Nucleus-Nucleus Collision

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Part of the smaller Linear Momentum Transfer (LMT) found in Nucleus-Nucleus collision is explained by the application of autodynamics equations. The "missing mass" or "missing momentum" in RaE, 238U, muon decay and similar phenomena like anomalous mean pass, electron-electron and proton-proton annihilation, all have in common that the failure to explain the experimental values found is due to the application of special relativity equations. Autodynamics equations apply to these phenomena and explain precisely the results obtained experimentally. The momentum sum of all the products after compound nucleus fission has only a limited relation to the original projectile's momentum. In nucleus-nucleus collision, the "missing momentum" is inherent to the phenomenon itself. Looking at the experimental energies found causes a new idea to arise as proposed in this paper: a chain reaction.

Introduction

Since its discovery(1), the "missing momentum" in nucleus-nucleus collision provoked much experimental and theoretical work, but the real situation is still not clear. This is because it is not "apparent", as some researchers have suggested, but rather represents a real loss in nucleus-nucleus collisions. Furthermore, this loss of momentum is a characteristic of both central and peripheral projectile impacts on the target. As the projectile velocity generally is large, and the velocity of the fragments produced by compound nucleus disintegration is also large, special relativity equations are used to calculate their momenta and energies. They are also used to calculate the energies of the RaE(2) electrons emitted, 238U(3)(4) decay, muon decay(5), and similar decay phenomena, annihilation phenomena, and anomalous mean pass. It is well known that experimental values found cannot be explained by the special relativity equations even though, in some cases, they can be explained by the participating neutrino. However, in nucleus-nucleus collision, nucleon annihilation, and anomalous mean pass, neutrinos cannot be used, or at least, their use has not as yet been attempted.

Nucleus-nucleus collision is important not only to understand the phenomenon itself, but also because experiments reveal a surprising failure to conserve momentum. This result is not a surprise, however, when applying the autodynamics paradigm.

Autodynamics

We are trying to demonstrate that the "missing momentum" in nucleus-nucleus collision is real, i. e., it is not due to undetected particles, as in the original definition(6). The arguments given in reference (7), page 615, regarding the undetected neutrons and justifying the loss of linear momentum transfer, are irrelevant even though the detector used can only detect charged

particles, because if the phenomenon is symmetrical, the momenta will cancel automatically. If the phenomena are not symmetrical, the large number of the experimental results gives an LMT lower than 90 % of projectile momentum. When the LMT is small, the undetected particles argument is still irrelevant. The difference between the experimental values and the calculated ones is due to two things: the use of special relativity equations to calculate the particles' momenta, and a special *signature*. The difficulty in applying special relativity equations arises because they can only be used when the particle energies are externally provided(8). We normally apply special relativity kinetic energy equation to the wrong cases! When the particles receive the energies from decay, the momentum is less than when they receive energy from the external medium. In these decay cases autodynamics equations apply(5). To see the Addendum.

In fact, the momentum sum of the compound nucleus residues has nothing to do with projectile momentum. This is very easy to see in Table I of reference (9), because when the projectile momentum increases 3.75 times, the LMT only increases from 230 to 265, producing a decreasing ratio in LMT-projectile momentum, from 0.83 to 0.48. When the folding angles are close to 180o the LMT are small, and when the former decreases, the LMT increases. There is an inverse ratio between the fission fragments' folding angle and the LMT. The larger the folding angle, the lower the LMT.

A few different cases will be given as calculated examples. The autodynamics equations used to calculate are(2,8):

$$E_c = \mathrm{m_0 c^2}\left(1 - \sqrt{1-\beta^2}\right)$$

$$m = \mathrm{m_0}\left(\sqrt{1-\beta^2}\right)$$

$$p = \mathrm{m_0}\left(\sqrt{1-\beta^2}\right)\mathrm{v}$$

Where E_c = Kinetic Energy, m = mass, p = momentum, $\beta = v/c$, v = particle velocity, c = light velocity.

It will be supposed that the collision between projectile and the bombarded nucleus is central, and compound nucleus fission is symmetrical with respect to its center of mass with relativity and autodynamics momenta conservation. The values given in Table I show the small difference, in the center of mass, between special relativity's (SMR) and Autodynamics' (SMA) momenta, only 2 %, meanwhile the difference between the LMTA and LMTR is 12 % (PLMTAR=88 %) on the laboratory system. This results in a special *signature* for nucleus-nucleus collision. This special signature is given by the fact that fission is characterized by two heavy fragments (mass between 70 and 170 MU) flying away with large angles, forming a "folding angle" close to 180 degrees, and also light nuclei, and especially, the very light particles such as alpha, tritium, deuteron, neutron and/or proton, generally at small angles, where the autodynamics momentum, compared to special relativity's momentum is smaller, contributing more to an LMT difference. There is an inverse relation between folding angle and partial or total LMT due to the fact that an important part of the LMT is given by P|R (Ref. (6) Fig, 4 and 5) and this "is mainly determined by the folding angle TAB=TA + TB between the two coincident fission fragments", ref. (6) page 1931 2o column. Considering full LMT the situation

is the same, ref. (16) Fig. 7.

In Table II there are not either symmetrical energies or fission fragments of equal mass (A=80, B=120). The LMT is considerably smaller because the folding angle increased by 10 degrees, and the ratio autodynamics/relativity decreased to 78 %, even though this case is favorable with respect to Table I, because the light particles' energies are greater.

When the LMTA is equal to projectile momentum the special relativity calculated values (LMTR) are at 108 % of the projectile momentum. This value is very close to the maximum value reported, about 120 %, even though the probability of finding this value is very small, and normally, the LMT is smaller than the projectile momentum. (Ref. 16, Fig. 12; Ref. 7, Fig. 2; Ref. 9, Fig. 7 and 8; Ref. 17, Fig. 3).

But if in Tab. I we make EA, EB, equal to 113 MeV (kinetic energy 1/2) and angles A=102o and B=258o, the "critical"(6) folding angle is 173.4o (FAR) and the LMTRA is equal to 74.8 %. If in an example like this we look for values to find an LMTA equal to projectile momentum (autodynamics momentum conservation) the LMTR will increase to Õ 125 %.

It is surprising that to our knowledge, not one author comments on this compound nucleus fission energy. It is accepted by everyone that there is an excitation energy in the compound nucleus, and it seems that the fission residue energies after compound nucleus decay are bigger than the projectile energy. If this is the case, where do the fission residue energies come from? Of course, part of the energy is given by the projectile energy, but the complementary part must be provided by compound nucleus mass decay.

The Chain Reaction

In reference (9) the authors propose to use the technique to produce a heavy nucleus. It is possible to form a new and important conclusion regarding the phenomena: it seems, looking at the experimental literature, that in each fusion-fission reaction the compound nucleus fission energy is bigger than the projectile energy. If this is the case, it should be possible to produce a chain reaction using an inexpensive element like Pb(10) mixed with other inexpensive elements to form a compound material with the capacity to maintain the chain reaction. Of course, this could be a long road, but the scientific possibility is a real one.

In Table I we probably gave to each fission product a kinetic energy that is too large, reference (6) page 1933-1934-1935, reference (11) page 2188, reference (9) page 2529, reference (12) page 1948 (Here C energy peaks around 215 MeV), reference (13) page 418, but when the kinetic energy values are reduced to 1/2, the LMT proportion is approximately the same even though its value is bigger.

If in this example, we reduce the fission fragment and all residue energies to 1/2 of their original ones (ET=1600 MeV), the final total energy is 2.54 times bigger than the projectile energy. If we reduce those energies to 1/4, the final total energy is 1.27 times bigger than the projectile one. But in the last case especially, the calculated statistical value is too small with respect to the residues' emission probability. For example, there is only a small quantity of carbon under a value of 100 MeV, and no boron under 50 MeV (Fig. 6 of Ref. (6)) and 1/2 or 1/4

of its original value is 100 and 50 MeV, respectively. In the beryllium case the original energy is 125 MeV, and 1/2 and 1/4 of this value is 62.5 and 31.75 MeV, a region where there are only small quantities of Be, if in fact there is any at all.

A realistic value could be 1/3 of the original energy, and in this case, the ratio is 1.7 times bigger than projectile energy. If this is the case, to satisfy energy conservation, it is necessary to look at the contribution of decay of a portion of the compound nucleus mass.

In reference (9), Table I, TAB=176.6o, p|=230+-20 MeV/c for 40 MeV proton bombarding energy. Supposing that all the p| are produced by the two fission fragments with equal mass of 119 MU, the kinetic energy is 135.6 MeV. With TAB=175.9, p|=265+-20 MeV/c the kinetic energy is 123.81 MeV. The first energy is 3.8 times bigger than the bombarding proton's, but in the last case the energy is less than the projectile's. Evidently, there is a question of performance (Ref. 9 Fig. 3 and 4, ref. (7) page 629). A more realistic feature is what follows. We will only take for FF 25 % of p| value with the other 75 % produced by compound nucleus fission residues. The reaction will produce two FF of 85 MU, 2 N14, 2 9Be, 2 alpha particles, 2 tritons, 2 deuteriums, and 5 protons or neutrons. The fission residue energies will be taken from experimental results. With conservative values, the energy sum is bigger than the two cases calculated above. With Ea>30 MeV (Ref. (12) fig 1 and 2), Ea>10 MeV (Ref. (15) fig 8 with T= 78o-156o and Ea>15 MeV with T=15o-68o, Ed>5 MeV fig.7 with T=78o-156o and Ed>10 MeV with T=15o-68o, Ep>5 MeV and Ep>10 MeV in Fig 6 with the same criteria. In Table I (ref.(15)) there are kinetic energy averages for p, d, t, a and HI (heavy ions) that are bigger than the above references cited. In many other experimental results the values are even bigger. For the first case, with ref. (12) values, the ratio is 4.3 times and, in the second case, the ratio gives 1.13 times the projectile energy. If we take averages cited above, the ratios are 6.1 times and 1.6 times greater energy than the proton bombarding energy.

A totally different situation is given in ref. (6) fig. 17 where P|R=1120 MeV/c (FF) and P|3=1520 MeV/c (9Be), and the energies of FF plus FR are bigger than the projectile energy. The average excitation energy in table I, of the same reference, is illustrative with respect to performance, because the ratio is inversely proportional to projectile energy, even though the connection between compound nucleus excitation energy and FF and FR energies is unknown.

As said before it is necessary to study this very carefully, but especially by experiment.

Nuclear Waste

In a meeting with Hans Kautzky, from Fermilab, to discuss a new experiment with RaE(2) and a new theory of universal gravitation founded on interstellar quanta of energy in the form of gravitons or neutrinos (17), he proposed a new use for nucleus-nucleus collision: to bombard commercial and military nuclear waste to transform these dangerous materials into nonradioactive nuclei.

Conclusion

It is necessary to perform new experiments to test concurrent fission residues, that is to say, all compound nucleus residues, produced simultaneously (prompt events), measuring the

parameters in such a way as to make it possible to calculate values that allow comparison of special relativity predicted kinetic energies and momenta with those of autodynamics. As a result of experiments already done, such information may have been recorded. Obviously, this permits easy re-calculation using autodynamics equations, and thus allows comparison of values. Researchers can take advantage of this situation.

Acknowledgment

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TABLE I

CENTER OF MASS VALUES

	Proj.	C.N.	F.A	F.B	B1	B2	Be1	Be2	a1	a2	N1	N2	N3	N4	N5	N6
m	16	254	101	101	10	10	9	9	4	4	1	1	1	1	1	1
ER	315	20	225	225	200	200	125	125	80	80	55	55	60	60	55	55
EA	315	19	225	225	200	200	125	125	80	80	55	55	60	60	55	55
MR	3080	3080	6510	6510	1940	1940	1453	1453	776	776	324	324	339	330	324	324
MA	3016	3016	6487	6487	1878	1878	1420	1420	751	751	296	296	307	307	296	296
theta		90	270	315	135	15	195	10	190	5	185	355	175	8	188	

SMR	23339
SMA	22879
PMAMR	98.02
ET	1600
MT	254

LABORATORY VALUES

F.A.R	158.79
F.A.A	159.04
LMTR	3080
LMTA	2710
PLMTAR	88
PLMTR	100
PLMTA	89.86

Horizontal Abbreviations
Proj. = Bombarding projectile, C.N. = Compound nucleus, F.A = Fission Fragment A, F.B. = Fission Fragment B, B = Boron, Be = Beryllium, a = Alpha particle, N = Neutron or proton particle.

Vertical Abbreviations
m = mass(MU), ER = Relativity kinetic energy(MeV), EA = Autodynamics kinetic energy(MeV), MR = Special relativity momentum(MeV/c), MA = Autodynamics momentum(MeV/c), theta = Angles(degree), SMR = Special relativity momentum sum(MeV/c), SMA = Autodynamics momentum sum(MeV/c), PMAMR = Percent of momentum A respect to momentum R(%), ET

= Kinetic energy sum(MeV), MT = Mass sum(MU).

Laboratory Value Abbreviations
F.A.R = Relativity folding angle(degree), F.A.A = Autodynamics folding angle(degree), LMTR = Linear Momentum Transfer, Relativity(MeV/c), LMTA = Linear Momentum Transfer, Autodynamics(MeV), PLMTAR = Percent of Linear Momentum Transfer Autodynamics respect to Relativity(%), PLMTR = Percent Linear Momentum Transfer, Relativity, respect to projectile momentum(%), PLMTA = Percent Linear Momentum Transfer, Autodynamics, respect to projectile(%).

TABLE II

CENTER OF MASS VALUES

	Proj.	C.N.	F.A	F.B	B1	B2	Be1	Be2	a1	a2	N1	N2	N3	N4	N5	N6
m	16	254	80	120	10	10	9	9	4	4	1	1	1	1	1	1
ER	315	20	200	200	210	235	125	160	85	90	65	105	70	90	60	75
EA	315	19	200	200	210	235	125	160	85	90	65	105	70	90	60	75
MR	3080	3080	5463	6689	1989	2105	1453	1645	800	823	354	454	367	419	339	381
MA	3016	3016	5441	6671	1922	2026	1420	1598	773	794	318	381	327	360	307	336
theta			96	264	315	135	15	195	10	190	5	185	355	175	8	188

SMR	23287
SMA	22681
PMAMR	97.4
ET	1770
MT	252

LABORATORY VALUES

F.A.R	169.31
F.A.A	169.71
LMTR	1301
LMTA	1018
PLMTAR	78
PLMTR	42
PLMTA	33

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17. As the gravitational quantum of energy seems to be very close to the neutrino hypothesis, the author gives to this graviton the name of neutrino.

Addendum

In a very interesting reviewer's report on this paper, the following comments were made: "On the face of it, this claim (momentum conservation violated) by the author is not very convincing to me because the conservation of linear momentum is one of the most thoroughly tested laws in physics. To abrogate it on just the basis of ad hoc experimental evidence cannot be allowed. (There is always the possibility of error in the experiments)", and "what I would suggest to increase the plausibility of the author's arguments, would be to show that the use of his autodynamics is equivalent to there existing some sort of "extra" (as yet unknown) physical process with- in the collision event that absorbs the momentum discrepancy. He should describe at least the rough nature of this "extra" physical process (even if it is highly speculative). Thus he would stop intimating the violation of momentum conservation.

However, the author didn't abrogate the violation of momentum conservation on the basis of ad hoc experimental evidence. He doesn't know the exactly number of experiments carried out, but he can say that more than two hundred were performed, and all of them confirm the violation of momentum conservation!!!. The systematic application of momentum and energy conservation to all phenomena of decay, from the RaE to proton-proton annihilation (including the Compton effect) confirms that the autodynamics equations match the experimental results obtained. The author come upon the autodynamics equations, at the beginning, through a systematic discussion of systems (frames) in relative movement. This was the foundation of a new theory of relativity called autodynamics. But it is easy to demonstrate that the autodynamics kinetic energy equation is general, that is to say, it can represent the case where a particle receives energy from the external medium. (Special relativity equation). We can write the autodynamics equation as follows:

$$E_c = \mathrm{M}\left(1 - \sqrt{1 - \beta^2}\right)$$

If $\mathrm{M} = m_o c^2$ we have the autodynamics kinetic energy equation. If $\mathrm{M} = m_o c^2 + E_c$ (rest mass

energy plus kinetic energy from the external medium) we have the special relativity kinetic energy equation:

$$E_c = \mathrm{m_0 c^2}\left(\frac{1}{\sqrt{1-\beta^2}} - 1\right)$$

From the scientific view-point it has sometimes been possible to have two different explanations of the same phenomenon (wave-particles, for example), but "to invent something "extra" and "highly speculative" (in the words of the reviewer) to explain the violation of momentum conservation in nucleus-nucleus collision alone is to create another problem because the solution for it cannot be used on *other* phenomena. The author's original discovery was precisely that *all* phenomena have in common the violation of momentum conservation, and these momenta violations come about from the systematic application of special relativity kinetic energy equations, which are inadequate in describing a decay phenomenon. We don't need to invent anything new! A lot of new "particles", "forces", "physical process" were created to explain new phenomena without success. Even Einstein's "cosmological constant" was later considered by him "his greatest mistake". No, simplicity is the rule in nature, and autodynamics is very simple! The explanation is general, universal, and therefore applicable to all phenomena!

The following is the complete second report by the same reviewer. I want to publish the whole report because it is a very interesting analysis of the matter and the answer permit to clarified many aspect of the problem.

"Actually, I do not see that the treatment that he gives now has changed in any significant way from the one given in the first manuscript. He is still opting for the use of "autodynamics" kinematics in place of special relativity kinematics in nuclear decay processes almost entirely on the basic of experimental data. (He has rejected my suggestion of invoking "extra" physical processes.)"

"once again, I cannot go along with this hypothesis since, in my view, special relativity is one of the most established disciplines of modern physics. Moreover, in the manuscript he advocates two additional "revisions" of established modern physics that are completely "unpalatable" to me. He rejects Pauli's theory of the existence of neutrinos and, what is even more unlikely, he maintains that the charge of the electron is not constant but decrease its value with velocity."

"As I said before, in as much as I am not very familiar with the work that has been done in experimental nuclear physics, I feel that it would be inappropriate to make professional recommendations as to whether you should publish this article or not. However, my personal opinion (for what it is worth) is that you should publish it. As far as I can see, the article is not blatantly "crackpot" and it does not have any readily demonstrable errors in development. Not having these two failings and having (what one must admit it) a novel approach, a journal such as yours, which does not at all object to completely novel approaches, must be inclined to publish this article."

"An other consideration might be mentioned here. After all, the author has discovered in his "autodynamics" formulas a mathematical format which is able to fit all of the experimental data. (I am taking the authors word that it is so). This in itself is worthy of notice. Both Galileo and

Kepler really did not do any more than this. It is just that he has actually not provided a physical basis for using these "autodynamics" formulas (at least in my opinion). I hope that my comments have been of use to you."

The author's answer is the following:

Thank you very much for your new comment on my paper (N-N collision and A.), especially for your last words.

I beg your pardon, but I am not "still opting for the use of "autodynamics" kinematics in place of special relativity kinematics in nuclear processes ....."

The special relativity approach - its equations - were applied to all the experimental results obtained up to now, from the first RaE, through 238U decay, neutron decay, Cl38 decay, 7Be decay and similar, muon decay and similar, nucleus-nucleus collision, anomalous mean pass, electron-electron and proton-proton annihilation, but the experimental values found are not explained by special relativity's equations. The first failure was in the historical RaE (210Bi83) experiment. Calculating kinetic energy with the velocity at the end point of the electron spectrum, the value is 1.16 MeV, but the experimental value found is 0.36 MeV. Pauli invented a "new particle" (a ghost particle) called neutrino by Fermi. Autodynamics kinetic energy explains perfectly this experimental value of .36 MeV. Einstein's equation fails but not Autodynamics. I am not "opting": I only have autodynamics' equations, which can explain this phenomenon and in fact all decay phenomena, indeed !!!.

I am not rejecting your suggestion about an "extra" physical process !!. Autodynamics doesn't need it because autodynamics explains all decay phenomena. Autodynamics does not have any "extra" physical processes - at this level - because it was developed with the classical relativistic conception (Poincare-Einstein). Autodynamics' general theory about mass-energy-mass transformation in the Universe, explains the perpetual changes, the perpetual transformation of mass-energy as the most basic principle for the universal evolution of matter (At this level the "extra" is relevant. You will see it). The Compton effect, the canon ball, particles moving in an accelerator, are all, basically, intrinsically, phenomena of decay. The canon ball's chemical energy and the accelerator's electromagnetic energy come, originally, from decay, from transformation of mass into energy.

I agree with you: "Special relativity is one of the most established disciplines of modern physics". But, I am sorry, with a condition: *until now, or until 30 years ago, more or less*. Special relativity cannot explain any decay phenomena. *It is useless in particle and nuclear physics*!! To save special relativity it was necessary to create a lot of ad-hoc theory for each phenomenon. Pauli's hypothesis has reached a crazy state: *neutrino's delirium tremens. There are more than 40 or 50 different "qualities" for neutrinos, all of them as "extra qualities", and most of them very frustrating, indeed, and truly fantasies, really. Attached to this letter there is a list that I prepared for another reason. I am not rejecting Pauli's theory. Whether I reject it or not is irrelevant! *It is rejected by itself*!! It is rejected by Autodynamics. The special relativity equations don't apply to decay phenomena. Special relativity equations apply only when the particles receive energy from the external medium. It is not my fault if the wrong equation is applied to a decay case !!

I "maintain that the charge of the electron is not constant ....." But I maintain this only when the electron (particles in general) is going through a process of decay!!! In the RaE decay, as example, the electron doesn't decay!!! The neutron decay in an electron, and a proton, providing the kinetic energy to both particles. This kinetic energy come from the energy (mass transformation) that maintain bound the proton and electron, in what we call the neutron - the sum of proton and electron mass is less than the neutron mass. The electron here is "an electron", a normal electron, "an entire" electron, and its electric charge is the total electric charge, equal in movement to the value at rest!!! There is no electron decay, there is no electron mass transformation into kinetic energy, and there is no charge variation!!! The RaE is a decay process because the neutron decay and the RaE lose the electron. But this electron didn't decay. It is a formal electron. You can apply the electric charge variation equation when the phenomenon exist, but the phenomenon doesn't exist because the equation exist!!!.

The "physical basis" of my theory is in the paper entitled "Fundamental Basis for a New Relativistic Mechanics. Autodynamics". The ideas are very simple! Please, find it enclosed. The English is not perfect but you will understand the ideas. Please, improve it and let me know.

Regarding your expression "is worthy of notice " I can tell you that my theory is being taught in a Chinese University and it is receiving constantly more support. If you are a professor you could start teaching Autodynamics for the next generation. The principal reason why I am sending you the paper is because in it, in section 13.- SO FAR AND BEYOND, you will find "your" "invoking "extra" physical processes". You are going in the right direction, I hope. I also hope Autodynamics will be the next paradigm in the relativity field, particle, nuclear and plasma physics.

Your comments are very important to me because I can test if my theory can explain all the question!

Thank you very much for your collaboration.

The list about neutrinos mentioned above is the following:

Neutrino Delirium Tremens

14.1.- Philosophy

Discussing autodynamics' philosophical implications with a scientist, with regard to the universal transformation of mass into energy, and vice versa, I arrived at the conclusion that is possible to explain all phenomena as decay process. When we are talking about external energy we think of something striking the particle to increase its kinetic energy. But, another picture is possible: the external energy - generally as an electromagnetic field - is absorbed by the particle, it decaying later. The increasing kinetic energy is a consequence of a decay process.

Whether the total energy absorbed is converted into kinetic energy or part of it is kept by the particle to increase its mass, will be a matter of discussion in another paper about proton-proton annihilation. Actually, it is only interesting that this accelerating process by external energy

could be interpreted as a decay phenomenon. The Compton effect was explained by autodynamics as a decay phenomenon.

Beyond

If part of the energy is taken by the particle "without increasing its mass" we will have "mass without weight", "mass without inertia", which will be transformed in "inertial mass" at fission time, after the fusion of the particles at collision time (annihilation)

To special relativity, Newton's universe is relevant, but to autodynamics a new different universe is opening. The fundamental "action" in the universe is alternatively given by decay process and energy absorption.