

March 2005

**RICHARD A. MULLER**

*Personal Information*

Birthdate: January 6, 1944

Married, two children. Wife is architect and structural engineer.

*Education*

A.B. 1964, Columbia University, New York

Ph.D. 1969, University of California, Berkeley, Physics

*Professional positions*

1969-1975 Assistant Research Physicist, Space Sciences Laboratory

1971-1974 Lecturer, Department of Physics, U.C. Berkeley

1975-1978 Associate Research Physicist, Joint Appointment at Lawrence Berkeley Laboratory and Space Sciences Laboratory

1978-1980 Associate Professor of Physics, U.C. Berkeley

1979-Present Faculty Senior Scientist, Lawrence Berkeley Laboratory  
Group Leader, LBL Astrophysics.

1980-present Professor of Physics, University of California, Berkeley

*Research*

1965-1969 Cosmic-ray studies with balloon-borne superconducting magnet.

1968-1973 Nuclear interactions and decay of cascade hyperon  
Liquid proportional counters for high-energy physics and medicine.

Gravity wave detection. Cosmic ray measurements.

1973-1977 Discovered cosine anisotropy in cosmic microwave background  
and high peculiar velocity (600 km/sec) of Milky Way.

"Image sharpness" theorem. Experimental adaptive optics.

Search for heavy charge +1 particles in terrestrial matter.

1976-1991 Accelerator Mass Spectrometry: Invented and first to use method  
for direct detection of natural radioisotopes.

Design and construction of table-top "cyclotron" for dating.

1980-1992 Automated system for supernovae; discovered 20.

1984-present Nemesis theory, and experimental program to find Nemesis.  
Periodicities in crater ages.

Theory of the effect of galactic tides on comet orbits.

1986 Geomagnetic reversals: theory, and association with climate  
events.

1988 Origin of meteorites in comet showers.

1993-2004 Radioisotope dating of lunar spherules for crater rates

1993-2003 Glacial cycles and Earth orbit perturbations (Milankovitch cycles)

1999-present Fossil extinctions

Extraterrestrial accretion

Climate-Astrophysics links

vita of Richard A. Muller

## Deep Earth geophysics

### *Awards and Honors*

- 1977 Texas Instruments Foundation Founders' Prize "for outstanding achievement in the physical sciences."
- 1978 National Science Foundation Alan T. Waterman Award "for highly original and innovative research which has led to important discoveries and inventions in diverse areas of physics, including astrophysics, radioisotope dating, and optics."
- 1982 MacArthur Foundation Prize Fellowship
- 1984 Science Digest list of 100 Outstanding Scientists Under Age 40
- 1985 Fellow, American Physical Society
- 1989 Honorary Doctor of Humane Letters, American University of Switzerland
- 1989 Newsweek citation as one of 25 Innovators in United States
- 1990 Miller Professorship, University of California, Berkeley
- 1991 Fellow, American Association for the Advancement of Science
- 1999 Distinguished Teaching Award, University of California at Berkeley
- 1999 Fellow, California Academy of Arts and Sciences

### *Honorary lectures*

- 1988 Vaden Miles Memorial Lecture, Wayne State University
- 1990 Maria Goeppert Mayer Memorial Lecture, U.Calif. La Jolla
- 1990 Distinguished Lecturer, Mitre Institute, Bedford Massachusetts
- 1990 Wright Science Colloquium speaker, Geneva Switzerland

### *Physics Courses Taught*

for physics majors: H7a, 105 (Mechanics); 49 (Thermodynamics); H5c, H7b, 7b, 110a,b (Electricity and Magnetism, Special Relativity); 110C (Optics); 5e, H5e, 7c, 137a,b,c (Quantum Mechanics); 129a,b (Nuclear Physics) 199, H190 (honors seminar), 295, 299 (Research), H195 (senior honors thesis), 111 (Advanced Laboratory); Graduate Seminar on Physics and U.S. Defense.

for non-majors: 10 (Qualitative Physics), 39 (Freshman Seminars); 106 (Optics for optometrists); 121, 132 (Modern Physics).

Geology & Geophysics: Seminar

### *New Course created*

Physics for future Presidents. This is a complete overhaul for Physics 10.

### *Ph. D. thesis students supervised:*

- Marc Gorenstein, A Measurement of Anisotropy in the Cosmic Background Radiation on a Large Angular Scale at 33 GHz (1978)
- Jordin Kare, Automated Search for Supernovae, LBL-19340 (1984)
- James J. Welch, A Low Energy Cyclotron for Radiocarbon Dating (1984)

vita of Richard A. Muller

- M. Shane Burns, Development of a CCD Camera for an Automated Supernova Search, and Observations of a Supernova in NGC 5033 (1985)
- Saul Perlmutter, An Astrometric Search for a Stellar Companion to the Sun LBL-23187 (November 1986)
- Peter G. Friedman, A Low Background-Rate Detector for Ions in the 5 to 50 keV Energy Range to be used for Radioisotope Dating with a Small Cyclotron, LBL-17804 (1986)
- Kirk Bertsche, A Small Low Energy Cyclotron for Radioisotope Measurements, LBL-28106, November 1989.
- Timothy Sasseen, An Optical and Near Infrared Search for a Pulsar in Supernova 1987A, LBL-29992, December 1990.
- Li Ping Wang (Mechanical Engineering), "Development of the 30" Remote-Operating Robotic Telescope System for the Berkeley Automated Supernova Search." July 1991.
- Heidi Marvin Newberg, "Measuring  $q_0$  using Supernovae at  $z \approx 0.3$ ," July 1992, LBL-32634.
- Craig Kenton Smith, Supernova Rates for the Berkeley Automated Supernova Search Using V and R Band Light Curve Templates (1995)
- Alex Kim, 1997.
- Matthew Kim, High Redshift Supernova Light Curves (1999).
- Timothy Culler 1999 (Geophysics)
- Jonathan Levine 2004. Lunar Glass Spherules as Probes of the Meteoroid Impact History of the Moon.
- Robert A. Rohde (shared with P. Buford Price).

*Consulting, Advisory boards, National Committees*

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|--------------|--|
| 1972-1973    | Oximetrix, San Francisco, Biomedical instrumentation.  |
| 1972-1973    | Unimark, Livermore. Electrostatic printing.  |
| 1974-1975    | American Physical Society. Nuclear reactor safety.   |
| 1973-present | JASON consultant to U.S. Government on energy and U.S. security. Member of steering committee 1980 to 1982.              |
| 1979         | NASA: member of Innovation Study group.<br>NSF: consultant on basic/applied research concepts.                           |
| 1979-1980    | White House Office of Science and Technology Policy: member of committee to analyze putative South African nuclear test. |
| 1981-1987    | Lawrence Livermore Laboratory. Consultant fusion, U.S. security.   |
| 1982-1986    | Advisory Board, Institute of Theoretical Physics, Santa Barbara.   |
| 1983         | Accelerator Mass Spectroscopy committee, Geological Survey.  |
| 1986-1987    | Panel to Explore New Directions, Lawrence Berkeley Laboratory  |

vita of Richard A. Muller

1984-1987	National Academy of Sciences Committee on International Security and Arms Control. Met twice yearly with Soviet delegation.
1989-1990	Board of Overseers, American College of Switzerland, Leysin
1989-present	Institute for Defense Analyses, CRD, Princeton N.J.
1989-1990	FAS Committee to study possible ASAT treaty
1990-	Fellow of the Committee for the Scientific Investigation of Claims of the Paranormal
1990-present	Sponsor, Federation of American Scientists
1991	Helped organize the Kuwaiti Oil Fire Symposium, sponsored by the Union of Concerned Scientists
1990-1992	Organizing committee, NSF Symposium on Frontiers of Science
1991-1992	NRC Committee on Special Operations and Low Intensity Conflict
1991- 1999	Lawrence Livermore Laboratory -- advisory committee for Laboratory Directed Research and Development
1992-present	Institute for Nuclear and Particle Astrophysics, founding committee, Board of Advisors
2000-present	Berkeley Geochronology Center (BCG). Member, Board of Directors

*Professional societies*

American Physical Society (fellow), American Astronomical Society, American Association for the Advancement of Science (fellow); International Astronomical Union, Sigma Xi, American Geophysical Union

*Publications* (numbers in **boldface** indicate refereed journals)

1. Production and decay of cascade hyperon, with P. Dauber, J. Berge, J. Hubbard, D. Merrill, *Phys. Rev.* **179**, 1262 (1969).
2. Study of the reaction  $K^-N$  to  $\Xi^-K$  from threshold to 2.7 GeV/c (Ph.D. thesis), UCRL-19372 (August 8, 1969).
3. Prospect of high spatial resolution for counter experiments: a new particle detector using electron multiplication in liquid Argon, with S. Derenzo, R. Smits, L. Alvarez, UCRL-19254, NAL Summer Study Report, 79-102, Aspen, Colorado (July 1969).
4. Liquid-filled proportional counter, with S. Derenzo, G. Smadja, D. Smith, R. Smits, H. Zaklad, L. Alvarez, *Phys. Rev. Lett.* **27**, 532 (1971).
5. Twin paradox in special relativity, *Am. J. Phys.* **40**, 966 (1972).
6. High precision charged particle detector using Noble liquids, with S. Derenzo, G. Smadja, R. Smits, H. Zakland, L. Alvarez, *Nature* **233**, 617 (1971).
7. Observation of cascade hyperon interactions, *Phys. Lett.* **38B**, 123 (1972).

8. Search for seismic signals from gravitational radiation of pulsar CP1133, with T. Mast, J. Nelson, J. Saarloos, B. Bolt, *Nature* **240**, 140 (1972).
9. High energy particle astronomy, with A. Buffington, L. Smith, G. Smoot, in "Astronomy from a Space Platform," *Am. Astronaut. Soc. Sci. Tech.* **28**, 289 (1972).
10. Recent developments in high resolution Noble liquid counters, with S. Derenzo, D. Smith, R. Smits, H. Zaklad, L. Alvarez, UCRL-20118, NAL Summer Study Report, 45-74, Batavia, Illinois (December 1970).
11. Particle detectors based on Noble liquids, with S. Derenzo, R. Smits, H. Zaklad, Proc. Int. Conf. Instr. for High Energy Physics, Dubna USSR (December 1971).
12. Source of alpha particle collimated to 35 microns, with 7 other authors, UCRL-20857, UC-37 Instruments, TID-4500 58th edition (June 1971).
13. Liquid Xenon radioisotope camera, with H. Zaklad, S. Derenzo, G. Smadja, R. Smits, L. Alvarez, *IEEE Trans. Nucl. Sci.* **NS-19**, 206 (1972).
14. Measurements of geomagnetic cutoff rigidities, with C. Pennypacker, G. Smoot, A. Buffington, L. Smith, *Jour. Geophys. Res.* **78**, 1515 (1973).
15. Liquid-filled multi-wire proportional counter, with S. Derenzo, et al., Fourth Hawaii Topical Conf., U. Hawaii UH-511-109, 109-111 (August 1971).
16. Preliminary images in a 24 wire liquid Xenon gamma ray camera, with H. Zaklad, S. Derenzo, R. Smits, L. Alvarez, *IEEE Trans, Nuc. Sci.* **NS-20**, 429 (1973).
17. Liquid Xenon filled wire chambers, with S. Derenzo, et al., LBL-1321, Proc. XVI Int. Conf. High Energy Physics, U. Chicago (September 1972).
18. Liquid Xenon Compton telescope: a new technique for gamma-ray astronomy, with 7 other authors, UCBSL report series 14, issue 17.
19. Electronic processes in liquid Xenon, with S. Derenzo, T. Mast, H. Zaklad, *Nucl. Inst. & Meth.* **118**, 611 (1974).
20. Real-time correction of atmospherically degraded telescope images through sharpening, R. A. Muller and A. Buffington, *J. Opt. Soc. Am.* **64**, 1200 (1974).
21. Light-water reactor safety, H. Lewis and 11 other authors, *Rev. Mod. Phys.* **47** Suppl 1 (1975). Summary section published separately in *Physics Today* **28**, 38 (July 1975); *Nuclear Safety* (October 1975).
22. Image, optical, R. A. Muller and A. Buffington, 1976 McGraw-Hill Yearbook of Science and Technology.
23. Active image restoration with a flexible mirror, with 4 other authors, Topical Meeting on Imaging in Astronomy, Cambridge, MA (June 18-21, 1975).
24. Active image restoration with a flexible mirror, with 4 other authors, *SPIE/SPSE Tech. Symp. East*, 75 (March 23, 1976).
25. Correction of atmospheric distortion with an image sharpening telescope, A. Buffington, F. Crawford, R. Muller, A. Schwemin, R. Smits, *Jour. Opt. Soc. Am.* **67**, 298 (1977).
26. First observatory results with an image-sharpening telescope, A. Buffington, F. Crawford, R. Muller, and C. Orth, *Jour. Opt. Soc. Am.* **67**, 304 (1977).

27. Aether Drift and the Isotropy of the Universe: Proposal to NASA for a search for anisotropy in the primordial blackbody radiation (1976). Principal Investigator.
28. Quarks with unit charge: a search for anomalous Hydrogen, R.A. Muller, L. Alvarez, W. Holley, E. Stephenson, *Science* **196**, 521 (1977).
29. Radioisotope dating with a cyclotron, *Science* **196**, 489 (1977).
30. Anisotropy of the cosmic microwave background radiation, M. Gorenstein, R.A. Muller, G. Smoot, *Bulletin of Am. Astron. Soc.* **9**, 431 (1977).
31. Detection of anisotropy in the cosmic blackbody radiation, G. Smoot, M. Gorenstein and R.A. Muller, *Phys. Rev. Lett.* **39**, 898 (1977).
32. Radiometer system to map the cosmic background radiation, M. Gorenstein, R.A. Muller, G. Smoot, J. Tyson, *Rev. Sci. Instrum.* **49**, 440 (1978).
33. Sharpening Stellar Images, A. Buffington, F. Crawford, R.A. Muller, S. Pollaine, C. Orth, *Science* **200**, 489 (1978).
34. The Cosmic Background Radiation and the New Aether Drift, *Scientific American* **238**, 64-74 (May 1978).
35. Radioisotope Dating with an Accelerator: a Blind Measurement, R. A. Muller, E. Stephenson, T. Mast, LBL-7249 (December 1977), *Science* **201**, 347 (1978).
36. Radioisotope dating with the Berkeley 88" cyclotron, LBL-7585 (April 1978), in Proc. of the Conf. on Radiocarbon Dating With Accelerators, H.E. Gove, editor, University of Rochester, 1978.
37. Radiocarbon Dating with a Cyclotron, with E. Stephenson, T. Mast. *Nucl. Instr. Meth.* **158**, 571 (1979).
38. Radioisotope Dating with Accelerators, *Physics Today*, p.23-29 (February 1979).
39. Cosmic Microwave Background--present status and future prospects, LBL-8799, *Annals New York Acad. Science* **336**, 116 (1980).
40. Cosmology, 1980 McGraw-Hill Yearbook of Science and Technology.
41. Magnet-gun Igniter for Controlled Thermonuclear Fusion, R. Garwin, R.A. Muller and B. Richter, SRI Technical report JSN-77-20 (1978), *Atomkernenergie* **35**, 300 (1980).
42. Impact Fusion with a Segmented Rail Gun, R. Garwin, R.A. Muller, and B. Richter, in Proc. of the Conference on Impact Fusion, Los Alamos (1979).
43. Radiocarbon Dating, with E. Taylor, McGraw-Hill Encyclopedia of Science and Technology, 5th edition, p. 328-335 (1982).
44. Cosmic Microwave Radiation, McGraw-Hill Encyclopedia of Science and Technology, 5th edition, p. 668-670 (1982).
45. Innovation and Scientific Funding, *Science* **209**, 880 (1980). (Based on testimony to the House Subcommittee on Science, Research, and Technology, 11 September 1979. Excerpts in *Federation of American Scientists Newsletter*.)
46. Radioisotope Detection and Dating with Accelerators, Terry S. Mast and Richard A. Muller, *Nuclear Science Applications* **1**, 7 (1980).
47. Radioisotope detection with accelerators, T.S. Mast, R.A. Muller, and P.P. Tans, in "The Ancient Sun", R. Pepin, J. Eddy, R. Merrill ed., (Permagon Press, 1980); *Geochimica et Cosmochimica Acta*, Suppl. 13, 191 (1980).

48. Cosmic Quadrupole?, *Nature* **291**, 609 (1981).
49. Mass Spectrometry with a Very Small Cyclotron, R.A. Muller, P.P. Tans, T.S. Mast, and J.J. Welch, LBL-12797, published in Proceedings of the Symposium on Accelerator Mass Spectrometry, Argonne National Lab, Report ANL/PHY-81-1 (1981).
50. The Berkeley Automated Supernova Search, presented at NATO Conference on Supernovae, June 29 - July 10, 1981, Cambridge, England. Published as Lawrence Berkeley Laboratory report LBL-13317 (1981), and in "Supernovae: A Survey of Current Research", M.J. Rees and R.J. Stoneham, editors, (D. Reidel Co., Dordrecht 1981) p. 325-339.
51. How Black is the Universe? *Nature* **295**, 95 (1982).
52. Submarines, Quarks, and Radioisotope Dating, LBL-13902 (January 1982). in *The Selected Works of Luis W. Alvarez, with Commentary*, W. Peter Trower editor, Univ. Chicago Press, 1987.
53. Extinction of Species by Periodic Comet Showers, Marc Davis, Piet Hut, and R.A. Muller, LBL-177298 (December 1983), *Nature* **308**, 715-717 (1984).
54. Evidence in Crater Ages for Periodic Impacts on the Earth, W. Alvarez and R.A. Muller, LBL- 17300 (January 1984), published in *Nature* **308**, 718-720 (1984).
55. Evidence for a Solar Companion Star, LBL-18271 (August 1984), published in *The Search for Extraterrestrial Life: Recent Developments* (M.D. Papagiannis, editor), pp. 233-243, (D. Riedel Pub. Co., Dordrecht, Holland, 1985).
56. Tidal Gravitational Forces: The Infall of "New" Comets and Comet Showers, D. E. Morris and R.A. Muller, LBL-18942 (January 1985), *Icarus* **65**, 1-12 (1986).
57. Terrestrial catastrophism: Nemesis or Galaxy? R.A. Muller, M. Davis, and P. Hut, *Nature* **313**, 503 (February 1985).
58. Cometary showers and unseen solar companions -- a reply, R. A. Muller, P. Hut, M. Davis, and W. Alvarez, *Nature* **314**, 517-518 (1985).
59. Evidence for Nemesis: a Solar Companion Star, September 1985, LBL-20438 (October 1985), published in *The Galaxy and the Solar System*, ed. R. Smoluchowski, J. Bahcall, and M. Matthews, pp. 387-396 (University of Arizona Press, Tucson, 1986).
60. A 40 keV Cyclotron for Radioisotope Dating, with J.J. Welch, Kirk J. Bertsche, P.G. Friedman, D. E. Morris, and P.P. Tans, *Nucl. Instr. Meth. Phys. Res.***B5**, 230-232 (1984).
61. A Low Energy Cyclotron for Radiocarbon Dating, J.J. Welch, K.J. Bertsche, P. Friendman, and D.E. Morris, R. A. Muller, and P. P. Tans, *Nuclear Instruments and Methods in Physics Research* **B18**, 202-214 (1987).
62. Geomagnetic Reversals from Impacts on the Earth, Richard A. Muller and Donald E. Morris, LBL-20131, (September 1985, revised August 1986), published in *Geophysical Research Letters* **13**, 1177-1180 (1986). The article is summarized in *Physics Today*, February 1987, pp 17-20.
63. Evidence for Comet Showers in Meteorite Ages, S. Perlmutter and R. A. Muller, LBL-22659 (December, 1986), *Icarus*.**74**, 369-373 (1988).

64. A low background-rate detector for 40 keV ions, P. G. Friedman, K. J. Bertsche, M. C. Michel, D. E. Morris, R. A. Muller, P. P. Tans, and J. J. Welch, LBL-22676 (January 1987), *Reviews of Scientific Instruments* **59**, 98-111 (1988).
65. An Automated Search for Supernova Explosions, with J. T. Kare, M. S. Burns, F. S. Crawford, P. G. Friedman, C. R. Pennypacker, S. Perlmutter, and R. Williams, LBL-23782 (July 1987); *Reviews of Scientific Instruments*. **59(7)**, 1021-1030 (July 1988).
66. Status of the Berkeley Small Cyclotron AMS Project, K. J. Bertsche, P. G. Friedman, Donald E. Morris, Richard A. Muller, James J. Welch, *Nuclear Instruments and Methods in Physics Research* **B29**, 105-109 (1987).
67. Advanced Accelerator Methods: The Cyclotron, J. J. Welch, K. J. Bertsche, P. G. Friedman, D. E. Morris, and R. A. Muller, LBL-23323 (April 1987), published in the Proceedings of the University of California Conference on Accelerator Mass Spectrometry, Irvine California, February 1986, J. E. Ericson and R. E. Taylor, eds, CONF-8602126 (Aug 1989; Lawrence Livermore National Lab.).
68. Observation of the Type II Supernova in M99, Carl Pennypacker, M. S. Burns, F. S. Crawford, P. G. Friedman, J. R. Graham, J. T. Kare, R. A. Muller, S. Perlmutter, C. K. Smith, R. R. Treffers, R. W. Williams, G. Basri, J. Bixler, A. V. Filippenko, C. Foltz, D.R. Garnett, R. P. Harnkess, V. Junkkarinen, R. Kennicutt, P. J. McCarthy, H. Spinrad, J. C. Wheeler, H. Willick, B. J. Wills, *The Astronomical Journal* **97**, 186-193, plate p. 313 (January 1989).
69. Comet Showers, Periodic Extinctions, and Iridium, *Science* **234**, 1484-1485 (1986).
70. The Berkeley search for a faint stellar companion to the sun, S. Perlmutter, M. S. Burns, F. Crawford, P. Friedman, J. Kare, R. A. Muller, and C. Pennypacker, in *Astrophysics of Brown Dwarfs*, eds. M. Kafatos, R. Harrington, and S. Maran, p. 87-92 (Cambridge University Press, 1986).
71. 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*, Conference Proceedings, Santa Cruz 1987, p. 674-680 (1988).
72. Magnetic reversal rate and sea level, R. A. Muller and D. E. Morris, *Nature* **332**, 211 (1988).
73. Geomagnetism, Sea Level and Tectonics, a letter in reply, R.A. Muller and D.E. Morris, *Physics Today* **41**, 122 (1988).
74. Limits on an Optical Pulsar in Supernova 1987A, C. Pennypacker, J. Kristian, J. Middleditch, M. Hamuy, J. Imamura, W. Kunkel, D. Morris, R. Muller, S. Perlmutter, S. Rawlings, T. Sasseen, I. Shelton, T. Steiman-Cameron, I. Tuohy, *Astrophysical Journal Letters* **340**, L61-L64 (May 15, 1989).
75. Submillisecond optical pulsar in supernova 1987A, J. Kristian, C. R. Pennypacker, 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, *Nature* **338**, 234-236 (16 March 1989).



76. A Search for Nemesis: Current Status and Review of Theory. S. Perlmutter, R. A. Muller, C. R. Pennypacker, C. K. Smith, L. P. Wang, S. White, H. S. Yang, to be published in the proceedings of the Second Snowbird Conference on Mass Extinctions (1989).
77. Further Analysis of the PSR1987A Discovery Data: 7.5-hour and 2-hour periods, pulse profile, and revised pulsed luminosity, J. Middleditch, C. R. Pennypacker, J. Kristian, J. R. Graham, S. Heathcote, 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, to be submitted to the *Journal of Irreproducible Results*.
78. Recent Advances in the Berkeley Automated Supernova Search: The Introduction of a Real-Time System, C. K. Smith, F. Crawford, R. A. Muller, C. Pennypacker, S. Perlmutter, T. Sasseen, R. Williams, R. Treffers, in *Automatic Small Telescopes*, ed. D. S. Hayes and R. M. Genet editors, pp. 47-64 (Fairborn Observatory, 1988).
79. Automated Supernova Discoveries: status of the Berkeley project, Carl Pennypacker, Frank Crawford, Heidi Marvin, Richard A. Muller, Saul Perlmutter, Tim Sasseen, Craig Smith, Richard Treffers, Roger Willimas, Li-Ping Wang, in *Particle Astrophysics: Forefront Experimental Issues*, E. B. Norman editor, pp. 188-189 (World Scientific, 1989).
80. The First Year (Almost) of Real-time Automated Operation of the Berkeley Supernova Search, Saul Perlmutter, Frank Crawford, Heidi Marvin, Richard Muller, Carl Pennypacker, Tim Sasseen, Craig Smith, Li-Ping Wang, in *Particle Astrophysics: Forefront Experimental Issues*, E. B. Norman editor, pp. 196-197 (World Scientific, 1989).
81. Current Status of the Berkeley Cyclotron, K.J. Bertsche, P.G. Friedman, R.A. Muller, and J.J. Welch, LBL-25450 (1988), to be published in the proceedings of the 13 International Radiocarbon Conference, Dubrovnik, Yugoslavia, June 20-25, 1988.
81. Detection of radiocarbon in the cyclotron, K.J. Bertsche, C.A. Karadi, R.A. Muller, G. C. Paulson, LBL-29556, *Nucl Instr Meth in Physics Research B*, 398-404(1991).
82. Radiocarbon detection with a small low energy cyclotron, K.J. Bertsche, C.A. Karadi, R.A. Muller, LBL-29567 (1990), *Nucl. Instr. Meth.* A301, March 1 1991.
83. Accelerator AMS: Cyclotrons and Cyclotrons, R. A. Muller and K. J. Bertsche, in "Rare Nuclear Processes," pp. 93-99, World Scientific (1992); the Proceedings of the 14th Europhysics Conference on Nuclear Physics, 22-26 October 1990, Bratislava Czechoslovakia.
85. Thomas Precession: Where is the Torque? R. A. Muller, *Am. J. Physics.* **60**, 313-317 (1992).
86. The New 30-inch Telescope for the Berkeley Automated Supernova Search, Li-Ping Wang, Frank S. Crawford, Ned Hamilton, Richard A. Muller, Carlton R.

- Pennypacker, Saul Perlmutter, and Robert Smits, in *Robotic Telescopes*, M. Seeds editor, Fairborn Press (1991).
87. Operatorless Discoveries of Supernovae, Carlton R. Pennypacker et al., in *Robotic Telescopes*, M. Seeds editor, Fairborn Press (1991).
  88. Progress and New Directions for the Berkeley Supernova Search, S. Perlmutter, H. J. Marvin, R. A. Muller, C. R. Pennypacker, T. P. Sasseen, and C. K. Smith, in *Supernovae*, S. E. Woosley, editor, p. 727-730, Springer-Verlag (1991).
  89. The Berkeley/Anglo-Australian Observatory High-Redshift Supernova Search, G. Goldhaber, S. Perlmutter, C. Pennypacker, H. Marvin, R. A. Muller, W. Couch, B. Boyle, LBL-30591 (November 1990); Proc. Supernova Watch Workshop, Los Angeles CA, Nov. 26-27, 1990. LBL-30591, published in *Trends in Astroparticle Physics*, D. Cline & R. Peccei, eds, pp 504-525 (1992).
  90. No Pulsar in SN1987A, J. Kristian, C. R. Pennypacker, J. Middleditch, M. A. Hamuy, S. Heathcote, J. N. Imamura, W. E. Kunkel, R. Lucino, D. E. Morris, R. A. Muller, S. Perlmutter, S. J. Rawlings, T. P. Sasseen, I. K. Shelton, T. Y. Steiman-Cameron, and R. Tuohy, *Nature* **349**, 747 (Feb 1991).
  91. Preliminary Estimates of Core-Collapse Supernova Rates, C. Pennypacker et al., Proc. Supernova Watch Workshop, Los Angeles CA, Nov. 26-27, 1990. LBL-30590, published in *Trends in Astroparticle Physics*, D. Cline & R. Peccei, eds, pp 477-482 (1992).
  92. High Rate for Type Ic Supernovae, Richard A. Muller, Heidi Jo Marvin Newberg, Carlton R. Pennypacker, Saul Perlmutter, Timothy P. Sasseen, and Craig K. Smith, LBL preprint #31220, *Ap. J. Lett.* **384**, L9-L13, January 1, 1992.
  93. Cosmic background radiation, Richard A. Muller, McGraw-Hill Encyclopedia of Astronomy, 2nd Edition (to be published, 1992).
  94. The Most Distant Supernova Observed So Far and the Quest for Omega, G. Goldhaber, C. Pennypacker, S. Perlmutter, A. Goobar, J. Desai, A. Kim, M. Kim, R. Muller, H. Newberg, I. Small, B. Boyleh, P. Bunclark, D. Carter, R. McMahon, R. Terlevich, R. Ellis, K. Glazebrook, W. Couch, proc. 2nd Nestor International Workshop in Pylos, Greece, Oct 19-21, 1992.
  95. The Nemesis Theory for a 26-Million-year Cycle, a Point/Counterpoint to Steven M. Stanley, in *Biology, The Web of Life*, by Daniel D. Chiras (West Publishing Co, 1993), p. 622.
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### ***Patents***

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### ***Poetry, Popular Articles, and unrelated experience***

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