year 12-14: General astronomical phase
Yeear 15: End of 6 year prime mission

5. ROUGH ESTIMATE OF COST RANGES:
Whatever the best information available (eg. $M +/-30~50%, $150~250M, etc.). Total cost range including non-DOE funding (if any other funding sources are assumed and if known, state from where and how much. Also indicate remaining R&D cost to go.
Total project: $500 million - $1 billion (?) split between DOE and NASA

6. DESIRED NEAR TERM R&D
Major activities needed to be completed before start construction.
(Fermilab activities only):

1. Photometric calibration
2. Scientific software, data streams, and archiving
3. Electronics
    a. Mass memory
    b. Data compression and management hardware
4. Radiation shields
5. Science and simulations

7. LABORATORY'S ANTICIPATED ROLE:
Expected unique capabilities to be provided by lab. Rough estimate of human resources from lab (#FTE in what type labor).
Fermilab's contributions will be in two major areas: scientific and engineering/technical.

Through the Experimental and Theoretical Astrophysics groups, Fermilab has a strong scientific background in the science of dark energy, both the analysis of the techniques for measuring its parameters by different types of experiments, and in the processing and calibration of imaging and spectroscopic astronomical data that will be used in many of those experiments. A particular area of interest is the wide area survey, which will be used for the weak lensing studies. Members of Fermilab are actively working with other members of the SNAP collaboration on analyzing the sensitivity and biases of the weak lensing measurements. Through its participation in the Sloan Digital Sky Survey, members of Fermilab have developed considerable experience in analyzing astronomical data of the sort that will be generated by SNAP. SDSS has produced the largest volume of imaging data to date of any comparable survey, and SNAP will produce a yet larger volume.

Fermilab has engineering and technical in a number of areas relevant to SNAP, particularly with regard to detectors in high radiation environments. The areas where it is contributing at present are in electronics, in particular evaluation devices such a flash memory for tolerance to radiation, and the radiation shielding around the focal plane. Programs such as MARS and Geant that were developed for particle physics experiments are also applicable to evaluation of radiation damage in space.

These activities are being supported by scienstists in the Computing Divison, the Particle Physics Division, the Technical Division, and the Accelerator Divison.

The expected resources for the R&D phase are:

- 4 FTE scientists (spread over 16 total)
- 5 FTE technical staff