RECIPROCITY

Editor, F. H. Meyer
146 Ross Hall
University of Wisconsin
Superior, WI 54880

Published by NEW SCIENCE ADVOCATES, INC., an organization devoted to promoting the Reciprocal System of physical theory.

Treasurer: Rainer Huck
1195 South Windsor St.
Salt Lake City, UT 84105

Secretary: Ronald W. Satz
Transpower Corporation
P. O. Box 473
Fort Washington, PA 19034

Vol. IX, No. 2 Summer, 1979

OUR PHYSICAL UNIVERSE
(We only know the half of it -- D. B. Larson)

LARSON LECTURE AT SUPERIOR IN JULY

Mr. Dewey B. Larson will be the featured speaker, sponsored by the University of Wisconsin-Superior College of Letters and Science, July 19th, Thursday evening, 8:00 P.M. in the Holden Fine Arts Lecture Room 2125 on the UW-S campus. His topic will be SCIENCE WITHOUT APOLOGIES.

CONTENTS OF THIS RECIPROCITY

FOURTH ANNUAL NSA CONFERENCE

NEW SCIENCE ADVOCATES, INC., a non-profit, educational corporation, will hold its Fourth Annual Conference on the campus of the University of Wisconsin-Superior, Barstow Hall 108, Friday-Saturday, July 20-21, 1979, the two days following the Thursday evening Larson Lecture.

What of it? A fresh, coherent answer has been discovered to the question, WHAT IS THE PHYSICAL UNIVERSE? The answer originated several decades ago in the United States but not inside the official citadel of physics research in this country, the American Physical Society.

The discovery consists of the theoretical finding that the physical universe is a universe of motion, time and space, and not merely "space and matter". The discovery is the creation and fruit of the labor of an uncommitted investigator, Mr. Dewey B. Larson, 80 years-young engineer-scientist-author. It is named by him the reciprocal system of physics.

Purpose of the Superior Conference is to review and develop organization of the NSA corporation and its organ, Reciprocity, and to examine critically, elaborate and evaluate current results, claims and implications of the reciprocal system.

Conference Program Notes

NSA Business Meeting will be held 9 A.M.-11:30 A.M. Friday morning, July 20, Barstow Hall 108, Dr. Frank Anderson, NSA President, presiding. After lunch Conference meeting will resume at 1:30 P.M.-5 P.M. to discuss current issues about the reciprocal system, including response by Mr. Larson to follow-up comment and question with regard to the Thursday evening lecture, Science Without Apologies. As time allows, presentation of contributed papers is scheduled. Friday evening, 7 P.M.-10 P.M., an NSA social period with delicious food and drink will take place in the lovely home of NSA member, Dr. Joseph Mengel, and his wife, Luise, 192 Billings Drive in Superior ($2 per person donation). Saturday morning, July 21, presentation of more contributed papers will begin at 9 A.M. and continue until each one has had a chance to have his or her say about any question or issue related to the reciprocal system. As a rule, presentation may be limited to 15 minutes per paper with 5 additional minutes for questions to the author. If you intend to contribute to this program, please notify Dr. Rainer Huck, Mr. Todd Kelso or Professor William Mitchell of the 1979 Program Committee, if you have not already done so, about the title of your paper and any A-V aids you may need by July 4th. Saturday afternoon a meeting of NSA members who are present in Superior will take place (time to be announced later) to elect NSA Board of Trustees and officers for the 1979-1980 period.

You should promptly make motel reservations, if you intend to live off campus during your stay in Superior, because the region usually is visited by many tourists during the summer. Low cost housing, $6.00 per person per night, (which may be reduced to $4.00), will be available in Ross Hall on campus for those who want it. Price includes sheets, blanket, pillow and pillow case, but not towels and soap. Please send your Ross Hall reservation to Professor Frank Meyer promptly, if you choose this accommodation. Holiday Inn (715-392-4783), motel where Dewey and Dorothy Larson will stay, is one of nearest to UW-S campus.

If you let Professor Meyer (612-331-6086 or 715-392-9631) know when you are arriving at Duluth airport (nearest to Superior), he will try to have you met at the airport.

DIRECTIONS IN PHYSICS

Frank H. Meyer
University of Wisconsin-Superior
Superior, WI 54880

So What?

The reciprocal system of physics, originated by D. B. Larson (1), foretells some new directions in physics. It does so while endorsing numerous old orientations.

The reciprocal system is unique among theories of physics and natural philosophy. It is the first general unified true system of physics known on earth. All of its results and conclusions have been deduced entirely from its fundamental postulates, of which there are two.

If the Larson theory is a truer theory than the prevailing paradigms of physics, then the new directions it has foretold should be meeting with growing support and confirmation.

Is this at all the case?

I shall indicate five instances where it does appear to be so.

Expansion of the Universe

Will the universe of galaxies expand forever or not?

The expansion was announced by the American astronomer, Hubble (2) in 1929.

In 1959 Larson (1) attributed the expansion of the physical universe to the progression of space-time. He predicted also that since the expansion depends on the physical nature of time and space, it will continue so long as they exist--forever. Larson concluded further that the expansion of the physical universe is compatible with the steady state of it as a whole.

Each of these results, as is every result of the reciprocal system, is deduced entirely from its two fundamental postulates:

1. The physical universe is entirely composed of one component, motion, existing in three dimensions, in discrete units and in two reciprocal forms, space and time.

2. The physical universe conforms to the relations of ordinary mathematics, its magnitudes are absolute and its geometry is Euclidean.

Most physicists, astronomers and cosmologists have not accepted the reciprocal system explanation of the expanding universe. They believed rather that the present expansion could not and would not continue indefinitely. They have preferred a different explanation--the Big Bang hypothesis.

According to the Big Bang theory, the physical universe began only a finite time ago. Some believe that this was about six thousand years ago; others, that it was about eighteen billion years ago. The advocates of the Big Bang assume that except for one primeval Lemaitre (3) atom, until the physical universe was created from this single atom, space, time and matter did not exist. The universe began when the primeval atom for some unknown reason exploded. It has been expanding ever since as a result of this postulated explosion. But it will not go on expanding forever. Because of the

"universal" gravitation force, the expansion presumably is slowing down already and will ultimately stop and then change into a contraction. Hence the currently prevailing cosmological paradigm leans toward the view that the universe of galaxies cannot possibly continue to expand forever.

Does recent evidence support the Big Bang view or the reciprocal system view whether the universe of galaxies will not or will expand forever?

Recently, an outstanding contemporary of Larson, the physicist, P. A. M. Dirac (4) reached the same conclusion Larson reached 20 years ago: the universe must go on expanding forever.

Recently, four astronomers, J. E. Gunn, B. M. Tinsley, J. R. Gott and D. N. Schramm (5) reported the result of their taking inventory of the total mass of the physical universe in an experimental endeavor to estimate the longevity of the expanding universe. The evidence they gathered supported the Larson contention that it will expand forever.

The reciprocal system explanation of the expanding of the physical universe is based on a new conception of space and time. They are reciprocally related as motion. One implication of this inverse relation is that space and time are made of discrete units, which are equivalent, so that not only are units of space equal and units of time equal, but also one unit of space equals one unit of time. Space and time do not exist apart from each other but only as units of motion. Motion assumes diverse forms, of which the first is the space-time progression, from which all other forms derive by speed displacements from its unit speed. The uniform scalar progression of space with time at unit speed, 186,000 miles/second in conventional units, is an original deduction by Larson from the basic postulates of the reciprocal system.

Newton (6) conceived space and time to be absolutely unrelated, while Einstein (7) supposed time and space to be inseparably related to each other and to solid matter. Both Newton and Einstein considered that motion is applicable only to things, particles and matter. Neither considered the possibility that motion applies even more to space and time.

But are not space and time the very essence of motion? In what does the unity of the opposites, space and time, consist? Motion! To have motion what more is needed than space and time? And in the absence of either space or time motion would be impossible. Without motion neither light nor electricity nor matter nor life could be nor come into being. Is this not what Benjamin Franklin meant when in his Autobiography he remarked that "time is the stuff life is made of"? Space is another "stuff of life," since, in fact, life and matter are inseparable from motion.

Solar Energy

Is the radiant energy from the sun essentially generated by a nuclear fusion process?

Twenty years ago Larson (1) raised this question, which physicists and astronomers to-day find it necessary to reexamine. Deduction from the postulates of the reciprocal system has not supported the positive answer that nuclear physicists once took for granted.

The experimental evidence has not been forthcoming that was directly to prove beyond a reasonable doubt that the sun generates radiant energy by fusing hydrogen to helium particles. Solar neutrinos have not been detected in the predicted amounts. Yet this was a carefully designed and executed experimental project to check the proposition that solar energy must be generated primarily by fusion processes.

As a consequence of this experimental non-confirmation, recently published astronomy textbooks (8, 9) are expressing doubt that the accepted descriptions of solar energy generation as a fusion process are necessarily correct. Lately this spreading doubt was expressed in the widely circulated Science News (10). (See also Reciprocity, Vol. IX, No. 1, pages 14-15, Spring, 1979.)

It is odd that nuclear physicists and modern astronomers have not considered ways the sun could generate radiant energy other than fusion. It is true that hydrogen and helium are by far the most abundant chemical elements found in the sun. However, it is not made only of these two materials. Nor is fusion the only type of radioactive process. The successive spontaneous fission as a function of temperature of a sequence of the heavier chemical elements of the sun, beginning with the heaviest, is a possible way the sun generates the gist of its radiant energy. Such a way also would be compatible with the sun's prolonged stability. When the turn of more abundant elements in the sequence, such as iron and nickel, came, because the temperature at which they spontaneously disintegrate is reached, then the eventual termination of the sun's existence in a supernova explosion is also possible.

As evidence accumulates, the hypothesis of the hydrogen to helium conversion (fusion) process seems increasingly not to be in accord with the facts. Why, in fact, should the reaction of hydrogen proceed irreversibly to helium instead of in the opposite direction? If nevertheless hydrogen does so convert to helium in the stars, why is there no evidence of the existence of helium-rich structures in space-time? Van Horn (10) who speculates that the absence of hydrogen from the interiors of white dwarf stars is certain, reports that in the spectra and hence in the atmospheres of about two-thirds of these stars, "only the pressure-broadened Balmer-lines of hydrogen are to be found."

Thus, the finding of the reciprocal system of physics that the radiant energy of the sun is not generated via a nuclear fusion process is not without experimental and theoretical support.

Atom Has No Nucleus

Does each atom of matter have a nucleus?

Is the atom composed of elementary particles?

Physics and chemistry textbooks in and out of the U.S.A. presently teach that each atom of matter has a nucleus. It is alleged as proved that in and out of the nucleus are certain elementary particles. It is alleged as almost proved or about to be proved that these elementary particles are composed of still more elementary particles, called quarks.

Among the particles said to be in the nucleus are protons, tightly packed together in defiance of the law of electricity that like particles repel one another. A nuclear attractive force overcomes the repulsive electrical force at sufficiently small distances.

Short-lived neutrons become endowed with long life when they find themselves associated with protons in said nucleus.

To complete the picture, "to a first approximation," as we say, electrons are alleged to circulate about the nucleus in an amount equal to the number of protons in the nucleus. This number is taken to be the meaning of atomic number, an important mathematical fact about any chemical element.

Before the neutron was discovered, some electrons were allowed in the nucleus and the remainder were kept in the atom but outside the nucleus. Since an atom is electrically neutral, in this arrangement, too, the total number of electrons inside and out of the nucleus had to add up to the total of positive charge in the nucleus, according to the nuclear atom model.

No one should express doubt about the existence and reality of actual electrons, neutrons and charged hydrogen particles (ions).

The doubt that is increasingly expressed and should be expressed concerns the questions whether the atom of matter is indeed made of parts in the form of so-called elementary particles, and if so, which particles and whether atom indeed has a nucleus.

The position of the reciprocal system with regard to these questions is unequivocal. If one can create particles, then the question of which are the fundamental constituents of matter ceases to have a definite meaning. Thus, there are no elementary particles. The atom is not made of parts, but is a combination of simple, discrete motions. The atom has no nucleus. It is about 10,000 times smaller than commonly represented. This position of the reciprocal system is ably expressed in detail in a book by Larson (11). An interesting but unconvincing attempt at refutation of the thesis of this Larson book has appeared in a book review by Isaac Asimov (12).

Do Larson and the reciprocal system stand alone in making out the case against the nuclear atom? Twenty and more years ago this may have appeared to be so but this is no longer so. In fact, even thirty years ago du Noüy (13) characterized the nuclear atom as "only an impostor" and declared that the real atom "never resembled such a monster."

A careful reexamination recently of the nuclear atom model by Schrader-Frechette (14) has led him to the conclusion that no more evidence that an atom is made of certain elementary particles is available than that the atom is <u>not</u> so made.

Faster Than Light

Do any physical entities have intrinsic rates of motion larger than light speed in empty space?

The answer of the reciprocal system to this question is: yes, of course.

All physical entities whose mode of motion is in space and which belong to the material sector necessarily move with rates <u>less</u> than the speed of light. According to the reciprocal system, this speed is equal in magnitude to the unit speed of the space-time progression. This is not a maximum of physical speeds, but rather a watershed.

All physical entities whose mode of motion is in time and which belong to the cosmic ("anti-matter") sector of the physical universe necessarily move with rates <u>more</u> than unit speed.

The theory of relativity has been understood to prohibit any physical entity from going faster than light or unit speed.

In the light of currently accumulating evidence, which is closer to correct on the question, the reciprocal system or the theory of relativity?

The evidence available now, while it has <u>not</u> eliminated the negative answer to the question entirely to everyone's satisfaction, is beginning to accentuate the positive answer.

Some of the adherents of relativity themselves are no longer quite certain that the correct answer is No.

Explaining how the relativity theory seems to imply that nothing can travel faster than light, Davies (14) remarks:

> "Strictly speaking this is not true. Only material objects cannot be accelerated through the 'light barrier.' There is no known reason why there cannot exist superluminal bodies, provided they are always superluminal bodies, i.e. cannot be slowed to less than light speed. Indeed, such bodies (in the form of microscopic particles) have been actively searched for by experimental physicists in the last decade or so. They have even been given a name--tachyons. So far no tachyons have been found."

For some time now the concept of tachyons has been around to reconcile the theory of relativity with the possible existence of faster-than-light particles. Yet this theory, if true, has the reputation of rendering the existence of such particles impossible.

The question concerning the truth of the theory of relativity should not be taken for granted. A friend and associate of Einstein, Bergmann (16), in the continuing inquiry about the question has put this point aptly:

> "Like all other theories of nature, relativity is certain to require modification, and perhaps even complete replacement, as man's actual knowledge of the physical universe increases."

The notion that the theory of relativity already has been proven true sometimes is taken for granted. Heinsenberg (17) said:

> "It (relativity) has become a permanent property of exact science just as has classical mechanics or the theory of heat."

Hitherto the issue of faster-than-light particles has arisen only in the context of the theory of relativity. What is at issue is not simply whether tachyons or particles like the postulated tachyons have not or have been found, do not or do exist. The real issue for theoretical physics is whether such particles can not or can exist. If such particles can not exist, then, of course, they do not exist and so are not to be found. If such particles, called tachyons or cosmic particles (1), can exist, then probably they do exist and are to be found. This would be so in spite of any theory, like relativity, created by the human mind.

What is so depends on no theory, including the reciprocal system. However, the main claim of the reciprocal system is that it is about what is so. About the present issue what does it assert?

Within the context of the reciprocal system of physics the type of physical particles which Davies calles 'superluminal' can and must exist, do exist and are found in the same physical universe in which actual material particles can exist, do exist and are found. According to the reciprocal system, these 'superluminal' particles move in time at rates in excess of unit speed, are as numerous as are material particles and belong to a sector of the physical universe, called by Larson the 'cosmic sector.'

Therefore, the answer of the reciprocal system to the question whether physical entities exist having intrinsic rates of motion faster than light speed is yes. There are as many such cosmic entities as there are material entities in the physical universe.

The answer of some adherents of relativity theory no longer is a categorical no, but a maybe yes, coupled with the claim that no such entities have yet been found in the physical universe.

Structure of the Physical Universe

What is the physical universe?

What is anti-matter?

Profound differences exist between the answers given by the reciprocal system to these questions and the answers offered by modern quantum mechanics, nuclear physics, elementary particle theory and relativity theory.

The reciprocal system answers that the physical universe is the world of space and time. And this world of space and time is coterminous with the world of motion. Whatever is beyond space, time and motion is not the physical universe.

The prevailing view about the structure of the physical universe is, as formulated by Davies (15) that "the universe is space and matter (p. 1)." This view derives from the atomic hypothesis of the ancient Greeks, Democritus and Leucippus, that the world is composed of atoms and the void. In this view the common denominator of the physical universe is matter rather than motion.

Which of the above two conflicting natural philosophies is the more correct? The orthodox physics or the reciprocal system of physics?

The answers to these questions now involve in part the question: what is "anti-matter"?

That which others allude to by the misnomer, "anti-matter" (19), Larson (1) refers to as the cosmic sector of the physical universe. A reason for the name "cosmic sector" is that cosmic radiation provides the best evidence for the existence of the particles of the cosmic sector. The essential nature of cosmic particles has remained virtually undiscovered hitherto, since all of them, while remaining in their own sector, are superluminal particles moving in time with speeds in excess of unit speed.

Burbidge and Hoyle (19) dismiss the possibility that a sector of "anti-matter" coequal with the material sector coexists with it in the physical universe. This view of the significance of so-called anti-matter in relation to matter appears representative of the prevailing view of orthodox physics.

The view of the reciprocal system is that the cosmic sector coexists equally with the material sector of the physical universe.

Which view of the cosmic sector ("anti-matter") is the more correct, the view of the reciprocal system or the prevailing orthodox view?

The deep irreconcilable differences between the two views arise primarily from their profoundly different conceptions of space and time. While the two views agree that Newton (6) was incorrect in assuming that space and time are unrelated, they disagree about what constitutes the unity and relatedness of space and time.

The prevailing view postulates that the concept of motion is inapplicable to space and time.

The reciprocal system postulates that space and time constitute the essence of all motion. In other words, motion is always a reciprocal or inverse relation between space and time or between time and space (1).

It follows from the postulates of the reciprocal system that, because space and time are the reciprocals of each other, that for every physical entity or phenomenon, there is an inverse, which is identical in all respects except that space and time are interchanged. Thus, for example, for every material chemical element in the chemist's Periodic Table, its inverse exists in the form of a cosmic chemical element. This inverse is not an additive (+ and -) inverse, which is what the term 'anti matter' implies; it is a multiplicative inverse.

This is how it happens that there exists a second half of the physical universe, the cosmic sector, which is related inversely to the material sector (1, 18).

Does present available evidence support the claim of the reciprocal system that chemical elements of the cosmic sector inverse to the elements of the material sector exist? Yes, it does.

The cosmic sector makes its existence known to the curious inquirer principally by the way of cosmic radiation and cosmic ray decay.

Twenty years ago Larson (1) identified as isotopes of particlar cosmic chemical elements the following particles with Greek names:

the muon	cosmic argon	(c-Ar^{35})
the pion	cosmic silicon	(c-Si^{27})
the lambda	cosmic neon	(c-Ne^{20})
the sigma	cosmic nitrogen	(c-N^{14})
the xi	cosmic boron	(c-B^{10})
the omega	cosmic lithium	(c-Li^{5})

The identification procedure depends on the convergence of several lines of approach, including theoretical computation of the mass and lifetime of each particle and also examination whether and how it can fit into the regular cosmic ray decay sequence after the particle enters the material sector.

Recently two new particles of the cosmic sector were discovered not in cosmic radiation but with the aid of human machines. In November, 1974, two teams, one at the Brookhaven National Laboratory and the other at the Lawrence Livermore Laboratory announced the discovery of two new particles, one with a mass equivalent to 3,105 MeV/c^2, the other with a mass equivalent to 3,695 MeV/c^2. The lifetime of each particle is about 10^{-20} second, considered by some to be a remarkably long lifetime for particles of this heavy mass. These particles have been given Greek names, they are called 'psi resonances.'

The discovery of the mere existence of these high-energy particles has been deemed so important that the leaders of the two teams, Drs. Samuel Ting and Burton Richter, were awarded the 1976 Nobel Prize in physics for this discovery.

The quark hypothesis, a derivative of the prevailing natural philosophy, has not proved helpful in elucidating how the psi resonances fit into the scheme of things. Part of the difficulty is that the quarks themselves remain undiscovered.

Meanwhile, the psi resonances both have been identified and distinguished with the aid of the reciprocal system.

The psi resonance with a mass equivalent to 3695 MeV/c^2 has been identified as the isotope of cosmic hydrogen, c-H^2, cosmic deuteron with two material gravitational charges. This is a deduction from the reciprocal system and the achievement of Satz (20).

The psi resonance with a mass equivalent of 3105 MeV/c^2 has been identified with the isotope of cosmic helium, c-He^3 with two material gravitational charges. This is an achievement of the author of the reciprocal system (18).

In the light of these reported developments the reciprocal system conception of the physical universe and "anti-matter" appears to be better supported by presently available evidence than the prevailing orthodox conception of the subjects under inquiry.

In summary, the reciprocal system's results have been gaining support and confirmation in at least five important subjects of physical inquiry.

References

1. Larson, D. B. The Structure of the Physical Universe. North Pacific Publishers. Portland, Oregon. 1959.
2. Hubble, E. The Realm of the Nebulae. Yale University Press, 1936; reprinted by Dover Publications, 1938.
3. Lemaitre, G. Theorie de Atome Primitif, 1927.
4. Dirac, P. A. M. Directions in Physics. John Wiley & Sons, 1978.
5. Gott, J. R., J. E. Gunn, D. N. Schramm, B. M. Tinsley. "Will the Universe Expand Forever?" Scientific American, March, 1976, 234, No. 3, pages 62-79.
6. Newton, I. Mathematical Principles of Natural Philosophy, 1687; University of California Press, 1934.
7. Einstein, A. The Principle of Relativity. Dover Publications, 1923.
8. Zeilik, M. Astronomy: the evolving universe. Harper & Row, 1979.
9. Pasachoff, J. M. Contemporary Astronomy. W. B. Saunders Co., 1977.
10. Van Horn. Physics To-day. May, 1979.
11. Larson, D. The Case Against the Nuclear Atom. North Pacific Publishers , 1961.
12. Asimov, I. Chemical and Engineering News. July 29, 1963.
13. du Noüy, L. The Road to Reason. Longmans, Green and Co., p. 230, 1949.
14. Schrader-Frechette, L. Philosophy of Science. 44, No. 3, p. 409-440, September, 1977.
15. Davies, P. C. W. Space and time in the modern universe. Cambridge University Press, 1977, p. 46.

16. Bergmann, P. The Riddle of Gravitation. Charles Scribner's Sons, New York, 1968, p. 209.

17. Heisenberg, W. Philosophical Problems of Nuclear Science, Pantheon Books, New York, 1952, p. 12.

18. Larson, D. B. Nothing But Motion. North Pacific Publishers, 1979.

19. Burbidge, G. and Hoyle, F. Anti-Matter. Scientific American, p. 2-7, April, 1959.

20. Satz, R. RECIPROCITY, Vol. V, No. 2, p. 3, May, 1975.

REVIEWERS COMMENTS ON LARSON'S EARLIER WORKS

BEYOND NEWTON (1964)

--a book that opens up an entirely new field of thought.

--Pakiston Journal of Scientific and Industrial Research, Jan. 1964

--recommended to anyone who thinks the subject of gravitation and general relativity was open and closed by Einstein.

--The Science Teacher, Dec. 1964

NEW LIGHT ON SPACE AND TIME (1965)

The author of this book may well be right in believing that the root cause of the unsatisfactory state of physics--in its basic character--is that conception, or understanding, has been lost in a maze of mathematical expertise.

--Contemporary Physics, April 1966

Only careful checking of all of the author's considerations can show whether he is right or not. The official school of natural philosophy ought not to avoid this (of course, considerable) effort; after all, it is a question of fundamental significance. Still less will it be permissable to condemn the author as a heretic just because he opposes the "accepted" doctrines of modern physics. Opposition is illegitimate only if essential error is proved . . . Whether an unbiased investigation of the author's theses would lead to confirmation or rejection is not for the reviewer to say in advance; the question is too complicated to be decided briefly.

--Naturwissenschaftliche Rundschau, Sept. 1966

QUASARS AND PULSARS (1971)

Whether this Reciprocal Theory would stand the test of time has to be patiently observed. If it does, the physicists will find in it their long-cherished desire, viz., one comprehensive theory with universal applicability, although many of the currently cherished theories will then receive death blows and will vanish yielding place to the new.

--Indian Journal of Physics, Aug. 1973

TIME REGION PARTICLE DYNAMICS

by

Ronald W. Satz

Fort Washington, PA

Mr. Larson has worked out the static relations between particles in the time region; specifically, he has calculated the equilibrium interatomic distances for all the elements and many compounds (see pages 27-49 of The Structure of the Physical Universe). This paper will explore the dynamic relations between particles in the time region.

Consider a particle (say an alpha particle) moving directly towards a stationary atom (say a gold atom fixed in thin foil). Initially the particle has a velocity v_o. Once it enters the time region, that is, when its distance is less than one one natural unit of space, two forces are encountered: the progression and gravitation. In the time region, the progression acts to bring particles closer together, whereas gravitation acts to repel particles--the reverse of gravitation in the time-space region. The progression is stronger until the equilibrium distance is reached, then the gravitational force becomes stronger. I believe that the equation of motion is

$$F_p - \frac{K_G}{(x_u - x)^4} = m \frac{d^2x}{dt^2} \qquad (1)$$

where

F_p = unit force of the progression

K_G = magnitude of the rotational motion of the particles

x_u = natural unit of space

m = mass of the moving particle

x = distance measured from start of time region

Dividing by m gives

$$\frac{F_p}{m} - \frac{K_G}{m(x_u - x)^4} = \frac{d^2x}{dt^2}$$

The right hand side reduces to

$$\frac{d^2x}{dt^2} = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} \qquad (2)$$

Thus

$$\frac{F_p}{m} - \frac{K_G}{m(x_u - x)^4} = v\frac{dv}{dx}$$

Separating variables and integrating, we have

$$\int_0^{x_f} \frac{F_\rho}{m}\,dx - \int_0^{x_f} \frac{K_G\,dx}{m(x_u-x)^4} = \int_{v_0}^{v_f} v\,dv$$

or

$$\frac{F_\rho}{m}x_f - \frac{K_G}{3m}\left[(x_u-x_f)^{-3} - (x_u)^{-3}\right] = \frac{1}{2}(v_f^2 - v_0^2) \qquad (3)$$

There are two cases of interest with this equation.

Case 1: Suppose we want to know the initial velocity required to bring the particles to a certain distance apart from each other. Equation (3) is solved for v_0, letting v_f be zero.

$$v_0 = \sqrt{2\left[\frac{K_G}{3m}\left\{(x_u-x_f)^{-3} - (x_u)^{-3}\right\} - \frac{F_\rho}{m}x_f\right]} \qquad (4)$$

Case 2: Suppose we want to know the final separation between two particles, given v_0. Let

$$x_{sep} = x_u - x$$

Equation (3) becomes

$$\frac{F_\rho}{m}(x_u - x_{sep}) - \frac{K_G}{3m}\left[x_{sep}^{-3} - x_u^{-3}\right] = \frac{1}{2}(v_f^2 - v_0^2)$$

With $v_f = 0$, and putting the terms involving x_{sep} on one side of the equation, we have

$$\frac{F_\rho}{m}x_u + \frac{K_G x_u^{-3}}{3m} + \frac{1}{2}v_0^2 = \frac{F_\rho}{m}x_{sep} + \frac{K_G}{3m}x_{sep}^{-3}$$

Define the following coefficients:

$$C_1 = \frac{F_\rho}{m}x_u + \frac{K_G x_u^{-3}}{3m} + \frac{1}{2}v_0^2$$

$$C_2 = \frac{F_\rho}{m}$$

$$C_3 = \frac{K_G}{3m}$$

$$C_4 = -\frac{C_1}{C_2}$$

$$C_5 = \frac{C_3}{C_2}$$

With these coefficients, the result is a quartic equation:

$$x_{sep}^4 + C_4 x_{sep}^3 + C_5 = 0 \qquad (5)$$

This equation can then be solved by the usual means.

Now, going back to equation (3) we can solve for v as a function of x:

$$v = \frac{dx}{dt} = \sqrt{\left\{2\left[\frac{F_p}{m}x - \frac{K_G}{3m}\left[(x_u - x)^{-3} - x_u^{-3}\right]\right] + v_0^2\right\}}$$

Separating variables and integrating we have

$$t = \int_0^x \frac{dx}{\left\{2\left[\frac{F_p}{m}x - \frac{K_G}{3m}\left((x_u - x)^{-3} - x_u^{-3}\right)\right] + v_0^2\right\}^{1/2}} \qquad (6)$$

The integral can be evaluated numerically by Romberg's method.

Example

Consider an alpha particle moving directly towards a gold atom in a foil, at an initial velocity of 2.06×10^7 meters/sec. What is the distance of closest approach? How long does it take to get there? What happens afterward?

Here we have

$v_0 = 2.06 \times 10^7$ m/sec

$m = 6.64 \times 10^{-27}$ kg

$x_u = .455884 \times 10^{-7}$ m

$F_p = 1.09699 \times 10^{-3}$ N

Now,

$$K_G = \frac{1.09699 \times 10^{-3} \times (.455884 \times 10^{-7})^4}{(156.44)^4} \times \ln^2 t_A \ln^2 t_B$$

For gold, $t_A = 4.5$; for helium, $t_B = 3$. But helium has only one active dimension so the force is multiplied by 1/3. Thus

$$K_G = \frac{1.09699 \times 10^{-3} \times (.455884 \times 10^{-7})^4}{(156.44)^4} \times \ln^2(4.5) \ln^2(3) \times \frac{1}{3} = 7.20006 \times 10^{-42} \text{ N-m}^4$$

(This assumes that since helium is inert, the electric displacements of gold have no bearing on the motion). The coefficients are next calculated:

$C_1 = 7.74350594 \times 10^{15}$

$C_2 = 1.65209334 \times 10^{23}$

$C_3 = 3.614455 \times 10^{-16}$

$C_4 = -4.65727054 \times 10^{-5}$

$C_5 = 2.187523 \times 10^{-39}$

The quartic equation is

$$x_{sep}^4 - 4.65727054 \times 10^{-5} x_{sep}^3 + 2.187523 \times 10^{-39} = 0$$

The only physical solution is

$$x_{sep} = 3.6014325 \times 10^{-11} \text{ m} \approx .36 \text{ Å}$$

Note that his is considerably greater than that predicted by use of classical atomic theory and Coulomb's law: 2.581×10^{-14} m.

Using equation (6) and Romberg's method I find that

$$t = 6.3041312 * 10^{-16} \text{ sec}$$

The average velocity of the particle to the point of closest approach is

$$4.552356 * 10^{-8} / 6.3041312 * 10^{-16} = 7.221274 * 10^{7} \frac{m}{sec}$$

The initial velocity having been dissipated, the particle goes back to the equilibrium point. Of course, at room temperature, helium is a gas, and so the particle would not remain in the time region!

Situations in which the particle is not moving directly towards the atom will be treated in a future paper.