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Current Comments

The 1977 Articles Most Cited from 1977 to 1979. 2. Physical Sciences

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Last week, we published lists of about 125 of the 1977 life sciences articles that were most cited in 1977-79.[1] This week, we present a similar list of articles from the physical sciences. Studies of papers that receive immediate bursts of citations are useful for identifying the "hot" disciplines of science. They also serve as good predictors of future citation activity. In last week's study, for example, we showed that if we had taken into account citations received in 1979, three-quarters of the life sciences papers that were most cited in 1977-78 would remain on the list for 1979.

One would expect the average paper in the *Science Citation Index® (SCI®)* to receive a citation or two over a two year period. But the least cited papers on this week's list received 29 citations in 1977-78. The most-cited paper received 171 citations. The average paper was cited 45.2 times. It received 8.9 of those citations in 1977, and 36.3 in 1978. In our study of the 1977 life sciences papers, we found an average of 66 citations per paper.[1] This difference in average citation rates can of course be explained by the greater volume of the life sciences literature. But it also reflects a trend in many life science disciplines toward increasing numbers of references per article.[2]

The papers in our study were published in 28 journals. *Physical Review Letters* alone contributed 32 papers. *Physics Letters B* contributed 13. These same journals were also the top contributors to our study of the most-cited 1976 physical science articles.[3] Table 1 lists the journals represented in this study.

The 74 institutions that produced these papers are listed in Table 2. Well over half of these institutions, 41, are in the United States. The Federal Republic of Germany accounts for 11. France and the United Kingdom each have five of the institutions listed here. Italy and the Soviet Union each have two. Two institutions are located in Switzerland, although one of them cannot be properly called a Swiss lab. The European Organization for Nuclear Research (CERN), which operates one of the world's largest particle accelerators, has its headquarters in Geneva, but it is actually a consortium of 12 Western European nations. Belgium, Chile, Denmark, Japan, Spain, and Sweden each have one institution listed in Table 2.

All of the papers presented here were published in English. However, the papers by E.V. Dehmlow and W. Oppolzer were also published in the German edition of *Angewandte Chemie*. The citation figures given for these papers include both the English and German versions. However, the number of citations received by the English versions of these papers alone was enough to qualify them for inclusion in this study.

Twenty-one papers on the list are single-author works. Thirty-four have two authors. Seventeen have three, and six have four. Two papers have five authors, three have six, four have seven, one has nine, and one has 13. There are

Table 1: The 28 journals represented on the list of 1977 physical science papers most cited in 1977-79. The numbers in parentheses are the impact factors for the journals. (Impact equals average number of citations received by articles within each journal according to the 1978 *Journal Citation Reports®*.) The figures at the right indicate the number of papers from each journal which appear on the list.

Phys. Rev. Lett. (6.573)	32
Phys. Lett. B (4.037)	13
Nucl. Phys. B (3.670)	7
Phys. Rev. D (2.982)	7
Astrophys. J. (4.348)	5
Phys. Rev. B (3.255)	5
J. Amer. Chem. Soc. (5.327)	4
Angew. Chem. Int. Ed. (4.684)	2
Ann. Phys. NY (3.242)	2
Opt. Commun. (1.950)	2
Phys. Rev. C (2.268)	2
Rev. Mod. Phys. (19.213)	2
Solid State Commun. (2.252)	2
Adv. Chem. Phys. (9.813)	1
Annu. Rev. Astron. Astrophys. (9.914)	1
Annu. Rev. Nucl. Sci. (5.524)	1
Appl. Phys. Lett. (3.244)	1
Chem. Phys. Lett. (2.322)	1
Chem. Rev. (10.471)	1
Commun. Phys. (Not calculated)	1
Icarus (2.032)	1
Inorg. Chem. (2.652)	1
J. Chem. Phys. (3.043)	1
J. Opt. Soc. Amer. (2.289)	1
Nucl. Phys. A (2.813)	1
Phil. Mag. (2.138)	1
Phys. Lett. A (1.246)	1
Science (5.927)	1

three papers with 16 authors, one with 17, one with 24, three with 29, one with 36, and one with 40. One paper had 51 authors.

Eighty-eight authors have two papers on the list. J.C. Le Guillou, J. Zinn-Justin and R. Jackiw each have three papers. S. Weinberg, the 1979 Nobelist in physics, has four papers on the list, more than any other author.

We have divided the list into 12 subject headings and alphabetized the listings under each heading. We did this to discourage comparisons of citation rates among individual papers. I have repeatedly cautioned that the papers appearing in our studies are not necessarily the "best" ones.

The subject areas represented in our study are field theory, elementary particle physics (theoretical), elementary particle physics (experimental), condensed matter physics, physical chemistry, astrophysics and astronomy, atomic and molecular physics, nuclear physics, lasers and fiber optics, organic chemistry, geophysics, and inorganic chemistry.

Twenty-one papers represent work on field theory, the study of the fundamental forces of the universe. The ultimate goal of field theory is to explain all forces in terms of a single theoretical framework, or unified field theory. Seven papers in this group are directly concerned with gauge theories, although several others deal peripherally with the subject. Gauge theories provide a common form for describing each of the four known forces of nature. The fourth most-cited paper on the list, that by T.P. Cheng and L.F. Li, discusses the behavior of certain particles in terms of gauge theory. That paper received 84 citations. A paper by 1979 Nobel prize winners S.L. Glashow and S. Weinberg appears in this group.

Table 2: *The institutional affiliations of authors on* the list. Institutions are in descending order of the number of papers produced. The number of authors from each institution is shown in parentheses.

Harvard University[1]		17 (36)
Univ. California		10 (52)
Berkeley	7 (43)	
Irvine	1 (4)	
Los Alamos, NM	1 (2)	
San Diego	1 (3)	
MIT		8 (14)*
Stanford University[2]		8 (40)*
Fermi National Accelerator Laboratory		8 (27)*
CERN, Geneva		7 (35)
State Univ. New York		6 (14)*
Stony Brook	5 (13)*	
Buffalo	1 (1)	
California Inst. Technol.		5 (18)
Princeton University		5 (13)
CENS, Gif-sur-Yvette, France		5 (21)
University of Pennsylvania		5 (12)
Cornell University		4 (6)
CNRS, Paris, France		4 (15)
Bell Laboratories, Murray Hill, NJ		3 (5)*
University of Chicago[3]		3 (14)
University of Illinois		3 (8)
Urbana-Champaign	2 (7)	
Chicago	1 (1)	
University of Oxford, UK		3 (14)
University of Wisconsin		3 (9)
Columbia University		2 (12)
City Univ. New York, City College		2 (2)
IBM, Yorktown Heights, NY		2 (2)

Inst. Haut. Etud. Sci. Bures-sur-Yvette, France	2 (2)
Rhine-Westphalia Tech. Univ. Aachen, FRG	2 (18)
Rockefeller University	2 (3)
Rutgers Univ., New Brunswick, NJ	2 (6)
University of Bologna, Italy	2 (6)
University of Cambridge, UK	2 (2)
University of Dortmund, FRG	2 (11)
University of Heidelberg, FRG	2 (11)
University of Munich, Garching, FRG	2 (3)
Acad. Cien. Exact., Zaragoza, Spain	1 (1)
Brookhaven Nat. Lab., Upton, NY	1 (1)
Brown University, Providence, RI	1 (2)
Chalmers University Technol. Göteborg, Sweden	1 (1)
Company for Heavy-Ion Research, Darmstadt, FRG	1 (2)
Cerro Tololo Inter-Amer. Observ. LaSerena, Chile	1 (2)
Carnegie-Mellon University	1 (1)
DESY, Hamburg, FRG	1 (8)
DuPont Co., Wilmington, DE	1 (1)
Inter-Univ. Inst. High Energies Brussels, Belgium	1 (5)
Nordita, Copenhagen, Denmark	1 (1)
Inst. Adv. Study, Princeton, NJ	1 (2)
Karlsrühe University, Karlsrühe, FRG	1 (1)
L.D. Landau Inst., Theoret. Phys. Moscow, USSR	1 (1)
Max-Planck-Inst., Munich, FRG	1 (8)
Montana State University Bozeman, MT	1 (1)
Moscow Inst. Phys. Engineering, USSR	1 (1)
Naval Research Lab., Washington, DC	1 (3)
New York University	1 (1)
Northern Illinois University	1 (1)
Northwestern University	1 (7)
NASA, Moffett Field, CA	1 (2)
Oak Ridge Nat. Lab.	1 (4)
Polytechnic School, Palaiseau, France	1 (6)
Rutherford Lab., Oxfordshire, UK	1 (1)
Technical University of Berlin, FRG	1 (1)
University of Birmingham, UK	1 (1)
University of Colorado & Nat. Bureau Stds., Boulder, CO	1 (1)
University College, London, UK	1 (4)
University of Geneva, Switzerland	1 (1)
University of Hamburg, FRG	1 (8)
University of Hawaii	1 (7)
University of Marburg, FRG	1 (2)
University of Milan, Milan, Italy	1 (7)
University of Missouri	1 (1)
University of Minnesota	1 (1)
University of Paris VI, France	1 (1)
University of Rochester	1 (2)
Univ. of Southern Calif., Los Angeles	1 (1)
University of Tokyo	1 (8)
University of Texas, Austin, TX	1 (2)
University of Washington, Seattle, WA	1 (2)
Vanderbilt University, Nashville, TN	1 (1)
Yale University	1 (2)

*one or more of these authors represents a second affiliation for a single-authored paper

1) including the Smithsonian Astrophysics Observatory

2) including SLAC

3) including the Enrico Fermi Institute

Theoretical work in elementary particle physics accounts for 19 of the papers listed. This branch of research is primarily concerned with finding a fundamental theory to explain the existence, properties, and interactions of various subatomic particles. The second most-cited paper on the list is from this field of research. That paper, by R.D. Field and R.P. Feynman, received 129 citations during the two year period. It discusses one source of mesons, particles consisting of a quark and its antimatter equivalent. Quarks are the most fundamental particles known, although no one has even seen a quark in isolation.

Fourteen papers are from the field of experimental elementary particle physics. It is this group which contains most of the papers that have more than ten authors. In fact, papers in this group average nearly 24 authors apiece. Much of this research involves the use of gigantic particle accelerators, which shoot particles into bubble chambers where their behavior can be recorded and studied. Experiments that use such equipment require enormous collaborative effort. The most-cited paper in our study, that by S.W. Herb and others, made use of the Fermi National Laboratory Accelerator at Batavia, Illinois, to study certain types of particle collisions. The third most-cited paper, by A. Benvenuti and colleagues, received 96 citations. It too described an experiment performed at the Fermi Laboratory.

Ten papers are on various topics in condensed matter physics. This broad field encompasses solid state physics, condensed liquids, and superconductors. Researchers in condensed matter physics study the structure of condensed matter, as well as its mechanical, electric, magnetic, and optical properties.

Eight papers were from the field of physical chemistry. E.L. Muetterties has two papers in this group. The one he co-authored with G.C. Demitras concerns a method for obtaining synthetic fuel from coal, while his other paper provides a general description of certain catalytic reactions as they apply to fuel synthesis.

Astrophysics and astronomy contributed seven papers to the list. The topics of these papers range from a theory of how the process that formed our solar system was triggered, to a listing of the various kinds of quasars, the most distant objects in our universe.

Seven papers are from atomic and molecular physics. Four of them deal with a recently discovered phenomenon called multiphoton molecular dissociation. By this process, a molecule loses one or more of its constituent atoms when exposed to a laser beam. Research into this process can have applications to the synthesis of chemicals.

Five papers were on various topics in nuclear physics. Four papers involved research in lasers and fiber optics. There are three organic chemistry papers, while geophysics and inorganic and organometallic chemistry each contributed one paper.

As in last week's study of the 1977 life sciences articles, we looked at what would happen if we counted citations received in 1979. We find that 80 of the papers in Figure 1 would remain on the list. In Figure 2, we present the additional highly cited 1977 papers that would have been on the list if we had taken into account citations received in 1979.

It is probable that many of the papers in Figure 2 barely missed the list in Figure 1 because they were actually published in the early part of 1978. Since the cover dates of journals do not always correspond to the dates they are published, we may have omitted a few papers with equivalent citation rates from this study. It is worth repeating that only a small fraction of the millions of papers published ever achieve a lifetime impact of 100 or more citations. Yet some truly milestone papers never achieve such a distinction. This is a subject of interest to science historians who want to use quantitative methods to identify the major breakthroughs in each field.

We have to date published lists of the most-cited articles for each year since 1970. This series of studies will continue. I would expect our analysis of the most-cited papers of 1979 to appear in the spring of 1981, shortly after we complete the processing for the annual edition of the *SCI*.

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3. --------------. The 1976 articles most cited in 1976 and 1977. 2. Physical sciences. *Current Contents* (17):5-16, 23 April 1979.

Figure 1: The 1977 physical sciences articles most-cited in 1977-78. Authors' affiliations follow each citation. Journals are often ambiguous about addresses. When we could not tell which author was at which organization, we have simply given the addresses without linking them to specific authors.

1977 Articles Most-Cited in 1977-1978

FIELD THEORY

77	78	Total Citations	Bibliographic Data
5	24	29	**Beg M A B,[1] Budny R V,[1] Mohapatra R[2] & Sirlin A.[3]** Manifest left-right symmetry and its experimental consequences. *Phys. Rev. Lett.* 38:1252-5, 1977. 1. Rockefeller Univ., New York, NY; 2. CUNY, City Coll., New York, NY; 3. New York Univ., New York, NY
12	41	53	**Brézin E, Le Guillou J C & Zinn-Justin J.** Perturbation theory at large order. I. The ϕ^{2N} interaction. *Phys. Rev. D* 15:1544-57, 1977. CENS, Serv. Theor. Phys., Gif-sur-Yvette, France
9	27	36	**Brézin E, Le Guillou J C & Zinn-Justin J.** Perturbation theory at large order. II. Role of the vacuum instability. *Phys. Rev. D* 15:1558-64, 1977. CENS, Serv. Theor. Phys., Gif-sur-Yvette, France
49	35	84	**Cheng T P[1] & Li L F.[2]** Nonconservation of separate μ- and e- lepton numbers in gauge theories with $V + A$ currents. *Phys. Rev. Lett.* 38:381-4, 1977. 1. Univ. Missouri, Dept. Phys., St. Louis, MO; 2. Carnegie-Mellon Univ., Dept. Phys., Pittsburgh, PA
22	54	76	**De Rújula A, Georgi H & Politzer H D.** Demythification of electroproduction local duality and precocious scaling. *Ann. Phys. NY* 103:315-53, 1977. Harvard Univ., Lyman Lab. Phys., Cambridge, MA
13	17	30	**Ferrara S, Scherk J & Zumino B.** Supergravity and local extended supersymmetry. *Phys. Lett. B* 66:35-8, 1977. CNRS, Ecole Norm. Super., Lab. Theor. Phys., Paris, France
26	36	62	**Glashow S L & Weinberg S.** Natural conservation laws for neutral currents. *Phys. Rev. D* 15:1958-65, 1977. Harvard Univ., Lyman Lab. Phys., Cambridge, MA
4	30	34	**Hawking S W.** Gravitational instantons. *Phys. Lett. A* 60:81-3, 1977. Univ. Cambridge, Dept. Appl. Math. & Theoret. Phys., Cambridge, UK
11	35	46	**Hinchliffe I & Smith C H L.** Possible pattern of scaling violations in the production of w's, z's and μ-pairs. *Phys. Lett. B* 66:281-5, 1977. Univ. Oxford, Dept. Theoret. Phys., Oxford, UK
2	49	51	**Jackiw R.** Quantum meaning of classical field theory. *Rev. Mod. Phys.* 49:681-706, 1977. MIT, Lab. Nucl. Sci. & Dept. Phys., Cambridge, MA
7	22	29	**Jackiw R & Rebbi C.** Degrees of freedom in pseudoparticle systems. *Phys. Lett. B* 67:189-92, 1977. MIT, Lab. Nucl. Sci. & Dept. Phys., Cambridge, MA
16	46	62	**Jackiw R, Nohl C & Rebbi C.** Conformal properties of pseudoparticle configurations. *Phys. Rev. D* 15:1642-6, 1977. MIT, Lab. Nucl. Sci. & Dept. Phys., Cambridge, MA
15	61	76	**Lee B W & Weinberg S.** $SU(3) \otimes U(1)$ gauge theory of the weak and electromagnetic interactions. *Phys. Rev. Lett.* 38:1237-40, 1977. Fermi Nat. Accelerator Lab., Batavia, IL; Stanford Univ., Stanford, CA
3	38	41	**Le Guillou J C[1] & Zinn-Justin J.[2]** Critical exponents for the *n*-vector model in three dimensions from field theory. *Phys. Rev. Lett.* 39:95-8, 1977. 1. Univ. Paris VI, Lab. Theor. Phys. & High Energ., Paris, France; 2. CENS, Serv. Theor. Phys., Gif-sur-Yvette, France
10	25	35	**MacDowell S W & Mansouri F.** Unified geometric theory of gravity and supergravity. *Phys. Rev. Lett.* 38:739-42, 1977. Yale Univ., Phys. Dept., New Haven, CT
19	64	83	**Mohapatra R N[1] & Sidhu D P.[2]** Implications for gauge theories if search for parity nonconservation in atomic physics fails. *Phys. Rev. Lett.* 38:667-70, 1977. 1. CUNY, City Coll., Dept. Phys., New York, NY; 2. Brookhaven Nat. Lab., Upton, NY
13	17	30	**Parisi G.** Asymptotic estimates in perturbation theory. *Phys. Lett. B* 66:167-9, 1977. Inst. Haut. Etud. Sci., Bures-sur-Yvette, France

19 59 78 **Polyakov A M.** Quark confinement and topology of gauge theories. *Nucl. Phys. B* 120:429-58, 1977. Nordita, Copenhagen, Denmark; L.D. Landau Inst. Theoret. Phys., Moscow, USSR

7 26 33 **Schwarz A S.** On regular solutions of Euclidean Yang-Mills equations. *Phys. Lett. B* 67:172-4, 1977. Moscow Inst. Phys. Engn., Moscow, USSR

4 28 32 **Wess J & Zumino B.** Superspace formulation of supergravity. *Phys. Lett. B* 66:361-64, 1977. Karlsrühe Univ., Karlsrühe, FRG; CERN, Geneva, Switzerland

17 40 57 **Witten E.** Some exact multipseudoparticle solutions of classical Yang-Mills theory. *Phys. Rev. Lett.* 38:121-4, 1977. Harvard Univ., Lyman Lab. Phys., Cambridge, MA

ELEMENTARY PARTICLE PHYSICS (THEORETICAL)

15 35 50 **Albright C H,[1] Smith J[2] & Vermaseren J A M.[2]** Heavy-lepton-cascade interpretation of the neutrino-induced trimuon events. *Phys. Rev. Lett.* 38:1187-90, 1977. 1. Northern Illinois Univ., Dept. Phys., DeKalb, IL & Fermi Nat. Accelerator Lab., Batavia, IL; 2. SUNY, Inst. Theoret. Phys., Stony Brook, NY

2 32 34 **Altarelli G[1] & Parisi G.[2]** Asymptotic freedom in parton language. *Nucl. Phys. B.* 126:298-318, 1977. 1. CNRS, École Norm. Super., Lab. Phys. Theor. & Univ. Paris, France; 2. Inst. Haut. Etud. Sci., Bures-sur-Yvette, France

15 37 52 **Barger V,[1] Gottschalk T,[1] Nanopoulos D V,[1] Abad J[2] & Phillips R J N.[3]** Lepton-cascade-decay interpretation of neutrino-produced trimuons. *Phys. Rev. Lett.* 38:1190-3, 1977. 1. Univ. Wisconsin, Phys. Dept., Madison, WI; 2. Acad. Cien. Exact., Fisico-Quimicas Natur. Sci., Dept. Phys., Zaragoza, Spain; 3. Rutherford Lab., Chilton, Didcot, Oxfordshire, UK

17 19 36 **Bjorken J D & Weinberg S.** Mechanism for nonconservation of muon number. *Phys. Rev. Lett.* 38:622-5, 1977. Stanford Univ., SLAC & Dept. Phys., Stanford, CA

10 55 65 **Callan C G, Dashen R & Gross D J.** A mechanism for quark confinement. *Phys. Lett. B* 66:375-81, 1977. Inst. Adv. Study, Princeton, NJ; Princeton Univ., J. Henry Labs., Princeton, NJ

0 29 29 **Combridge B L, Kripfganz J & Ranft J.** Hadron production at large transverse momentum and QCD. *Phys. Lett. B* 70:234-8, 1977. CERN, Geneva, Switzerland

8 59 67 **Eichten E & Gottfried K.** Heavy quarks in e^+e^- annihilation. *Phys. Lett. B* 66:286-90, 1977. Cornell Univ., Lab. Nucl. Studies, Ithaca, NY

0 32 32 **Ellis J, Gaillard M K, Nanopoulos D V & Rudaz S.** The phenomenology of the next left-handed quarks. *Nucl. Phys. B* 131:285-307, 1977. CERN, Geneva, Switzerland

0 32 32 **Feynman R P, Field R D & Fox G C.** Correlations among particles and jets produced with large transverse momenta. *Nucl. Phys. B* 128:1-65, 1977. Calif. Inst. Technol., Pasadena, CA

18 111 129 **Field R D & Feynman R P.** Quark elastic scattering as a source of high-transverse-momentum mesons. *Phys. Rev. D* 15:2590-616, 1977. Calif. Inst. Technol., Pasadena, CA

8 38 46 **Jaffe R L.** Multiquark hadrons. I. Phenomenology of $Q^2\bar{Q}^2$ mesons. *Phys. Rev. D* 15:267-80, 1977. Stanford Univ., SLAC, Stanford, CA; MIT, Lab. Nucl. Sci. & Dept. Phys., Cambridge, MA

7 29 36 **Jaffe R L.** Multiquark hadrons. II. Methods. *Phys. Rev. D* 15:281-9, 1977. Stanford Univ., SLAC, Stanford, CA; MIT, Lab. Nucl. Sci. & Dept. Phys., Cambridge, MA

10 20 30 **Landshoff P V.** The transverse momentum of partons. *Phys. Lett. B* 66:452-4, 1977. Univ. Cambridge, Dept. Appl. Math. & Theoret. Phys., Cambridge, UK

3 37 40 **Langacker P & Segrè G.** Heavy leptons and trimuons in an $SU(3)\otimes U(1)$ model. *Phys. Rev. Lett.* 39:259-62, 1977. Univ. Pennsylvania, Dept. Phys., Philadelphia, PA

0 36 36 **Politzer H D.** Gluon corrections to Drell-Yan processes. *Nucl. Phys. B* 129:301-18, 1977. Harvard Univ., Lyman Lab. Phys., Cambridge, MA

0 34 34 **Quigg C & Rosner J L.** Quarkonium level spacings. *Phys. Lett. B* 71:153-7, 1977. Fermi Nat. Accelerator Lab., Batavia, IL

4 29 33 **Rossi G C & Veneziano G.** A possible description of baryon dynamics in dual and gauge theories. *Nucl. Phys. B* 123:507-45, 1977. CERN, Geneva, Switzerland

0 42 42 **Sterman G[1] & Weinberg S.[2]** Jets from quantum chromodynamics. *Phys. Rev. Lett.* 39:1436-9, 1977. 1. SUNY, Inst. Theoret. Phys., Stony Brook, NY; 2. Harvard Univ., Lyman Lab. Phys., Cambridge, MA

19 11 30 **Wilczek F & Zee A.** Rare muon decays, natural lepton models, and doubly charged leptons. *Phys. Rev. Lett.* 38:531-3, 1977. Princeton Univ., J. Henry Labs., Princeton, NJ

ELEMENTARY PARTICLE PHYSICS (EXPERIMENTAL)

8 34 42 **Anderson H L, Bharadwaj V K, Booth N E, Fine R M, Francis W R, Gordon B A, Heisterberg R H, Hicks R G, Kirk T B W, Kirkbride G I, Loomis W A, Matis H S, Mo L W, Myrianthopoulos L C, Pipkin F M, Pordes S H, Quirk T W, Shambroom W D, Skuja A, Staton M A, Williams W S C, Verhey L J, Wilson R & Wright S C.** Measurement of the proton structure function from muon scattering. *Phys. Rev. Lett.* 38:1450-4, 1977. Univ. Chicago, Enrico Fermi Inst., Chicago, IL; Harvard Univ., High Energy Phys. Lab. & Dept. Phys., Cambridge, MA; Univ. Illinois at Urbana-Champaign, Dept. Phys., Urbana, IL; Univ. Oxford, Dept. Nucl. Phys., Oxford, UK

9 30 39 **Antreasyan D,[1] Cronin J W,[1] Frisch H J,[1] Shochet M J,[1] Kluberg L,[2] Pirouè P A[2] & Sumner R L.[2]** Production of π^+ and π^- at large transverse momentum in p-p and p-d collisions at 200, 300, and 400 GeV. *Phys. Rev. Lett.* 38:112-4, 1977. 1. Univ. Chicago, Enrico Fermi Inst., Chicago, IL; 2. Princeton Univ., J. Henry Labs., Dept. Phys., Princeton, NJ

26 59 85 **Barish B C,[1] Bartlett J F,[1] Bodek A,[1] Brown K W,[1] Buchholz D,[1] Chu Y K,[1] Sciulli F,[1] Siskind E,[1] Stutte L,[1] Fisk E,[1] Krafczyk G,[2] Nease D[2] & Fackler O.[3]** Observation of trimuon production by neutrinos. *Phys. Rev. Lett.* 38:577-80, 1977. 1. Calif. Inst. Technol., Pasadena, CA; 2. Fermi Nat. Accelerator Lab., Batavia, IL; 3. Rockefeller Univ., New York, NY

16 47 63 **Benvenuti A, Cline D, Cooper P, Heagy S M, Imlay R, Johnson M, Ling T Y, Lundy R, Mann A K, McIntyre P, Mori S, Reeder D D, Rich J, Rubbia C, Stefanski R & Winn D.** Characteristics of neutrino-produced dimuon and trimuon events as evidence for new physics at the lepton vertex. *Phys. Rev. Lett.* 38:1183-6, 1977. Fermi Nat. Accelerator Lab., Batavia, IL; Harvard Univ., Dept. Phys., Cambridge, MA; Univ. Pennsylvania, Dept. Phys., Philadelphia, PA; Rutgers Univ., Dept. Phys., New Brunswick, NJ; Univ. Wisconsin, Dept. Phys., Madison, WI

24 72 96 **Benvenuti A, Cline D, Cooper P, Heagy M, Imlay R, Johnson M E, Ling T Y, Lundy R, Mann A K, McIntyre P, Mori S, Reeder D D, Rich J, Rubbia C, Stefanski R & Winn D.** Observation of a new process with trimuon production by high-energy neutrinos. *Phys. Rev. Lett.* 38:1110-3, 1977. Fermi Nat. Accelerator Lab., Batavia, IL; Harvard Univ., Dept. Phys., Cambridge, MA; Univ. Pennsylvania, Dept. Phys., Philadelphia, PA; Rutgers Univ., Dept. Phys., New Brunswick, NJ; Univ. Wisconsin, Dept. Phys., Madison, WI

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