On the Use of Relativistic Mass in Various Published Works

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Abstract

A lengthy bibliography of books referring to special and/or general relativity is provided to give a background for discussions on the historical use of the concept of relativistic mass.

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1 Introduction

The primary purpose of this paper is to provide a bibliographic base to the discussion of relativistic mass (RM). In a separate paper [Intro1], arguments dissuading the use of the concept of a velocity dependent mass are put forth and the need for such arguments is based on the continued widespread use of the concept. This article provides a reference list to the specific works listed in the survey.

The 634 works are separated into categories as presented in [Intro1]: textbooks devoted to special and/or general relativity; popularizations of relativity, physics, or modern physics; introductory and modern physics textbooks; and a miscellany of other works. In certain sections, in addition to the categorization of the use of RM, other facts of interest have been included. For example, in listing relativity texts the signature of the metric (if appropriate) is given as well as whether naturalized units (c=1) are employed. Additional commentary on several of the works is included here, most in relation to the use of the concept. A summary of the number of works employing relativistic mass and those that do not is given at the end, these numbers yielding the plots in [Intro1].

A brief comment about the manner in the classification of these works is in order. Whether or not a work employs relativistic mass is not always an objective choice. There are instances where an author may introduce the concept and then rail against it, while others may not explicitly introduce it yet allude to its validity, and in some small circumstances (found in introductory textbooks) make explicit contradictory statements. Thus in several instances it has been the judgment of this author as to whether it is employed or not. Those instances have, for the most part, been noted in the comments. The basis for judgment has been from the perspective of a first time learner; if the presentation leaves an impression that this concept is valid (regardless of its fashionability) then it has been listed as having introduced the concept. Some may disagree with the decision on some of these references and may be up for debate, however the vast majority or works take a clear-cut stance one way or the other.

The works here provide an extensive, but not exhaustive, base to evaluate the use of the concept of relativistic mass throughout the past century. This reference is a work in progress, it will be updated as new works are published as well as other, older, works are examined. The most up-to-date version of the bibliography will be made available on the internet[Intro4]. This bibliography will also be made available as both a spreadsheet and in Bibtext format. Therein is listed works that have not been examined.

[Intro1] G. Oas, “On the Abuse and Use of Relativistic Mass”, http://arxiv.org/abs/physics/0504110 (submitted to Amer. Jnl. Phys.)

[Intro2] A. Einstein “On a Method of the Determination of the Ratio of the Transverse and the Longitudinal Mass of the Electron”, Ann. Phys. 21 (1906).
2 Textbooks Devoted to Special and/or General Relativity (SGR)

There are 100 books that have been examined within this category. They are separated into two sections, those that do not employ RM and a second section listing those that do employ the concept. Of these works 63 introduce RM and there is not observed any significant historical trend away from or towards the concept. The number of texts published that do not use the concept has remained relatively constant over the past 35 years.

In the comments that follow each reference the signature of the metric is given as well as whether naturalized units (setting $c = 1$) are used. For the signature there are three possibilities; [W] are ones where the signature is $(+1, -1, -1, +1)$; [E] where $(-1, +1, +1, +1)$; and [M] which refers to Minkowski’s complex time coordinate (i.e. $ct \rightarrow ic\tau$) found in some older texts (which leads to a metric of signature [E]). As for units; [N] refers to the use of naturalized units and [S] refers to standard units where explicit reference to $c = 3 \times 10^8 m/s$ is continually made.

2.1 SGR Works that Do Not Employ RM

[SGRn1] H. Arzeleis. Relativistic Kinematics. Pergamon Press, Oxford, 1966.
  [Metric=E, Units = S]; This works only discusses kinematics, never mentions mass.

[SGRn2] G. Barton. Introduction to the relativity principle. J. Wiley, Chichester, 1999.
  [Metric=W, Units = N].

[SGRn3] M. V. Berry. Principles of Cosmology and Gravitation. Cambridge Press, Cambridge, 1976.
  [Metric=W, Units = S].

[SGRn4] S. K. Bose. An introduction to general relativity. Wiley, New York, 1980.
  [Metric=W, Units = N].

[SGRn5] H.A. Buchdahl. Seventeen simple lectures on general relativity theory. Wiley, New York, 1981.
  [Metric=W, Units = N].

[SGRn6] M. Carmeli. Classical Fields: General Relativity and Gauge Theory. Wiley, New York, 1982.
  [Metric=W, Units = S].

[SGRn7] Sean Carroll. Spacetime and Geometry: An Introduction to General Relativity. Addison-Wesley, San Francisco, 2004.
  [Metric=, Units = ].

[SGRn8] P. A. M. Dirac. General Theory of Relativity. Princeton Univ. Press, Princeton, N.J., 1975.
  [Metric=W, Units = N].

[SGRn9] A. Einstein. The Meaning of Relativity. Princeton Univ. Press, Princeton, N.J., 1 edition, 1922.
  [Metric=M, Units = N]; First manuscript written 1916.

[SGRn10] A. Einstein. The Meaning of Relativity. Princeton Univ. Press, Princeton, N.J., 15 edition, 1945.
  [Metric=M, Units = N].

[SGRn11] Richard L. Faber. Differential geometry and relativity theory: an introduction. M. Dekker, New York, 1983.
  [Metric=W, Units = N].
2.1.1 Footnotes

- [SGRn31] He uses the term “rest mass” continually in the section on SR. We shies away from saying that mass increases with speed but in the tensor chapter he does say it twice.

The problem here is that in using naturalized units, c = 1, energy appears to be exactly the same as mass, \( E = m \). This can be deceptive, see Okun’s article (“second argument”) [Intro6]. Uses terms interchangeably.

2.2 SGR Works that Employ RM

This section lists those works that employ the concept of relativistic mass.
[SGRy10] L. Brillouin. *Relativity Reexamined*. Academic Press, New York, 1970.
(Metric=E, Units = S).

[SGRy11] James Callahan. *The Geometry of Spacetime*. Springer-Verlag, New York, 2000.
(Metric=W, Units = N).

[SGRy12] C. Clarke. *Elementary general relativity*. J. Wiley, New York, 1979.
(Metric=E, Units = N); c.f. pg 32. Defines 'apparent mass' \( m^* \). Only uses in this one section.

[SGRy13] Anadijiban Das. *The special theory of relativity : a mathematical exposition*. Springer-Verlag, New York, 1993.
(Metric=E, Units = N); Is careful about it, c.f. pg 104.

[SGRy14] Ray D'Inverno. *Introducing Einstein’s Relativity*. Oxford Press, Oxford, 1992.
(Metric=W, Units = N); Surprising that RM is employed since it is so mathematically orientated.

[SGRy15] W. G. Dixon. *Special relativity : the foundation of macroscopic physics*. Cambridge Press, Cambridge, 1978.
(Metric=, Units = ]; Defines it but does not use it.

[SGRy16] A. Eddington. *The Mathematical Theory of Relativity*. Cambridge Univ. Press, Cambridge, 1923.
(Metric=W, Units = S); Changes metric, \( c=1 \) sometimes.

[SGRy17] George F.R. Ellis and Ruth M. Williams. *Flat and curved space-times*. Oxford Press, Oxford, 2 edition, 2000.
(Metric=E, Units = N).

[SGRy18] Wengenmayr R. Fayngold, M. *Special Relativity and Motions Faster Than Light*. Wiley-VCH, Weinheim, 2002.
(Metric=W, Units = S); c.f. pg 65.

[SGRy19] Theodore Frankel. *Gravitational curvature : an introduction to Einstein’s theory*. W. H. Freeman, San Francisco, 1979.
(Metric=E, Units = N).

[SGRy20] A. P. French. *Special relativity*. W.W. Norton, New York, 1968.
(Metric=W, Units = S).

[SGRy21] A. Hakim, R. King. *An Introduction to Relativistic Gravitation*. Cambridge Univ. Press, Cambridge, 1999.
(Metric=, Units = ]; c.f. pg 100.

[SGRy22] C. Kacser. *An Introduction to the Special Theory of Relativity*. Prentice-Hall, Englewood Cliffs, N. J., 1967.
(Metric=, Units = ).

[SGRy23] J.B. Kogut. *Introduction to Relativity: For Physicists and Astronomers*. Academic Press, New York, 2001.
(Metric=, Units = S); c.f. pg 70, uses then abandons -see footnote.

[SGRy24] W. Kopeckynski and A. Trautman. *Spacetime and gravitation*. J. Wiley, Chichester, 1992.
(Metric=W, Units = S).

[SGRy25] Malcolm Ludvigsen. *General relativity : a geometric approach*. Cambridge Press, Cambridge, 1999.
(Metric=W, Units = N); Introduces pg 42, \( M(v) \) briefly, but does not use.

[SGRy26] W.D. McComb. *Dynamics and Relativity*. Oxford Univ. Press, Oxford, 1999.
(Metric=W, Units = S).

[SGRy27] W.H. McCrea. *Relativity Physics*. J. Wiley, New York, 1954.
(Metric=, Units = S).

[SGRy28] G.C. McVittie. *General Relativity and Cosmology*. Univ. Illinois Press, Urbana, 1965.
(Metric=W, Units = S); Mentions although only briefly.
2.2.1 SGRy footnotes

- [SGRy23], pg73:
  "Most textbooks on relativity work with the relativistic energy \( E = mc^2 \) and rest mass \( m \) rather than with the relativistic mass, a velocity-dependent quantity, \( m(v) = \gamma v \). We shall do the same from here on to avoid possible confusion. Mass means rest mass \( m \), just as in Newton’s world."

- [SGRy58], pg 169:
  "Since \( m^* \) depends on \( u \) through \( \gamma \), it is customary to say that “mass depends on velocity.” But it must be remembered that this \( m^* \) is the relative mass; the proper mass does not depend on velocity, and the “dependence on velocity” is introduced merely for the sake of obtaining formal agreement between the equations of relativity and those of Newtonian mechanics.”
3 Popularizations of Relativity, Physics, or Science (PS)

Of the 105 works examined that present a popularized, pedagogically basic, introduction to relativity or the concepts of modern physics, only 18 were found not to utilize RM. A vast majority rely on this concept and the numbers have been growing. Since the publication of Stephen Hawking’s bestseller “A Brief History of Time”[PSy43], the number of books published presenting advanced concepts of physics to the general public has exploded (however there is recent evidence that this trend may be reversing[Intro5]).

More and more, prominent physicists have been lured into this lucrative market. In addition, non-physicists ranging from experts in different fields to science journalists to those with no credentials whatsoever have been publishing in this vein. In fact, in the period 2000 to the present, in this category 40 books were examined and of these exactly half were written by non-experts. The post-1999 works below list whether the author is an expert, [P] (that is, has a Phd. in physics or astrophysics, publish original research, and/or is an instructor) or not, [NP]. As many of these non-expert writers rely upon older popularizations or upon conversations with experts, it is no wonder why the number of works utilizing RM continues to grow.

3.1 PS Works that Do Not Employ RM

[PSn1] N. Calder. The Key to the Universe. Penguin Books, New York, 1977.

[PSn2] Mann C. Crease, R. The Second Creation. MacMillan Pub. Co., London, 1986.

[PSn3] A.K. Dewdney. Beyond Reason: Eight Great Problems That Reveal the Limits of Science. J. Wiley, Hoboken, N. J., 2004. [NP]

Does not introduce, however, there are other MAJOR problems with this work, see footnote.

[PSn4] A. Einstein. Relativity: The Special and General Theory. Crown Publ., New York, 16 edition, 1961.

c. f. pg 46. “absorb radiation so as to not change v. Then it is as if the mass increases.” But does not include KE in this discussion, thus does not introduce relativistic mass.

[PSn5] L. C. Epstein. Thinking Physics. Insight Press, San Francisco, 3 edition, 2002. [P].

[PSn6] Arthur Evett. Understanding the space-time concepts of special relativity. Halsted Press, New York, 1982.

No mention of mass at all.

[PSn7] Robert Geroch. General relativity from A to B. Univ. of Chic. Press, Chicago, 1978.

Does not go into dynamics, no mention of mass.

[PSn8] J.R. Gott. Time Travel in Einstein’s Universe. Houghton Mifflin, Boston, 2001. [P].

[PSn9] Brian Greene. The Fabric of the Cosmos. A. A. Knopf, New York, 2004. [P]

Another masterful exposition of spacetime view of the fundamental limit, and this time he does NOT resort to RM.

[PSn10] E. Harrison. Cosmology. Cambridge Univ. Press, Cambridge, 2 edition, 2000. [P].

[PSn11] R. Jones. Physics for the Rest of Us. Contemporary Books, Chicago, 1992.

[PSn12] M. Kaku, J. Trainer. Beyond Einstein. Bantam Books, New York, 1987.

[PSn13] J.P. Luminet. Black Holes. Cambridge Press, Cambridge, 1992.

Doesn’t mention it, primarily sticks with GR issues.

[PSn14] N. Mermin. Boojums All the Way through: Communicating Science in a Prosaic Age. Cambridge Univ. Press, Cambridge, 1990.

[PSn15] N. David Mermin. Space and Time in Special Relativity. Waveland Press, Prospect Heights, Illinois, 1968.

Thorough discussion of mass at end.
R. Mills. *Space, Time and Quanta: An Introduction to Contemporary Physics*. W. H. Freeman, New York, 1994. 
Says not to use it, or call it rest mass.

C. Seife. *Alpha and Omega*. Penguin, New York, 2003. [NP].

Kip S. Thorne. *Black holes and time warps, Einstein’s outrageous legacy*. W. W. Norton, New York, 1994.

F. Wilczek. *Longing for the Harmonies*. Norton, New York, 1987.

### 3.1.1 PSn footnotes

- [PSn3] Ok with regards to RM, but on pg. 32 says that from $E = m c^2$, 1 kg = $3 \times 10^{16}$ J and on pg. 56 says that when at rest the inside of the square root is zero when it should be 1.

### 3.2 PS Works that Employ RM

Steve Adams. *Relativity, An Introduction to Space-time physics*. Taylor & Francis, London, 1997. 
Argues for the use of RM. Relies on Law of conservation of mass a la Tolman. Also relies on Kauffman’s experiments.

J. Allday. *Quarks Leptons and the Big Bang*. Institute of Physics, Bristol, 2001. [P] 
See footnote.

J. Baggot. *Beyond Measure: Modern Physics, Philosophy and the Meaning of Quantum Theory*. Oxford Press, Oxford, 2004. [NP] A good basic level book on conceptual issues of QM. Does introduce RM though.

L. Barnett. *The Universe and Dr. Einstein*. Gollancz, London, 1948. 
printings: 48, 50, 52, 57, 82. All use RM even after Einstein told him it was not a good idea to do so.

M. Bartusiak. *Einstein’s Unfinished Symphony*. Joseph Henry Press, Washington D.C., 2000. [NP].

David Bodanis. $E = m c^2$. Walker, New York, 2000. [NP], c.f. pg 81 uses weight.

A. Bormanis. *Star Trek: Science Logs*. Pocket Books, New York, 1998. 
Explains some science in terms of Star Trek.

J. Breithaupt. *Teach Yourself Physics*. McGraw-Hill, New York, 2002. [P].

C. Bruce. *The Einstein Paradox*. Perseus Books, Reading, Mass., 1997. 
c.f. pg 158-159, spring-mass example.

Bill Bryson. *A Short History of Nearly Everything*. Broadway Books, New York, 2003. [NP].

N. Calder. *Einstein’s Universe: The Layperson’s Guide*. Greenwich House, New York, 1990.

C. Calle. *Superstrings and Other Things*. Institute of Physics, Bristol, 2001. 
Intro. physics notes.

J. Carter. *The Other Theory of Physics*. Absolute Motion Press, Enumclaw, WA, 2000. [NP] An alternative theory of physics (problematic).

D. C. Cassidy. *Einstein and Our World*. Humanity Books, Amherst, NY, 2 edition, 2004. [P].

Eric J. Chaisson. *Relatively speaking: relativity, black holes, and the fate of the universe*. W. W. Norton, New York, 1988.

K. C. Cole. *First You Build A Cloud*. Harcourt-Brace, San Diego, CA, 1999. 
See footnote.
[PSy17] Brown J. Davies, P. Superstrings : A Theory of Everything? (Canto). Cambridge Univ Press, Cambridge, 1988.
Uses RM to explain why you can’t go faster than c, only mention of it.

[PSy18] P. Davies. Space and Time in the Modern Universe. Cambridge Univ. Press, Cambridge, 1977.

[PSy19] P. Davies. Other Worlds. Simon & Schuster, New York, 1997.

[PSy20] C. Durell. Readable Relativity. Dover, New York, 2003. [P].

[PSy21] R. Ehrlich. Nine Crazy Ideas in Science : A Few Might Even Be True. Princeton Univ. Press, Princeton, NJ, 2001. [P]
Only mentions RM in footnote.

[PSy22] P. Epstein, L. C. Hewitt. Thinking Physics. Insight Press, San Francisco, 1 edition, 1981.

[PSy23] L.C. Epstein. Relativity Visualized. Insight Press, San Francisco, 1985.

[PSy24] D. Falk. Universe on a Tshirt. Arcade, New York, 2004. [NP]
see [Intro1] for quotes.

[PSy25] T. Ferris. Coming of Age in the Milky Way. Random House, New York, 1988.

[PSy26] T. Ferris. The Whole Shebang. Simon & Schuster, New York, 1997.

[PSy27] R.P. Feynman. Six Not-So-Easy Pieces: Einstein's Relativity, Symmetry, and Space-Time (Helix Books). Addison-Wesley, Reading, Mass., 1997.
c. f. pg 67.

[PSy28] N. Friedman. The Hidden Domain: Home of the Quantum Wave Function, Nature’s Creative Source. Woodbridge Group, Eugene, OR, 1997.

[PSy29] M. Gardner. Relativity for the Millions. MacMillan, New York, 1962.

[PSy30] M. Gardner. Relativity Simply Explained. Dover, New York, 1997.

[PSy31] J. Geis. Physics, Metaphysics and God. 1stBooks, Bloomington, IN, 2003. [NP']
Religious work.

[PSy32] S. Gibilisco. Physics Demystified. McGraw-Hill, New York, 2002. [NP].

[PSy33] S. Gibilisco. Astronomy Demystified (Demystified). McGraw-Hill, New York, 2003. [NP].

[PSy34] Stan Gibilisco. Understanding Einstein's Theories of Relativity. Dover, New York, 1983. [NP].

[PSy35] R. Gilmore. Scrooge’s Cryptic Carol. Copernicus, New York, 1996. [P].

[PSy36] E. Ginzburg. Unified Spiral Field and Matter - A Story of a Great Discovery. Helicola Press, Pittsburg, PA, 1999.
An alternative theory of physics (problematic).

[PSy37] V. Ginzburg. The Unification of Strong, Gravitational & Electric Forces. Helicola Press, Pittsburg, PA, 2002.
Alternative view of matter (problematic).

[PSy38] P. Gondhalekar. The Grip of Gravity. Cambridge Univ Press, Cambridge, 2001. [P].

[PSy39] Huffman Gonick. Cartoon Guide to Physics. Harper Perennial, New York, 1992.

[PSy40] Brian Greene. Elegant Universe. W.W. Norton, New York, 1999. [P]
See [Intro1] for quotes.

[PSy41] J. Gribbon. Q is for Quantum. Free Press, New York, 2000. [NP]
Glossary of terms.

[PSy42] K. Havel. Gravitation: Master Key to the Universe. Grevyt Press, Brampton, ON, 2003. [NP].
[PSy43] S. Hawking. *A Brief History of Time*. Bantam Books, New York, 1988. [P].

[PSy44] S. Hawking. *Universe in a Nutshell*. Bantam Books, New York, 2001. [P].

[PSy45] N. Herbert. *Faster Than Light: Superluminal Loopholes in Physics*. Penguin Books, New York, 1995.

[PSy46] P. Hey, T. Walters. *Einstein's Mirror*. Cambridge Univ. Press, Cambridge, 1997.

c. f. pg 4.

[PSy47] P. Hill. *Unconventional Flying Objects: A Scientific Analysis*. Hampton Roads, Charlottesville, VA, 1995.

c. f. pg 56, UFO study.

[PSy48] Banesh Hoffmann. *Relativity and its roots*. Scientific American Books, New York, 1983.

[PSy49] Brush S. Holton, G. *Physics, The Human Adventure*. Rutgers Univ. Press, New Brunswick, NJ, 2001. [P].

[PSy50] J. Jungerman. *World In Process*. State University of New York Press, Albany, NY, 2000. [P].

[PSy51] M. Kaku. *Hyperspace*. Anchor Books, New York, 1994. [P].

[PSy52] M. Kaku. *Einstein's Cosmos*. W. W. Norton, New York, 2004. [P]

Appears only as footnote. Bad quote says object increases mass in own frame. No, actually on pg 66 (check where footnote is).

[PSy53] S. Kaufman. *Unified Reality Theory: The Evolution of Existence into Experience*. Destiny Toad Press, Milwaukee, WI, 2001. [NP]

c. f. pg 144.

[PSy54] L. Krauss. *Fear of Physics*. Basic Books, New York, 1993. [P].

[PSy55] S. Kullander. *Out of Sight! : From Quarks to Living Cells*. Cambridge Univ Press, Cambridge, 1994.

[PSy56] R. Laughlin. *A Different Universe: Reinventing Physics from the Bottom Down*. Basic Books, New York, 2005. [P]

Quote, "weight increases at very high speeds".

[PSy57] D.F. Lawden. *Elements of relativity theory*. Dover, New York, 2004. [P]

c. f. pg 71.

[PSy58] D. F. Lawden. *An introduction to tensor calculus, relativity, and cosmology*. J. Wiley, Chichester, 1982. [P].

[PSy59] P. Lurquin. *The Origins of Life and the Universe*. Columbia Univ Press, New York, 2003. [NP].

[PSy60] J. Magueijo. *Faster than the speed of light*. William Heinemann, London, 2003. [P]

Gives reasons for NOC due to kinematics, then "what are the dynamical reasons?".

[PSy61] D. Marshall, I. Zohar. *Who's Afraid of Schrodinger's Cat*. Morrow, New York, 1997.

[PSy62] D. E. Mook and T. Vargish. *Inside relativity*. Princeton Press, Princeton, N.J., 1987.

[PSy63] R. Murray. *Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes*. Butterworth-Heinemann, Boston, 2001. [NP].

[PSy64] Y. Ne’eman. *The Particle Hunters*. Cambridge Univ Press, Cambridge, 1996.

[PSy65] I. Novikov. *The River of Time*. Cambridge Univ. Press, Cambridge, 1998.

[PSy66] B. Parker. *Albert Einstein's Vision*. Prometheus Books, Amherst, NY, 2004. [NP].

[PSy67] R. Penrose. *The Emperor’s New Mind*. Oxford Press, Oxford, 1989.

[PSy68] C.H. Peterson. *Eclectic Pragmatism: Is There a God?* Morris Pub., Kearny, NE, 1998.

c.f. pg 153, Religious study, see page 154 for quote that leads to trouble.
3.2.1 PSy footnotes

- [PSy1] On page 82 invokes the "Law of Conservation of Mass" (Lavoisier’s law) to derive relativistic mass from an inelastic collision viewed in two frames. Derivation is on pg 83.

On page 84 "We are in a sense placing rather too much emphasis on the concept of mass here. This is understandable since it plays such a central role in classical mechanics. In relativity there are several ways in which mass and inertia can be defined. Our use of 'relativistic mass'...makes the law of conservation of energy and mass equivalent statements. Once we have developed a proper relativistic concept of energy we will be able to tackle dynamic problems simply by considering the conservation of energy and momentum (and these too [sic] are closely related, as we shall see when we consider a spacetime representation in the next chapter).“
Page 161 end Now goes on and does it properly
“In section 2.12 we assumed a relativistic momentum of the form $p = m(v)v$ and used this to look for an expression for the relativistic mass $m(v)$ such that the conservation laws for mass and energy would hold in an interaction. The result was that $m(v) = \gamma m_0$ and $p = \gamma m_0 v$ ($m_0$ is rest mass). The expression for momentum is simply rest mass multiplied by $\gamma v$ which we now recognise as the first three components of the 4-velocity.”

- **[PSy2]** He says there is no difference in which way you look (rel mass or not). Explains that particle physicists do not use RM.
  Quote pg 36: “In this approach. M is termed the *rest mass* of the particle. This has the advantage of explaining why Newtonian momentum is wrong – Newton did not know that mass was not constant.”

- **[PSy17]** Pg 139, an exceptionally misleading quote:
  “The answer is no, you can’t get younger. But you can age more slowly than a friend (or twin) traveling at a slower speed. On the other hand, you pay a price: You also might temporarily get more massive in the process.”

- **[PSy52]** Quote from page 66:
  “For example, Einstein could show that the mass of an object increased the faster it moved. (Its mass would in fact become infinite if you hit the speed of light - which is impossible, which proves the unattainability of the speed of light.) This meant that the energy of motion was somehow being transformed into increasing the mass of the object. Thus, *matter and energy are interchangeable*!”

- **[PSy40]** pg 52 (whole first pp) (Also incorrect use of ”Einstein’s equation”)
  From the viewpoint of the concepts we have emphasized in this chapter, Einstein’s equation gives us the most concrete explanation for the central fact that nothing can travel faster than light speed. You may have wondered, for instance, why we can’t take some object, a muon say, that an accelerator has boosted up to 667 million miles per hour – 99.5 percent of light speed – and ”push it a bit harder,” getting it to 99.9 percent of light speed, and then ”really push it harder” impelling it to cross the light-speed barrier. Einstein’s formula explains why such efforts will never succeed. The faster something moves the more energy it has and from Einstein’s formula we see that the more energy something has the more massive it becomes. Muons traveling at 99.9 percent of light speed, for example, weigh a lot more than their stationary cousins. In fact, they are about 22 times as heavy–literally. (The masses recorded in Table 1.1 are for particles at rest.) But the more massive an object is, the harder it is to increase its speed. Pushing a child on a bicycle is one thing, pushing a Mack truck is quote another. So, as a muon moves more quickly it gets ever more difficult to further increase its speed. At 99.999 percent of light speed the mass of a muon has increased by a factor of 224; at 99.99999999 percent of light speed it has increased by a factor of more than 70,000. Since the mass of the muon increases without limit as its speed approaches that of light, it would require a push with an *infinite* amount of energy to reach or to cross the light barrier. This, of course, is impossible and hence absolutely nothing can travel faster than the speed of light.

- **[PSy73]** pg 212 (this comes after correctly describing spacetime via diagrams and KE leads to fundamental limit. “Whether or not to speak of velocity-dependent mass is largely a matter of taste. Although it is currently unfashionable to do so, Einstein did and we shall as well.” As discussed in [Intro1], this is a factually inaccurate statement.

### 4 Miscellaneous Works (Misc)

Those 119 books that did not fall under any of the other categories have been lumped into a miscellaneous category. Thus, a wide range of books are reported here. The general type of book is listed but subcategories have not been tabulated. The general type of books are referred to as: OT, other textbooks; APT, advanced physics texts (not SGRT); Phil, philosophical works, including those of a religious nature; Hist, historical accounts; REF, reference books, such as encyclopedias and dictionary of physics; and SF, science fiction books.

Of these works only 14 did not introduce the concept of relativistic mass. However, this should not point to the general disparity between the two categories as the survey conducted for this category was biased. A large number of works were located through searches (web search engines and library catalogues) for relativistic mass. Thus it can be noted that the number of works utilizing RM is growing but no firm conclusion can be made
about those that do not. It is far more difficult to search for non-occurrences of a concept. In addition, the use of internet search engines and online book stores have tended to return more modern books, thus the distribution is weighted towards the current era. Thus this category, unlike the others reported here, should be taken with a grain of salt, there are a large number utilizing it these days but the general historical trend requires more research to be conclusive.

4.1 Misc Works that Do Not Employ RM

[MISCn1] A. Arons. *A Guide to Introductory Physics Teaching*. J. Wiley, New York, 1990. [Type = Ref].

[MISCn2] J. Barbour. *The End of Time*. Oxford Univ. Press, Oxford, 2001. [Type = Phil].

[MISCn3] V. Olsson. Barger. *Classical Mechanics*. McGraw-Hill, New York, 2 edition, 1994. [Type = APT].

[MISCn4] R. Eisberg, R. Resnick. *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*. J. Wiley, New York, 1985. [Type = APT],
Continually refers to rest mass but no statement of relativistic mass.

[MISCn5] I. Hinkfuss. *The Existence of Space and Time*. Clarendon Press, Oxford, 1975. [Type = Phil],
c. f. pg 50. No disc of rel mass.

[MISCn6] MISCn6 Max Jammer. *Concepts of Space,.*. Dover, New York, 1993. [Type = Phil],
c. f. pg 196.

[MISCn7] Beiser A. Krauskopf, K. *The Physical Universe*. McGraw-Hill, New York, 11 edition, 2005. [Type = OT],
Close to including it but avoids.

[MISCn8] C. Lanczos. *The Variational Principle of Mechanics*. Univ. of Toronto Press, Toronto, 4 edition, 1970. [Type = APT].

[MISCn9] Marc Lange. *An Introduction to the Philosophy of Physics: Locality, Fields, Energy, and Mass*. Blackwell, Oxford, 2002. [Type = Phil],
c. f. pg 221. States the case nicely.

[MISCn10] R. Nesbet. *Variational Principles and Methods in Theoretical Physics and Chemistry*. Cambridge Univ. Press, Cambridge, 2002. [Type = MT],
Subtle, does not use it though.

[MISCn11] R. Panek. *The Invisible Century: Einstein, Freud, and the Search for Hidden Universe*. Viking, New York, 2004.
[Type = Hist].

[MISCn12] W.G. Rees. *Physics by Example : 200 Problems and Solutions*. Cambridge Univ. Press, Cambridge, 1994.
[Type = APT].

[MISCn13] A. Whitaker. *Einstein, Bohr, and the Quantum Dilemma*. Cambridge Univ. Press, Cambridge, 1995.
[Type = Phil].

4.2 Misc Works that Employ RM

[MISCy1] Carolyn Abraham. *Possessing Genius:*. St. Martin’s Press, New York, 2001. [Type = Hist],
See footnote.

[MISCy2] A. Akhiezer. *High Energy Electrodynamics in Matter*. Gordon and Breach, Luxembourg, 1996. [Type = APT].
[MISCy3] E. Alpen. *Radiation Biophysics*. Academic Press, San Diego, CA, 1998. [Type = OT].

[MISCy4] S. Amelinckx. *Electron Microscopy : Principles and Fundamentals*. 1997. [Type = OT].

[MISCy5] Roger B. Angel. *Title: Relativity, the theory and its philosophy*. Pergamon Press, Oxford, 1 edition, 1980. [Type = Phil].

[MISCy6] I. Asimov. *The History of Physics*. Walker, New York, 1966. [Type = REF].

[MISCy7] F. Attix. *Introduction to Radiological Physics and Radiation Dosimetry*. J. Wiley, New York, 1986. [Type = OT], pg 186, Medical text.

[MISCy8] M. Bakich. *The Cambridge Planetary Handbook*. Cambridge Univ. Press, Cambridge, 2000. [Type = OT].

[MISCy9] K. Balasubramanian. *Relativistic Effects in Chemistry Part A: Theory and Techniques*. J. Wiley, New York, 1997. [Type = OT], c. f. pg 60. Historical context. Chemistry text.

[MISCy10] E. G. Barter. *Relativity and Reality*. Watts, London, 1953. [Type = Phil].

[MISCy11] Petr. Beckmann. *Einstein plus two*. Golem Press, Boulder, CO, 1987. [Type = OT], Philosophical in nature.

[MISCy12] J. Bennett, M. Donahue, and M. Schneider, N. Voit. *Cosmic Perspective*. Addison-Wesley, Reading, Mass., 2 edition, 2004. [Type = OT].

[MISCy13] G. Berlyn. *Botanical Microtechnique and Cytochemistry*. Iowa State Univ Press, Ames, IA, 1976. [Type = OT].

[MISCy14] Max Born. *Atomic Physics*. Blackie & Sons, London, 1969. [Type = APT].

[MISCy15] T. Boyd. *The Physics of Plasmas*. Cambridge Univ. Press, Cambridge, 2003. [Type = APT].

[MISCy16] D. Brandon. *Microstructural Characterization of Materials*. J. Wiley, New York, 1999. [Type = OT].

[MISCy17] K. Breman. *The Physics of Semiconductors: With Applications to Optoelectronic Devices*. Cambridge Univ. Press, Cambridge, 1999. [Type = APT].

[MISCy18] D. Brian. *Einstein a Life*. J. Wiley, New York, 1997. [Type = Hist].

[MISCy19] P. Bryant. *The Principles of Circular Accelerators and Storage Rings*. Cambridge Univ. Press, Cambridge, 1993. [Type = APT].

[MISCy20] F. Capra. *The Tao of Physics*. Shambhal, Boston, 4 edition, 1999. [Type = Phil], 4th edition (’75, 83, 91, 99).

[MISCy21] J. Carr. *Microwave & Wireless Communications Technology*. Butterworth-Heinemann, Boston, 1996. [Type = OT].

[MISCy22] E. Chaisson and S. McMillan. *Astronomy: A Beginner’s Guide to the Universe*. Prentice-Hall, Englewood Cliffs, N.J., 4 edition, 2004. [Type = OT], Just states on page 350.

[MISCy23] D. Chalmers. *The Conscious Mind: In Search of a Fundamental Theory*. Oxford Univ. Press, New York, 1997. [Type = Phil].

[MISCy24] J. Clark. *The Essential Dictionary of Science*. 2004. [Type = Ref].

[MISCy25] R. Clark. *Einstein: The Life and Times*. World Pub. Co., New York, 1971. [Type = Hist].

[MISCy26] H. Cordes. *The Technique of Pseudodifferential Operators*. Cambridge Univ. Press, Cambridge, 1995. [Type = MT].
C. Norris. *Deconstruction and the 'Unfinished Project of Modernity'.* Routledge, New Y ork, 2001. [Type = Phil],
Distinguishes Newt. Mass from Einstein mass, meaning rel mass.

G. Oppy. *Ontological Arguments and Belief in God.* Cambridge Univ. Press, Cambridge, 1996. [Type = Phil],
Religious arguments.

L. Ostrovsky. *Modulated Waves: Theory and Applications.* John Hopkins Univ. Press, Baltimore, MD, 2003. [Type = APT].

B. Parker. *Einstein: The Passions of a Scientist.* Prometheus Books, Amherst, NY, 2003. [Type = Hist], [NP].

R. Penrose. *The Road to Reality: A Complete Guide to the Laws of the Universe.* A. A. Knopf, New Y ork, 2004. [Type = APT].

Christopher Ray. *The evolution of relativity.* Adam-Hilger, Bristol, 1987. [Type = Phil],
Says RM is a fact of SR but \( m_{\text{inert}} = m_{\text{grav}} \) does away with any need for discussion.

M. Reiser. *Theory and Design of Charged Particle Beams.* J. Wiley, New Y ork, 1994. [Type = OT].

M. Richard. *Meaning (Blackwell Readings in Philosophy).* Blackwell, Malden, Mass., 2002. [Type = Phil].

B. Russell. *The ABC of Relativity.* G. Allen & Unwin, London, 1958. [Type = Phil],
Lengthy discussion of mass, pg 91 (first edition 1925).

W. Scharf. *Particle Accelerators and Their Uses (Accelerators and Storage Rings).* Harwood Academic Pub, Chur, NY, 1991. [Type = OT].

R. Schmitt. *Electromagnetics Explained: A Handbook for Wireless/ RF, EMC, and High-Speed Electronics, Part of the EDN Series for Design Engineers.* Newnes, Amsterdam, 2002. [Type = OT],
c. f. pg 124.

M. Sedlacek. *Electron Physics of Vacuum and Gaseous Devices.* J. Wiley, New Y ork, 1996. [Type = OT].

L. Shlain. *Art and Physics.* Morrow, New Y ork, 2 edition, 1991. [Type = Phil],
1962, 91 for NOC.

F. Shu. *Physical Universe: An Introduction to Astronomy.* University Science Books, Mill Valley, CA, 1982. [Type = OT].

E. Slayter. *Light and Electron Microscopy.* Cambridge Univ. Press, Cambridge, 1992. [Type = OT].

J. Spence. *High-Resolution Electron Microscopy.* Oxford Univ. Press, Oxford, 2003. [Type = APT].

D. Swanson. *Plasma Waves (Series in Plasma Physics).* Institute of Physics Pub., Bristol, 2003. [Type = APT].

Taliaferro. *Philosophy of Religion: An Anthology.* Blackwell, Malden, Mass., 2003. [Type = Phil],
Phil of religion.

R. Torretti. *The Philosophy of Physics.* Cambridge Univ. Press, Cambridge, 1999. [Type = Phil.],
pg 287, Phil discussion of various forms of mass. (STILL uses rel mass).

N. Tsoulfanidis. *Measurement and Detection of Radiation.* Taylor & Francis, Washington D.C., 1995. [Type = OT].

D. Vakman. *Signals, Oscillations, and Waves: A Modern Approach.* Artech House, Boston, 1998. [Type = APT].

A. Von Hippel. *Dielectrics and Waves.* Artech House, Boston, 1995. [Type = APT].
4.2.1 MISCy footnotes

- [MISCy1] Quote pg 17:
  “The light beam, he now understood, travelled at its constant speed while matter became smaller and heavier the farther he got from it, the more slowly time passed.

- [MISCy8] Quote:
  “The addition of the relativistic mass to the overall mass of Mercury produces a very small acceleration to the orbital motion of the planet.”

- [MISCy33] Quote:
  “beam of particles faster than ever before by using an alternating electric field whose frequency could be adjusted for relativistic mass changes.”

- [MISCy70] Quote pg 222:
  “Finally in a law like the relativistic mass law, \( m = m_0 / \sqrt{1 - \frac{v^2}{c^2}} \), we have neither a summary of observations nor a tendency statement, but a frame proposition expressing a “grammatical” rule for the use of “m”, the concept of relativistic mass.”

5 Introductory Physics and Modern Physics Textbooks (IPT)

This category of these works is the most significant reported here and more effort has been made to classify each textbook edition. In all 315 editions of textbooks have been examined with the general result that a majority utilize RM (223 versus 92). However, as reported in [Intro1], the modern trend has been one of moving away from this concept. This is hypothesized to result from scrutiny of the literature on physics education research in writing introductory textbooks. Generally, one does not refer to this body of research when writing an advanced text or popularization of physics. It is interesting to note that this trend creates a widening gap between the two viewpoints, leading to significant inconsistencies in what is put forth. I have found that students arriving into my course on relativity have deep preconceptions of relativistic mass and often point to widely read popularizations
penned by some of the most prominent physicists today. To have them unlearn this concept requires significant
convincing (and time) and presents a sizable obstacle to an understanding of the modern geometrical formulation
of relativity. Thus, those who introduce this concept as a fact of nature are doing a disservice to those that want
to go on to become practicing relativists.

5.1 Category A: Conceptual Introductory Physics Textbooks

The following are references that fall under the classification of “conceptual” introductions to physics. This
corresponds to category A as designated by the College Board. A summary and historical trends is provided in
[Intro1] and will not be repeated here. There may be slight differences in the numbers as some works have been
reclassified.

The use of relativistic mass is given for each edition, as it sometimes changes during the history of a textbook.
Editions which utilize RM are denoted by bold years enclosed in square brackets, i.e. [1999]. Those editions
that do not not emphasized and are enclosed in parenthesis, (1999). There are some editions that have not been
examined, these edition years are in italics, (1999). And lastly, a small number of editions give contradictory
statements on the status of relativistic mass, these are noted in the comments and listed as such, [1999*]. As
before, relevant quotes and comments are given at the end of the listing.

[IMPa1] K. Atkins. *Physics: Once Over Lightly*. J. Wiley, New York.
Editions = [1972].

[IMPa2] S. Ballif and W. Dibble. *Conceptual Physics*. J. Wiley, New York.
Editions = [1969].

[IMPa3] F. Bueche. *Understanding the World of Physics*. McGraw Hill, New York.
Editions = [1983].

[IMPa4] L. Cooper. *Physics: Structure and Meaning*. UPNE, .
Editions = [1968,1992].

[IMPa5] L. C. Epstein. *Thinking Physics*. .
Editions = (2002).

[IMPa6] J. Faughn and K. Kuhn. *Physics for People Who Think They Don’t Like Physics*. Harcourt Brace, New
York.
Editions = [1976].

[IMPa7] D. Giancoli. *The Ideas of Physics*. Harcourt Brace, New York.
Editions = [1974].

[IMPa8] W. Griffith. *The Physics of Everyday Phenomena*. McGraw Hill, New York.
Editions = (1992,1998), (2001).

[IMPa9] P. Hewitt. *Conceptual Physics*. McGraw Hill, New York.
Editions = [1971,1974,1977,1981,1985,1989,1993], (1998,2001),
editions 1-3: Addison Wesley, 4-9: McGraw Hill.

[IMPa10] A. Hobson. *Physics, Concepts and Connections*. .
Editions = [1993,1999,2003].

[IMPa11] G Holton and S. Brush. *Introduction to Concepts and Theories in Physical Science*. Princeton Univ.
Press, Princeton, N.J.
Editions = [1973,1985].

[IMPa12] D. Kirkpatrick and G. Wheeler. *Physics: A World View*. Brooks Cole, .
Editions = (1992,1995,1998,2001,2004),
editions 1,2: Prentice Hall; 3,4: Saunders; 4: Brooks Cole.
5.1.1 IPMa, footnotes

- [IMPa18] 2nd edition:
  - pg 128 “The conclusion is that momentum conservation can only hold if a fast-moving body appears to have more mass than a slow moving one.”
  - pg 129 “At speeds approaching that of light, the body becomes more and more massive. Then the increase in momentum involves a large change in mass and a small change in velocity. This property of mass also assures us that Einstein’s requirement that nothing move faster than light will never be violated by a material object. As a body approaches the speed of light, the application of a force in the direction of motion will only make it more massive and not change its speed appreciably.”

- [IMPa18] 3rd edition:
  - pg 1313 footnote “Some relativity texts reserve the term mass for rest mass alone and put the γ in the definition of momentum. This is simply a semantic choice.”

- [IMPa9] Following is a quote from the 9th edition, previous editions had no such disclaimer.
  “Classically, the particles behave as if their masses increase with speed. Einstein initially favored this interpretation, and later changed his mind to keep mass a constant, a property of matter that is the same in all frames of reference. So it is γ that changes with speed, not mass.”
5.2 Category B: Algebra-based Introductory Physics Textbooks

These textbooks fall under category B as specified by College Board; introductory textbooks that do not assume knowledge of calculus.

[IMPb1] K. Atkins. *Physics*. J. Wiley, New York.
   Editions = [1965, 1970, 1976].

[IMPb2] A. Axelrod. *Ace Your Midterms & Finals: Introduction to Physics (Schaum's Midterms & Finals Series)*. McGraw Hill, New York.
   Editions = [1999],
   c.f. pg 184.

[IMPb3] A. Baez. *The New College Physics; A Spiral Approach*. W. H. Freeman, San Francisco.
   Editions = [1967].

[IMPb4] Arthur Beiser. *Modern Technical Physics*. Addison Wesley, Reading Mass.
   Editions = [1966, 1973, 1979, 1983, 1987, 1992].

[IMPb5] J. Betts. *Physics for Technology*. Reston, Reston, VA.
   Editions = [19761981],
   Places comment on RM in footnote.

[IMPb6] F. Blatt. *Principles of Physics*. Allyn & Bacon, Boston.
   Editions = [1983, 1986, 1989].

[IMPb7] M. Browne. *Schaums Outline; Physics for Engineering and Science*. McGraw Hill, New York.
   Editions = (1994).

[IMPb8] F. Bueche. *College Physics*. McGraw Hill, New York.
   Editions = [1936, 1939, 1940, 1942, 1946, 1961, 1978, 1989].

[IMPb9] F. Bueche. *Principles of Physics*. McGraw Hill, New York.
   Editions = [1965, 1972, 1977, 1982, 1988], (1994).

[IMPb10] F. Bueche and Wellach D. *Technical Physics*. J. Wiley, New York.
   Editions = [1977, 1981, 1985, 1994].

[IMPb11] D. Cassidy and G. Holton. *Understanding Physics*. Springer, New York.
   Editions = [2002].

[IMPb12] J. Cutnell and K. Johnson. *Physics*. J. Wiley, New York.
   Editions = (1989, 1992, 1995, 1998, 2000, 2003).

[IMPb13] K. Ford. *Basic Physics*. J. Wiley, New York.
   Editions = (1968),
   Mentions in footnote and says it is not invariant, so don’t use.

[IMPb14] H. Fuller, R. Fuller, and R. Fuller. *Physics: Including Human Applications*. Harper & Row, New York.
   Editions = [1978].

[IMPb15] A. Giambattista, B. Richardson, and R. Richardson. *College Physics*. McGraw Hill, New York.
   Editions = (2004).

[IMPb16] Douglas Giancoli. *Physics, Principles with Applications*. Prentice Hall, Englewood Cliffs, N.J.,
   Editions = [1980, 1985, 1991, 1995, 1998, 2004],
   See footnote.

[IMPb17] P. Gibbons. *Physics (Barron’s Ez-101 Study Keys)*. Barrons, New York.
   Editions = [1992].
[IMPb18] L. H. Greenberg. *Physics: with Modern Applications*. Saunders, Philadelphia. Editions = [1978].

[IMPb19] A. Halpern and E. Erlbach. *Schaum's Outline of Beginning Physics II: Electricity and Magnetism, Optics, Modern Physics*. McGraw Hill, New York. Editions = [1998], c.f. pg 435.

[IMPb20] E. Hecht. *Physics: Algebra & Trigonometry*. Brooks Cole, Pacific Grove, CA. Editions = (1994,1998,2002), Explains why not to use RM, nice derivation of NOC from time dilation.

[IMPb21] G. Holton and D. Roller. *Foundations of Modern Physical Science*. Addison Wesley, Reading Mass. Editions = [1958].

[IMPb22] J. W. Kane and M. M. Sternheim. *Physics*. J. Wiley, New York. Editions = (1978,1984), (1988).

[IMPb23] J. W. Kane and M. M. Sternheim. *Life Science Physics*. J. Wiley, New York. Editions = (1978).

[IMPb24] S. Marantz. *The Essence of Physics*. Benziger Bros., New York. Editions = [1969].

[IMPb25] J. B. Marion. *Physics and the Physical Universe*. J. Wiley, New York. Editions = [1971,1975].

[IMPb26] J. B. Marion and W. F. Hornyak. *General Physics; with Bioscience Essays*. J. Wiley, New York. Editions = [1979,1985], Hornyak author for 2nd edition only.

[IMPb27] F. Miller. *College Physics*. Harcourt Brace, New York. Editions = [1959,1967,1972,1977,1982].

[IMPb28] J. O'Dwyer. *College Physics*. Wadsworth, New York. Editions = (1981).

[IMPb29] H. Ohanian. *Principles of Physics*. W. W. Norton, New York. Editions = (1994).

[IMPb30] R. Oman and D. Oman. *Physics for the Utterly Confused*. McGraw Hill, New York. Editions = [1998].

[IMPb31] J. Orear. *Physics*. MacMillan, New York. Editions = [1979].

[IMPb32] Physical Science Study Committee PSSC. *College Physics*. Raytheon Educ. Co., Boston. Editions = (1968), Places comment on RM in footnote.

[IMPb33] G. Romine. *Applied Physics: Concepts into Practice*. Prentice Hall, Englewood Cliffs, N.J,. Editions = [2000].

[IMPb34] D. S. Saxon and W. B. Fretter. *Physics for the Liberal Arts Student*. Holt, Reinhart and Winston, New York. Editions = [1971].

[IMPb35] F. W. Sears, H. D. Zemansky, and M. W. Young. *College Physics*. Addison Wesley, Reading Mass. Editions = [1947,1952,1960], (1974), (1980,1985,1991), Authors for editions: 1-3, S. Z.; 4-7, S.Z.Y.

[IMPb36] R. Serway and J. Faughn. *College Physics*. Harcourt Brace, New York. Editions = [1985,1989,1992,1995], (1998,2002,2004).
5.2.1 IMPb footnotes

- [IMPb16] 6th edition: Clarifies his use, suggests many don’t like it and to be careful with it. But still refers to it on footnote on page 744.

5.3 Category C: Calculus-based Introductory Physics Textbooks

These textbooks fall under category C, calculus based introductory textbooks.
[IMPc27] J. B. Marion and W. B. Hornyak. *Physics; For Scientists and Engineers*. Harcourt Brace, Philadelphia.
Editions = [1982].

[IMPc28] W.W. McCormick. *Foundation of University Physics*. MacMillan, New York.
Editions = [1969].

[IMPc29] A. Melissinos and F. Lobkowicz. *Physics: for Scientists and Engineers*. Saunders, Philadelphia.
Editions = [1975].

[IMPc30] H. Ohanian. *Physics*. W. W. Norton, New York.
Editions = [1985,1989].

[IMPc31] S. Radin and R. Folk. *Physics; For Scientists and Engineers*. Prentice Hall, Englewood Cliffs, N.J.,.
Editions = [1982].

[IMPc32] R. Resnick, D. Halliday, and K. Krane. *Physics*. J. Wiley, New York.
Editions = [1960,1966,1978], (1991,2002),
Krane author for 4th and 5th editions only.

[IMPc33] R. Roller, D.and Blum. *Physics*. Holden Day, San Francisco.
Editions = [1981].

[IMPc34] J. Sanny and W. Moebs. *University Physics*. WC Brown, New York.
Editions = (1996).

[IMPc35] F. W. Sears, H. D. Zemansky, and M. W. Young. *University Physics*. Addison Wesley, Reading Mass.
Editions = [1949,1955,1964,1970], (1976,1982,1987),
Author history: editions 1-4, S.Z; 5-7, S.Z.Y; 8, Young; 9-11, Young & Freedman, see other entry for later editions.

[IMPc36] H. Young and R. Freedman. *University Physics*. Addison Wesley, Reading, Mass.
Editions = [8th, 1992; 9th, 1995; 10th, 1999; 11th, 2003],
See footnote.

[IMPc37] R. Serway. *Physics for Scientists and Engineers*. Harcourt Brace, Philadelphia.
Editions = [1982,1986], [1990*,1995*], (1999,2003),
See footnote, in 3rd and 4th editions contradictory statements are made.

[IMPc38] R. Serway and J. W. Jewett. *Principles of Physics*. Wadsworth, Belmont, CA.
Editions = [1994,1998,2001,2005],
(Jewett author for 3rd and 4th editions). Does not introduce RM explictly however does talk about kinetic mass of photon.

[IMPc39] G. Shortly and D. Williams. *Elements of Physics*. Prentice Hall, Englewood Cliffs, N.J.,
Editions = [1953,1955,1961,1965,1971].

[IMPc40] A.L. Stanford and J.M. Tanner. *Physics for Students of Science and Engineering*. Academic Press, New York.
Editions = [1985].

[IMPc41] P. Tipler. *Physics; For Scientists and Engineers*. W. H. Freeman, New York.
Editions = [1976,1982,1991,1999,2004*],
Subtle contradicting statements in latest edition (5th).

[IMPc42] A. Tribble. *Princetom Guide to Advanced Physics*. Princeton Univ. Press, Princeton, NJ.
Editions = [1996].

[IMPc43] D. Wells and H. Shusher. *Physics for Engineering and Science*. Schaums, New York.
Editions = [1983].

[IMPc44] D. Williams and J. Spangler. *Physics for Science and Engineering*. D.VanNorstrand, New York.
Editions = [1981].
5.3.1 IMPc footnotes

- [IMPc13] -pg 15-1 pp 3 “For those who want to learn just enough about it so they can solve problems, that is all there is to the theory of relativity – it just changes Newton’s laws by introducing a correction factor to the mass.”

  Also see 15-9, 15-10 and 11, 16-1, and 16-4

- [IMPc36] T.R. Sandin is now a contributing author (editions 10,11). As he is a vocal proponent of the use of RM, it is not too surprising that its use creeps back in these later editions. Added sentence in 10th ed. Introduces and say there are strong opinions on both sides.

  “Also with relativistic mass, the famous equation \( E = mc^2 \) can be applied to all types of energy, not just most types.”

- [IMPc37] This popular textbook has changed its position twice on the matter. And in transition, contradicting statements are made in the 3rd and 4th edition.

3rd edition

Pg 1124: Relativistic mass is introduced and the explicit formula presented.

Pg 1128: “Finally, note that since the mass \( m \) of a particle is independent of its motion, \( m \) must have the same value in all reference frames.”

4th edition

Pg 1175: “Finally, note that since the mass \( m \) of a particle is independent of its motion, \( m \) must have the same value in all reference frames.”

Pg 1177 “It follows that mass varies with speed (relative to the observer). We must therefore distinguish between rest mass, \( m_0 \), which is the mass measured by an observer at rest relative to the particle (and at the same location), and the mass measured in real experiments.”

By 5th edition this later terminology is removed, (but still states that light has mass).

- [IMPc41] Page 201, there is a discussion of energy and mass wherein \( E_0 = mc^2 \) is used and continual discussion of rest energy is used. Here a good statement of the relation between mass and energy is made.

  “According to Equation 7-7, a particle or system of mass \( m \) has “rest” energy \( mc^2 \). This energy is intrinsic to the particle.”

However, roughly 130 pages later, on page R-12, relativistic mass is introduced in relation to relativistic momentum.

  “Equation R-10 is sometimes written \( p = m_r v \), where \( m_r \) is called the relativistic mass”… “Relativistic mass and momentum are discussed further in Chapter 39.”

5.4 Category D: Modern Physics Textbooks

Here are listed modern physics textbooks intended for a first time exposure to the ideas of modern physics.

- [IMPd1] V. Acost, C. Cowan, and B. Graham. Essentials of Modern Physics. Harper Row, New York. Editions = [1973].
[IMPd2] N. Ashby and S. Miller. *Principles of Modern Physics*. Holden Day, San Francisco. Editions = [1966, 1970].

[IMPd3] A. Beiser. *Concepts of Modern Physics*. McGraw Hill, New York. Editions = [1963, 1973, 1981, 1987, 1995], (2002), c.f. pg 24.

[IMPd4] A. Beiser. *Modern Physics: An Introductory Survey*. Addison Wesley, Reading Mass. Editions = [1968].

[IMPd5] J. Bernstein, P. M. Fishbane, and S. Gasiorowicz. *Modern Physics*. Prentice Hall, Englewood Cliffs, N.J.,. Editions = (2000).

[IMPd6] Blanchard, Burnett, Stoner, and et. al. *Introduction to Modern Physics*. Prentice Hall, Englewood Cliffs, N.J.,. Editions = [1958, 1969].

[IMPd7] F. Blatt. *Modern Physics*. McGraw Hill, New York. Editions = [1992].

[IMPd8] J. Brehm and W. Mullin. *Introduction to the Structure of Matter; A course in modern physics*. J. Wiley, New York. Editions = (1989).

[IMPd9] R. Eisberg. *Fundamentals of Modern Physics*. J. Wiley, New York. Editions = [1961].

[IMPd10] R. Gautreau. *Schaum’s Outline of Modern Physics*. McGraw Hill, New York. Editions = [1978, 1999], c. f. pg 44.

[IMPd11] E. Harris. *Introduction to Modern Theoretical Physics*. J. Wiley, New York. Editions = (1975).

[IMPd12] R. Harris. *Nonclassical Physics: Beyond Newton’s View*. Addison Wesley, Reading Mass. Editions = (1999).

[IMPd13] Kim and E. Strait. *Modern Physics: for Scientists and Engineers*. MacMillan, New York. Editions = [1978].

[IMPd14] K. Krane. *Modern Physics*. J. Wiley, New York. Editions = [1983], (1995).

[IMPd15] R. Leighton. *Principles of Modern Physics*. McGraw Hill, New York. Editions = [1959], See footnote.

[1] W.W. McGervey. *Introduction to Modern Physics*. Academic Press, New York. Editions = (1971, 1983), Says to avoid RM in footnote.

[IMPd17] J. Norwood. *Twentieth Century Physics*. Prentice Hall, Englewood Cliffs, N.J.,. Editions = (1976).

[IMPd18] H. Ohanian. *Modern Physics*. Prentice Hall, Englewood Cliffs, N.J.,. Editions = (1987, 1995).

[IMPd19] J. Pfeffer and S. Nir. *Modern Physics, an Introduction*. World Scientific, Singapore. Editions = [2000].

[IMPd20] B. Robertson. *Modern Physics for applied science*. J. Wiley, New York. Editions = [1981].
[IMPd21] T. Sandin. *Essentials of Modern Physics*. Pearson, New York.
Editions = [1989].

[IMPd22] R. Serway, C. J. Moses, and C. A. Moyer. *Modern Physics*. Harcourt Brace, Philadelphia.
Editions = [1989], (1997,2004).

[IMPd23] O. Theimes. *A Gentleman’s Guide To Modern Physics*. Worth, New York.
Editions = [1973].

[IMPd24] S. Thornton and A. Rex. *Modern Physics: for Scientists and Engineers*. Harcourt Brace, Philadelphia.
Editions = (1993), (2000,2005).

[IMPd25] P. Tipler. *Foundations of Modern Physics*. Worth, New York.
Editions = [1969].

[IMPd26] P. Tipler and R. A. Llewellyn. *Modern Physics*. Worth, New York.
Editions = [1969], (1978,1999,2003),
Author Llewellyn only for 3rd and 4th edition.
1st Ed: introduces but then ignores it, saying that it leads to mistakes.

[IMPd27] Trinklein and Metcalf. *Modern Physics*. Holt, New York.
Editions = [1964,1968,1972,1976,1980],
Note AAPT poll shows this was one of the most used (2001).

[IMPd28] R. Weber. *Physics for Teachers: A Modern Review*. McGraw Hill, New York.
Editions = [1964].

[IMPd29] Weidner and Sells. *Elements of Modern Physics*. Allyn & Bacon, Boston.
Editions = [1960,1968,1980],
3rd edition introduces but does not use.

[IMPd30] H. Wilson. *Modern Physics*. Blackie & Son, London.
Editions = [1928,1937,1959].

5.4.1 IMPd footnotes

- [IMPd3] In the latest, 6th, edition of this long running text the author expresses his dislike for the concept of relativistic mass. It is interesting that it took so long for this view to be expressed in print.

- [IMPd15] States they are different approaches and equally valid.

  “In any case it is necessary to check the final physical laws, no matter by what process they are arrived at, against the actual properties exhibited by nature. By this criterion either of the above expressions for the dynamical laws must be considered to be experimentally verified, but of course the criteria of simplicity and aesthetics speak strongly for the 4-vector form.”

6 A Quick Summary

The historical trends on the above works are presented and discussed in [Intro1], they will not be repeated here. However a quick summary of the use of RM in these works is provided in the following table. The results may differ slightly than in [Intro1] as some works have been reclassified (and more refinement is still in order).
| Category | pre-1970 | '70-74 | '75-79 | '80-84 | '85-89 | '90-94 | '95-99 | '00-05 | Total  |
|----------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| SGR no   | 6       | 3      | 4      | 5      | 3      | 8      | 3      | 5      | 37     |
| SGR yes  | 27      | 5      | 4      | 0      | 3      | 8      | 8      | 8      | 63     |
| PS no    | 2       | 0      | 2      | 1      | 3      | 5      | 0      | 6      | 19     |
| PS yes   | 5       | 1      | 1      | 5      | 7      | 11     | 21     | 35     | 86     |
| MISC no  | 0       | 1      | 1      | 0      | 1      | 4      | 1      | 5      | 13     |
| MISC yes | 4       | 1      | 1      | 4      | 7      | 14     | 28     | 45     | 104    |
| IMPa no  | 0       | 1      | 0      | 0      | 2      | 5      | 8      | 16     |
| IMPa yes | 26      | 7      | 5      | 5      | 6      | 4      | 5      | 40     |
| IMPb no  | 2       | 1      | 1      | 2      | 4      | 6      | 4      | 9      | 29     |
| IMPb yes | 17      | 8      | 12     | 8      | 14     | 7      | 7      | 5      | 78     |
| IMPc no  | 0       | 0      | 1      | 3      | 3      | 4      | 8      | 10     | 29     |
| IMPc yes | 20      | 8      | 5      | 12     | 7      | 4      | 9      | 3      | 68     |
| IMPd no  | 0       | 1      | 3      | 1      | 2      | 0      | 5      | 6      | 18     |
| IMPd yes | 17      | 5      | 3      | 5      | 3      | 1      | 2      | 1      | 37     |
| ALL no   | 10      | 7      | 12     | 12     | 16     | 29     | 26     | 49     | 158    |
| ALL yes  | 92      | 35     | 31     | 39     | 47     | 50     | 69     | 91     | 476    |

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