

Saul Perlmutter

Lawrence Berkeley Laboratory
Room 50-232
University of California, Berkeley
Berkeley, CA 94720
(510) 486-5203

2730 Forest Ave. #Y
Berkeley, CA 94705
(510) 841-7285

Email: saul@LBL.gov

EDUCATION

Ph.D. December 1986, Physics, University of California, Berkeley

A.B. 1981 *magna cum laude*, Physics, Harvard University

HONORS AND AWARDS

American Astronomical Society

Henri Chrétien Award, international research grant “for past excellence and future promise,” 1996

E O. Lawrence Berkeley National Laboratory

Outstanding Performance Award, 1996

University of California Institutes

Distinguished Achievement Award for Outstanding Scientific Publication, 1993

University of California, Berkeley

Alfred F. Moore and Chella D. Moore University Fellowship, 1981-1982

Harvard University

John Harvard Honorary Scholarship, 1978 and 1979

Deturs Award for Academic Achievement, 1978

RESEARCH EXPERIENCE

Lawrence Berkeley Laboratory, Staff scientist, 1994-present. Center for Particle Astrophysics, University of California, Berkeley, Staff scientist, 1989-1993.

Group leader for two astrophysics research subgroups, and liaison for one education subgroup. Plan science, budgets, and develop funding resources for 12 faculty, scientists, postdocs, graduate students, and undergraduates.

Designed and led the Supernova Cosmology Project, which has so far discovered >50 of the most distant known supernovae, at $z = 0.35 - 0.83$. Published the first measurements of the mass density Ω and cosmological constant Λ of the universe, using 7 of these supernovae as calibrated “standard candles.”

Initiated and led a project to develop a novel CCD detector that achieves high quantum efficiency without the usual risk of thinning the silicon substrate. This proposed detector takes advantage of detector developments intended for the SSC. The first prototype 200-by-200 pixel detector imaged a test pattern, showing excellent noise properties, dynamic range, and quantum efficiency in the red. The first

science-scale 2k-by-2k pixel design is now in fabrication.

Studied the observational and statistical feasibility of using high-redshift Type Ia supernovae as standard candles or calibrated candles to measure the cosmological parameters, W_o , L , and q_o ,

Developing a rapid-response telescope system to find transient optical counterparts to Gamma Ray Bursts discovered by the GRO satellite. A two-month pilot run automatically observed at GRO trigger locations. Funding proposals have been submitted.

Developed science strategy, shared in design, and negotiated agreement with the Royal Greenwich Observatory for a CCD-mosaic camera and sufficient telescope time to find and study tens of distant supernovae for cosmology measurements.

Began, in an international collaboration, a search for galactic dark matter, using the microlensing of distant stars by the gravitational fields of dark objects in the Galactic halo. This search discovered a number of microlensing events in the first year's data,, in the directions of the halo and of the bulge of our galaxy.

Discovered high rates for core-collapse supernovae in an automated search for nearby supernovae. Now testing a new 30" automated telescope that we built to upgrade the search at a new mountain-top site in California.

Space Sciences Laboratory and Lawrence Berkeley Laboratory, University of California, Berkeley. Postdoctoral researcher, 1987-1988.

Designed and supervised implementation of a real-time automated supernova search. This system has detected 20 low-redshift supernovae.

Designed and used a high-speed photometry system as part of a collaboration searching for an optical pulsar inside Supernova 1987A. Analyzed the Fourier-transformed signals to study significance.

Found a correlation of meteorite exposure ages with probable dates of comet showers.

Lawrence Berkeley Laboratory. Research assistant in astrophysics, 1983-1986.

Designed and implemented an astrometric search for a solar companion star.

Analyzed Voyager radio data with statistical analysis of Fourier transforms to find signals from nearby pulsars.

Developed a theory of Apollo object formation as a consequence of periodic comet showers.

Built and tested electronics for a low-noise CCD camera.

University of California, Berkeley. Research assistant in physics, 1982-1983.

Determined limits on the existence of nonintegrally charged particles in high-energy ion accelerator experiments, using plastic elementary-particle track detectors.

Institut des Sciences Nucleaires, Grenoble, France. Research assistant, summer 1980.

Designed and tested a magnetic field detector for a neutron-capture-on-proton experiment.

TEACHING EXPERIENCE

Harvard University. Teaching assistant, 1981.

Developed curriculum, wrote and presented weekly one-hour lectures, and supervised lab for an electronics laboratory course to accompany introductory physics course.

PUBLICATIONS

Search for nonintegrally charged projectile fragments in relativistic nucleus-nucleus collisions. P. B. Price, M. L. Tincknell, G. Tarlé, S. P. Ahlen, K. A. Frankel, and S. Perlmutter, *Physical Review Letters*, **50**, 566 (1983).

Observation of anomalously short mean free paths of projectile fragments of $1.85A$ -GeV ^{40}Ar in CR-39 etched track detector. M. L. Tincknell, P. B. Price, and S. Perlmutter, *Physical Review Letters*, **51**, 1948 (1983).

The origin of Apollo objects. S. Perlmutter, *Lawrence Berkeley Laboratory Report*, LBL-17342 (1984).

The Berkeley search for a faint stellar companion to the sun. S. Perlmutter, M. S. Burns, F. Crawford, P. G. Friedman, J. T. Kare, R. A. Muller, and C. R. Pennypacker, in *Astrophysics of Brown Dwarfs*, eds. Kafatos, Harrington, and Maran, Cambridge University Press (1986).

An astrometric search for a stellar companion to the sun. S. Perlmutter, *Lawrence Berkeley Laboratory Report*, LBL-23187 (November, 1986).

An automated search for supernova explosions. J. T. Kare, M. S. Burns, F. Crawford, P. G. Friedman, R. A. Muller, C. R. Pennypacker, and S. Perlmutter, *Review of Scientific Instruments*, **59**, 1021 (1988).

Evidence for comet showers in meteorite ages. S. Perlmutter and R. A. Muller, *Icarus*, **74**, 369 (1988).

The status of Berkeley's real-time supernova search. S. Perlmutter, F. S. Crawford, R. A. Muller, C. R. Pennypacker, T. P. Sasseen, C. K. Smith, R. Treffers, and R. Williams, in *Instrumentation for Ground-Based Optical Astronomy*, ed. L.B. Robinson, Springer-Verlag (1988).

Observations of the Type II Supernova 1986I in M99. C. R. Pennypacker *et al*, *Astro-*

nomical Journal, **97** (1), 186 (1989).

Limits on an optical pulsar in Supernova 1987A. C. R. Pennypacker, J. Kristian, J. Middleditch, M. A. Hamuy, J. N. Imamura, W. E. Kunkel, D. E. Morris, R. A. Muller, S. Perlmutter, S. J. Rawlings, T. P. Sasseen, I. K. Shelton, T. Y. Steiman-Cameron, I. R. Tuohy, *Astrophysical Journal Letters*, **340**, L61 (1989).

Sub-millisecond optical pulsar in Supernova 1987A. J. Kristian, C. R. Pennypacker, J. Middleditch, M. A. Hamuy, J. N. Imamura, W. E. Kunkel, R. Lucinio, D. E. Morris, R. A. Muller, S. Perlmutter, S. J. Rawlings, T. P. Sasseen, I. K. Shelton, T. Y. Steiman-Cameron, I. R. Tuohy, *Nature*, **338**, 234 (1989).

The first year (almost) of real-time automated operation of the Berkeley supernova search. S. Perlmutter, F. Crawford, H. J. Marvin, R. A. Muller, C. R. Pennypacker, T. Sasseen, C. Smith, and L. Wang, in *Particle Astrophysics: Forefront Experimental Issues*, ed. E. B. Norman, World Scientific (1989).

A search for Nemesis: current status and review of theory. S. Perlmutter, R. A. Muller, C. R. Pennypacker, C. Smith, L. P. Wang, S. White, H. S. Yang, *Global Catastrophes in Earth History*, eds. V. L. Sharpton and P. D. Ward, Geological Society of America Special Paper 247 (1990).

The sub-millisecond pulsar in Supernova 1987A: a review of the first three months. S. Perlmutter, in *Last Workshop on Grand Unification*, ed. P. H. Frampton, World Scientific (1989).

Progress and new directions for the Berkeley supernova search. S. Perlmutter, H. J. Marvin, R. A. Muller, C. R. Pennypacker, T. P. Sasseen, C. K. Smith, and L. P. Wang, in *Supernovae*, ed. S. E. Woosley, Springer-Verlag (1991).

The sub-millisecond pulsar in Supernova 1987A: a review of the discovery data after six months. S. Perlmutter, R. A. Muller, C. R. Pennypacker, and T. P. Sasseen, in *Supernovae*, ed. S. E. Woosley, Springer-Verlag (1991).

The Berkeley-AAO Distant supernova search. W. J. Couch, S. Perlmutter, H. J. M. Newberg, C. Pennypacker, G. Goldhaber, R. Muller, and B.J. Boyle, *Proceedings Astronomical Society of Australia*, **9**, 261 (1991).

Gravitational microlensing as a method of detecting disk dark matter and faint disk stars. K. Griest, C. Alcock, T. S. Axelrod, D. P. Bennett, K. H. Cook, K. C. Freeman, H.-S. Park, S. Perlmutter, B. A. Peterson, P. J. Quinn, A. W. Rodgers, and C. W. Stubbs, *Astrophysical Journal Letters*, **372**, L79 (1991).

High rate for type Ic supernovae. R. A. Muller, H. J. M. Newberg, C. R. Pennypacker, S. Perlmutter, T. P. Sasseen, and C. K. Smith, *Astrophysical Journal Letters*, **384**, L9 (1992).

The search for massive compact halo objects. C. Alcock, T. S. Axelrod, D. P. Bennett, K. H. Cook, H.-S. Park, K. Griest, S. Perlmutter, C. W. Stubbs, K. C. Freeman, B. A. Peterson, P. J. Quinn, and A. W. Rodgers, in *Gravitational Lenses*, eds. R. Kayser, T. Schramm, and L. Nieser, Springer Lecture Notes in Physics, **406**,156 (1992).

The search for massive compact halo objects with a (semi) robotic telescope. C. Alcock, T. S. Axelrod, D. P. Bennett, K. H. Cook, H.-S. Park, K. Griest, S. Perlmutter, C. W. Stubbs, K. C. Freeman, B. A. Peterson, P. J. Quinn, and A. W. Rodgers, in *Robotic Telescopes in the 1990's*, ed. A. V. Filippenko, Astronomical Society of the Pacific (1992).

A doubly robotic telescope: the Berkeley automated supernova search. S. Perlmutter, R. A. Muller, H. J. M. Newberg, C. R. Pennypacker, and C. K. Smith, in *Robotic Telescopes in the 1990's*, ed. A. V. Filippenko, Astronomical Society of the Pacific (1992).

Galaxy clustering around QSOs at $0.9 < z < 1.5$. B. J. Boyle, S. Perlmutter, G. Goldhaber, R. Muller, H. Marvin, C. Pennypacker, and W. J. Couch, in *The Space Distribution of Quasars*, ed. D. Crompton, *Astronomical Society of the Pacific Conference Series*, **21**, 344 (1992).

Automated CCD photometry of T Tauri stars. M. Richter, G. Basri, S. Perlmutter, and C. Pennypacker, *Publications of the Astronomical Society of the Pacific*, **104**, 1144 (1992).

Photometric and spectroscopic observations of SN 1990E in NGC 1035: Observational constraints for Models of Type II supernovae. B. Schmidt *et al.*, *Astronomical Journal*, **105**, 2236 (1993).

A 32-megapixel dual color CCD imaging system. C. W. Stubbs *et al.*, in *Charge-coupled Devices and Solid State Optical Sensors III*, ed. M. Blouke, Proceedings of the SPIE, **1900**, 192 (1993).

The first data from the MACHO experiment, D. Bennett, *et al.*, *Annals of the New York Academy of Sciences*, 688,612 (1993).

The CCD array camera for the MACHO project, S.L. Marshall, *et al.*, IAU Symposium 161, Astronomy from Wide-Field Imaging, ed. H. MacGillivray (in press).

Possible gravitational microlensing of a star in the Large Magellanic Cloud. C. Alcock, C. W. Akerlof, R. A. Allsman, T. S. Axelrod, D. P. Bennett, S. Chan, K. H. Cook, K. C. Freeman, K. Griest, S. L. Marshall, H.-S. Park, S. Perlmutter, B. A. Peterson, M. R. Pratt, P. J. Quinn, A. W. Rodgers, C.W. Stubbs, and W. Sutherland, *Nature*, **365**, 621 (1993).

Discovery of the most distant supernovae and the quest for W. G. Goldhaber, S. Perlmutter, S. Gabi, A. Goobar, A. Kim, M. Kim, R. Pain, C. Pennypacker, I. Small, B. Boyle, R. Ellis, R. McMahon, P. Bunclark, D. Carter, and R. Terlevich, in proceedings of *The First Arctic Workshop on Future Physics and Accelerators*, Saariselkä, Finland (1994).

Discovery of the most distant supernovae and the quest for W. G. Goldhaber, B. Boyle, P. Bunclark, D. Carter, R. Ellis, S. Gabi, A. Goobar, A. Kim, M. Kim, R. McMahon, R. Pain, C. Pennypacker, S. Perlmutter, I. Small, and R. Terlevich, *Nuclear Physics B (Proc. Suppl.)* **38**, 435 (1995).

Application of cubic splines to the spectral analysis of unequally spaced data, C. W.

Akerloff, C. Alcock, R. Allsman, T. Axelrod, D. Bennett, K. Cook, K. Freeman, K. Griest, S. Marshall, H.-S. Park, S. Perlmutter, B. Peterson, P. Quinn, J. Reimann, A. Rodgers, C. Stubbs and W. Sutherland, *Astrophysical Journal*, **436**, 787 (1994).

Gravitational microlensing results from MACHO. W. Sutherland, C. Alcock, R. Allsman, T. Axelrod, D. Bennett, S. Chan, K. Cook, K. Freeman, K. Griest, S. Marshall, S. Perlmutter, B. Peterson, M. Pratt, P. Quinn, A. Rodgers, and C. Stubbs, *Nuclear Physics B (Proc. Suppl.)* **38**, 379 (1995).

Controlling bias and statistical uncertainty in measuring q_0 with type Ia supernovae. M. S. Burns, H. J. M. Newberg, and S. Perlmutter, submitted to *Publications of the Astronomical Society of the Pacific* (in revision).

A Type Ia supernova at $z = 0.457$. S. Perlmutter, C. Pennypacker, G. Goldhaber, A. Goobar, J. Desai, A. Kim, M. Kim, R. Muller, H. Newberg, I. Small, R. McMahon, B. Boyle, D. Carter, M. Irwin, P. Bunclark, K. Glazebrook, and R. Ellis, *Astrophysical Journal Letters*, **440**, L41 (1995).

The blue and visual absolute magnitude distributions of type Ia supernovae. T. Vaughan, D. Branch, D. L. Miller, and S. Perlmutter, *Astrophysical Journal*, **439**, 558 (1995).

Probable gravitational microlensing toward the Galactic bulge. C. Alcock, R. A. Allsman, T. S. Axelrod, D. P. Bennett, K. H. Cook, K. C. Freeman, K. Griest, S. L. Marshall, S. Perlmutter, B. A. Peterson, M. R. Pratt, P. J. Quinn, A. W. Rodgers, C.W. Stubbs, and W. Sutherland, *Astrophysical Journal*, **445**, 133 (1995).

The distant supernova search and implications for the cosmological deceleration. A. Goobar, B. Boyle, P. Bunclark, D. Carter, R. Ellis, S. Gabi, G. Goldhaber, M. Irwin, A. Kim, M. Kim, R. McMahon, R. Muller, R. Pain, C. Pennypacker, S. Perlmutter, and I. Small, *Nuclear Physics B (Proc. Suppl.)* **43**, 78 (1995).

Theory of exploring the dark halo with microlensing: I. Power-law models. C. Alcock, R. A. Allsman, T. S. Axelrod, D. P. Bennett, K. H. Cook, N.W. Evans, K. C. Freeman, K. Griest, J. Jijina, M. J. Lehner, S. L. Marshall, S. Perlmutter, B. A. Peterson, M. R. Pratt, P. J. Quinn, A. W. Rodgers, C.W. Stubbs, and W. Sutherland, *Astrophysical Journal*, **449**, 28 (1995).

Feasibility of measuring the cosmological constant Λ and mass density Ω using supernova standard candles. A. Goobar and S. Perlmutter, *Astrophysical Journal*, **450**, 14 (1995).

Experimental limits on the dark matter halo in the Galaxy from gravitational microlensing. C. Alcock, R. A. Allsman, T. S. Axelrod, D. P. Bennett, K. H. Cook, K. C. Freeman, K. Griest, J. A. Guern, M. J. Lehner, S. L. Marshall, H.-S. Park, S. Perlmutter, B. A. Peterson, M. R. Pratt, P. J. Quinn, A. W. Rodgers, C.W. Stubbs, and W. Sutherland,

Physical Review Letters, **74**, 2867 (1995).

A generalized K correction for type Ia supernovae: Comparing R -band photometry beyond $z = 0.2$ with B , V , and R -band nearby photometry. A. Kim, A. Goobar, and S. Perlmutter, *Publications of the Astronomical Society of the Pacific*, **108**, 190 (1996).

The MACHO project first year LMC results: the microlensing rate and the nature of the Galactic dark halo. C. Alcock, R. A. Allsman, T. S. Axelrod, D. P. Bennett, K. H. Cook, K. C. Freeman, K. Griest, J. A. Guern, M. J. Lehner, S. L. Marshall, H.-S. Park, S. Perlmutter, B. A. Peterson, M. R. Pratt, P. J. Quinn, A. W. Rodgers, C. W. Stubbs, W. Sutherland (The MACHO Collaboration), *Astrophysical Journal*, **461**, 84 (1996).

Scheduled discoveries of 7+ high-redshift supernovae: First cosmology results and bounds on q_0 . (The Supernova Cosmology Project: I.) S. Perlmutter, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, I. Hook, A. Kim, M. Kim, J. Lee, R. Pain, C. Pennypacker, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, M. Irwin, H. Newberg, A. V. Filippenko, T. Matheson, M. Dopita, J. Mould, and W. Couch, in *Thermonuclear Supernovae*, NATO ASI, eds. P. Ruiz-Lapuente, R. Canal, and J. Isern (1997).

The type Ia supernova rate at $z \sim 0.4$. (The Supernova Cosmology Project: IV.) R. Pain, I. Hook, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, A. Kim, M. Kim, J. Lee, C. Pennypacker, S. Perlmutter, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, and M. Irwin, in *Thermonuclear Supernovae*, NATO ASI, eds. P. Ruiz-Lapuente, R. Canal, and J. Isern (1997).

K corrections for type Ia supernovae and a test for spatial variation of the Hubble constant. (The Supernova Cosmology Project: II.) A. Kim, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, I. Hook, M. Kim, J. Lee, R. Pain, C. Pennypacker, S. Perlmutter, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, M. Irwin, H. Newberg, A. V. Filippenko, T. Matheson, M. Dopita, J. Mould, and W. Couch, in *Thermonuclear Supernovae*, NATO ASI, eds. P. Ruiz-Lapuente, R. Canal, and J. Isern (1997).

Observation of cosmological time dilation using type Ia supernovae as clocks. (The Supernova Cosmology Project: III.) G. Goldhaber, S. Deustua, S. Gabi, D. Groom, I. Hook, A. Kim, M. Kim, J. Lee, R. Pain, C. Pennypacker, S. Perlmutter, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, M. Irwin, H. Newberg, A. V. Filippenko, T. Matheson, M. Dopita, J. Mould, and W. Couch, in *Thermonuclear Supernovae*, NATO ASI, eds. P. Ruiz-Lapuente, R. Canal, and J. Isern (1997).

The Type Ia supernova rate at $z = 0.4$, R. Pain, I. Hook, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, A. Kim, M. Kim, J. Lee, C. Pennypacker, S. Perlmutter, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, and M. Irwin (The Supernova Cosmology Project), *Astrophysical Journal*, **473**, 356 (1996).

High-redshift supernova discoveries on demand: First results from a new tool for cosmology and bounds on q_0 . S. Perlmutter, B. Boyle, P. Bunclark, D. Carter, W. Couch,

S. Deustua, M. Dopita,, R. Ellis, A.V. Filippenko, S. Gabi, K. Glazebrook, G. Goldhaber, A. Goobar, D. Groom, I. Hook, M. Irwin, A. Kim, M. Kim, J. Lee, T. Matheson, R. McMahon, H. Newberg, R. Pain, C. Pennypacker, and I. Small, *Nuclear Physics B (Proc. Suppl.)*, **51**, 20 (1996).

Cosmological time dilation using Type Ia supernovae as clocks. G. Goldhaber, B. Boyle, P. Bunclark, D. Carter, W. Couch, S. Deustua, M. Dopita,, R. Ellis, A.V. Filippenko, S. Gabi, K. Glazebrook, A. Goobar, D. Groom, I. Hook, M. Irwin, A. Kim, M. Kim, J. Lee, T. Matheson, R. McMahon, H. Newberg, R. Pain, C. Pennypacker, S. Perlmutter, and I. Small, *Nuclear Physics B (Proc. Suppl.)*, **51**, 123 (1996).

Measurements of the cosmological parameters W and L from the first seven supernovae at $z \geq 0.35$. S. Perlmutter, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, I. Hook, A. Kim, M. Kim, J. Lee, R. Pain, C. Pennypacker, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, M. Irwin, H. Newberg, A.V. Filippenko, T. Matheson, M. Dopita, and W. Couch (The Supernova Cosmology Project), *Astrophysical Journal*, **483**, 565 (1997).

Implications for the Hubble Constant from the first seven supernovae at $z \geq 0.35$. A. Kim, S. Deustua, S. Gabi, G. Goldhaber, D. Groom, I. Hook, M. Kim, J. Lee, R. Pain, C. Pennypacker, S. Perlmutter, I. Small, A. Goobar, R. Ellis, R. McMahon, B. Boyle, P. Bunclark, D. Carter, K. Glazebrook, M. Irwin, H. Newberg, A.V. Filippenko, T. Matheson, M. Dopita, and W. Couch (The Supernova Cosmology Project), *Astrophysical Journal Letters*, **476**, L63 (1997).

A 200 x 200 CCD image sensor fabricated on high-resistivity silicon. S.E. Holland, G. Goldhaber, D.E. Groom, W.W. Moses, C.R. Pennypacker, S. Perlmutter, N.W. Wang, R.J. Stover, M. Wei, *IEDM Technical Digest*, 911 (1996).

The MACHO project: 45 candidate microlensing events from the first-year Galactic bulge data. C.Alcock, R.A.Allsman, D.Alves, T.S.Axelrod, D.P.Bennett, K.H.Cook, K.C.Freeman, K.Griest, J.A.Guern, M.J.Lehner, S.L.Marshall, H.-S.Park, S.Perlmutter, B.A.Peterson, M.R.Pratt, P.J.Quinn, A.W.Rodgers, C.W.Stubbs, W.Sutherland (The MACHO Collaboration), *Astrophysical Journal*, **479**, 119 (1997).

Characterization of a fully depleted CCD on high-resistivity silicon. R.J. Stover, M. Wei, Y. Lee, D.K. Gilmore, S.E. Holland, D.E. Groom, W.W. Moses, S. Perlmutter, *SPIE Proc.*, 3109 (in press)

A search for gamma-ray burst optical emission with the Automated Patrol Telescope. B. Grossan, S. Perlmutter, and M. Ashley, in *Gamma-Ray Bursts*, 4th Huntsville Symposium, ed. C. Meegan, R. Preece, and T. Koshut , New York: AIP (in press).

Discovery of a supernova explosion at half the age of the universe and its cosmological implications. S. Perlmutter, G. Aldering, M. Della Valle, S. Deustua, R.S. Ellis, S. Fabbro, A. Fruchter, G. Goldhaber, A. Goobar, D. E. Groom, I. M. Hook, A. G. Kim, M. Y. Kim, R. A. Knop, C. Lidman, R.G. McMahon, P. Nugent, R. Pain, N. Panagia (The Supernova Cosmology Project), *Nature* (in press).

Discoveries of supernovae, reported in *International Astronomical Union Telegrams and Circulars*:

Supernova 1986I in M99, Circular 4219, 20 May 1986. C. Pennypacker, S. Burns, F. Crawford, P. Friedman, J. Kare, J. Graham, R. Muller, S. Perlmutter, C. Smith, R. Treffers, and R. Williams.

Supernova 1986N in NGC 1667, Circular 4287, 23 December 1986, same authors.

Supernova 1986O in NGC 2227, Circular 4298, 15 January 1987, same authors.

Supernova 1987K in NGC 4651, Circular 4426, 30 July 1987, same authors.

Supernova 1988H in NGC 5878, Circular 4560, 3 March 1988, S. Perlmutter, C. Pennypacker, and the Berkeley Automated Supernova Search.

Supernova 1988L in NGC 5480, Circular 4590, 3 May 1988, S. Perlmutter, C. Pennypacker, and the Berkeley Automated Supernova Search.

Supernova 1989A in NGC 3687, Circular 4721, 24 January 1989, S. Perlmutter, C. Pennypacker, and the Berkeley Automated Supernova Search.

Supernova 1989L in NGC 7339, Circular 4791, 3 June 1989, C. Pennypacker, S. Perlmutter, and the Berkeley Automated Supernova Search.

Supernova 1990B in NGC 4568, Circular 4949, 23 January 1990, S. Perlmutter, C. Pennypacker, and the Berkeley Automated Supernova Search.

Supernova 1990E in NGC 1035, Circular 4965, 16 February 1990, C. Pennypacker, S. Perlmutter, and the Berkeley Automated Supernova Search.

Supernova 1990H in NGC 3294, Circular 4992, 11 April 1990, S. Perlmutter, C. Pennypacker, H. Marvin, T. Sasseen, C. Smith, and R. Muller.

Supernova 1990U in NGC 7479, Circular 5063, 28 July 1990, C. Pennypacker, S. Perlmutter, and H. Marvin.

Supernova 1990AA in UGC 540, Circular 5087, 4 September 1990, S. Perlmutter, C. Pennypacker, S. Carlson, H. Marvin, R. Muller, and C. Smith.

Supernova 1991A in IC 2973, Circular 5153, 1 January 1991, C. Pennypacker, S. Perlmutter, S. Block, S. Carlson, N. Hamilton, H. Marvin, R. Muller, and C. Smith.

Supernova 1991B in NGC 5426, Circular 5163, 14 January 1991, S. Perlmutter, C. Pennypacker, S. Carlson, N. Hamilton, H. Marvin, R. Muller, and C. Smith.

Supernova 1991M in IC 1151, Circular 5207, 13 March 1991, C. Pennypacker, S. Perlmutter, S. Carlson, N. Hamilton, H. Marvin, R. Muller, and C. Smith.

Supernova 1991N in NGC 3310, Circular 5227, 30 March 1991, S. Perlmutter, C. Pennypacker, S. Carlson, N. Hamilton, H. Marvin, R. Muller, M. Tetreault, and C. Smith.

Supernovae 1994F, 1994G, 1994H, Circular 5956, 24 March 1994, S. Perlmutter, *et al.*

Supernovae 1993al, 1994al, 1994am, 1994an, Circular 6263, 18 November 1995, S. Perlmutter, *et al.* (The Supernova Cosmology Project).

Eleven High-Redshift Supernovae: 1995aq through 1995az, and 1995ba, Circular 6270, 6 December 1995, S. Perlmutter, *et al.* (The Supernova Cosmology Project).

Nine High-Redshift Supernovae: 1996cf through 1996cn, Circular 6621, 9 April 1997, S. Perlmutter, *et al.* (The Supernova Cosmology Project).

Fourteen High-Redshift Supernovae: 1997F through 1997S, Circular 6540, 17 January 1997, S. Perlmutter, *et al.* (The Supernova Cosmology Project).

Sixteen High-Redshift Supernovae: 1997ac through 1997ar, Circular 6596, 20 March 1997, S. Perlmutter, *et al.* (The Supernova Cosmology Project).

PUBLICATIONS IN PREPARATION

Standard candle Type Ia supernovae and prospects for testing hypotheses of cosmic evolution. T. E. Vaughan, D. Branch, and S. Perlmutter, to be submitted to *Astrophysical Journal*.

Observation of cosmological time dilation using Type Ia supernovae as clocks. G. Goldhaber, S. Perlmutter, *et al.*, to be submitted to *Physical Review Letters*.

Light curve stretch factor: an alternative single parameter family of Type Ia supernova light curve shapes. S. Perlmutter, to be submitted to *Publications of the Astronomical Society of the Pacific*.

First catalog of photometry and spectroscopy for seven supernovae at $z \sim 0.4$. S. Perlmutter, *et al.*, to be submitted to *Astronomical Journal*.

Photometry and systematic error analysis techniques for high-redshift supernovae. S. Perlmutter, *et al.*, to be submitted to *Publications of the Astronomical Society of the Pacific*.

PRESENTED PAPERS

Departmental Colloquia and Seminars:

1988:Massachusetts Institute of Technology, Harvard University, Princeton University

1989:University of California, Santa Barbara; Stanford University; University of Pennsylvania; Brown University; Yale University; University of California, Santa Cruz; University of California, Berkeley

1990:Australian National University, Camberra; CEN Saclay, France; Institute of Astrophysics, Teneriffe, Spain

1991:University of Oklahoma; Lawrence Berkeley Laboratory; University of Pennsylvania; Lawrence Livermore Laboratory; Space Sciences Laboratory, Berkeley; Cambridge University, England

1992:Rutgers University, California Institute of Technology, Massachusetts Institute of Technology, Harvard University

1993:Carnegie Mellon University; University of California, Berkeley; Los Alamos National Laboratory

1994:Lawrence Livermore Laboratory; Berkeley Center for Extreme Ultraviolet Explorer

1995:University of Pennsylvania; Space Telescope Science Institute

1996:University of California, Santa Barbara; University of California, Berkeley; Fermi National Accelerator Laboratory; Institute for Advanced Study, Princeton; Carnegie Observatories; University of Chicago

1997:Stanford University; University of Washington; University of California, San Diego; University of Michigan; University of California, Santa Cruz

Conference Papers:

American Astronomical Society, Albuquerque, June 1990.

ESO Workshop on Supernova 1987A and Other Supernovae, Elba, Italy, September 1990.

American Astronomical Society, Philadelphia, January 1991.

American Astronomical Society, Seattle, May 1991.

American Astronomical Society, Atlanta, January 1992.

16th Texas Symposium on Relativistic Astrophysics and 3rd Symposium on Particles, Strings, and Cosmology, Berkeley, December 1992.

American Astronomical Society, Berkeley, June 1993.

American Astronomical Society, Minneapolis, June 1994.

Snowmass Conference, Colorado, July 1994.

American Astronomical Society, Tucson, January 1995.

American Astronomical Society, San Antonio, January 1996.

American Astronomical Society, Toronto, January 1997.

Invited Talks:

Tenth and Final Workshop on Grand Unification, Chapel Hill, April 1989.

American Physical Society, Spring Meeting, Baltimore, 1989.

Santa Cruz Summer Workshop on Supernovae, 1989.

Astronomy in Education, workshop, Tucson, November, 1990.

Symposium on Robotic Telescopes, Astronomical Society of the Pacific, Laramie, June 1991.

Aspen Winter Conference on Astrophysics, January 1993.

NATO Advanced Study Institute on Thermonuclear Supernovae, Aiguablava, Spain, June 1995.

2nd International Conference on Sources and Detection of Dark Matter in the Universe, sponsored by UCLA, Santa Monica, February 1996

18th Texas Symposium on Relativistic Astrophysics and Cosmology, December 1996, plenary overview talk on high redshift supernovae and cosmology.

Supernovae and Cosmology: Colloquium in honor of Professor Gustav Tammann, Basel, Switzerland, June 1997.

ITP Study Institute on Supernovae, University of California, Santa Barbara, August 1997.

International Astronomical Union Symposium 183: Cosmological Parameters and Evolution of the Universe, Kyoto, Japan, August 1997.

PROFESSIONAL ACTIVITIES

Steering Committee, Institute for Nuclear and Particle Astrophysics, Lawrence Berkeley Laboratory, 1993-present.

Program Coordinators Committee, Center for Particle Astrophysics, University of California, Berkeley, 1989-present.

Referee, *Astrophysical Journal Letters*, 1994.

Referee, Lawrence Livermore Laboratory Director's Funds Proposals, 1994.

Examiner for Physics Ph.D. thesis for University of New South Wales, 1995.

Referee, *Astrophysical Journal Letters*, 1996.

Leader, Science Team on "SNe and Cosmology Studies." for Next Generation Space Telescope Science Working Group

Referee, *Physics of Plasmas* journal, 1996.

Reviewer, Hubble Space Telescope Cycle 7 Time Allocation Committee, Member of Cosmology Panel, 1996

Organizer for session on High Redshift Supernovae and Cosmology at ITP Study Institute on Supernovae, University of California, Santa Barbara, August 1997.

Referee, *Astrophysical Journal*, 1997.

POPULAR ARTICLES AND PUBLIC PRESENTATIONS

Weighing the Universe with Supernovae, *Sky and Telescope Magazine*, January, 1996.

How to Weigh the Universe using Supernovae, Lawrence Berkeley National Laboratory, Popular talk, July, 1996.

PBS television documentary on astronomy and cosmology: was filmed in interviews and during observing at Keck telescope, 1995—1996.

Weighing the Universe with Supernovae, Sonoma State University, Popular talk, November, 1996.

The Fate of the Universe, Lawrence Berkeley National Laboratory, Popular talk, October, 1997.