Significance of Generalized form Third Law of Motion.
How it can change the status of existing laws of physics/science?

1 Large number of examples where Newton law is regarded as true but not confirmed.

Newton's Third Law of Motion {Action = Reaction; universally i.e. for all bodies, under all conditions, everywhere },

(i) Newton's law stated in the last decades of seventeenth century. The impact of this fact can be easily realized. Today a law is regarded as established, if predictions from mathematical equations are experimentally confirmed. The mathematical equations are expressed in terms of physical quantities such as velocity, acceleration force etc. For examples velocity has units (m/s) and dimensions (M^0LT^{-1}). But now as such 'Action' and 'Reaction' are not regarded as physical quantities. These are philosophically used in physics . Newton expressed 'action' and 'reaction' in first two examples as push or pull (now regarded as force), and third example in terms of change in momentum (mathematically comes out velocity).

Had Newton clearly and transparently expressed 'action' and 'reaction' , in terms of physical quantities , and given equations or other scientists have given quantitative explanation for the same , then there would have been no need for discussion.

However in Newton's time it was beginning of physics, so it was not possible for him to write equations as laws were not written in terms equations. Further dimensions and units were defined 1822 by Fourier. So Newton only started physics as subject, separately from natural sciences. Thus Newton's work was graceful beginning, not end.

Newton published first, second and third editions of *the Principia* in 1686, 1713, 1726, the 40 years did not change at the definitions of the three laws of motion.

(ii) Newton practically gave three examples to explain the law in view of existing background at that time. For example a stone is pushed by finger, the finger is also pushed by stone. Like this he justified that when a horse pulls stone, the stone is also pulls horse. Thus action and reaction are equal and opposite. Hence in both cases stone remains at rest.

However in this case force of friction [$f_r(max) = R = \mu mg$] needs to be mentioned. Newton should have done so. Also Galileo's inertia of motion (body maintains uniform velocity) , required to be mentioned for completeness. The laws of friction were re-discovered in 1699 by Guillaume Amontons and inertia of motion by Galileo in 1609.

In third example, Newton gave just a statement that when bodies collide the change in motion takes place, but without further explanation. The mathematical equations are written for this for time. Thus action and reaction are independent of properties, shape and size of body.

Some qualitative examples which are used to justify Newton's Third law of motion in

existing textbooks. But all the explanation must be quantitative, only then it is scientific.

But now Newton's third law of motion is applied universally (for all bodies, in all conditions, everywhere at all times) where bodies collide or interact and action and reaction are regarded as equal.

For examples when a swimmer swims, the action and reaction is regarded as equal. When a shot is fired from the gun, then bullet moves forward, the person moves backwards. The birds fly pushing air backwards. The forwards velocity of rocket, when it ejects mass of smoke, vapors, etc is yet to be quantitatively measured.

When rocket moves forwards then Newton's third law is applied and backward momentum of smoke is regarded as action. Is the third law applicable when an aeroplane or helicopter rise upward . If yes then how? If not then why?

When two iron bars strike , then third law is applicable as for other colliding or interacting bodies. But it not discussed when opposite poles of magnets stick. The characteristics of bodies must be considered. The various bodies move in opposite direction after striking.

All the examples must be explained quantitatively in all cases. Thus there are number of examples which can be discussed in view of generalized form of third law of motion.

2. One dimensional elastic collisions

The equations for one dimensional elastic collisions involve law of conservation of momentum and kinetic energy simultaneously. Under conditions we get same results as obtained in third application of third law of motion. Let us start from existing equations about collisions.

(i) **When target is very massive compared to the projectile i.e. $M_2 >> M_1$.** Thus the final speeds of the projectile and target can be calculated from eqs.(18-19); here initial speed of projectile is u_1 and final speed $u_2 = 0$.

$$v_1 \text{ (reaction)} = \frac{-M_2 u_1}{M_2} = -u_1 \text{ (action)} \qquad (20)$$

Initial speed of projectile = -Final speed of projectile

Action (u_1) = -Reaction (v_1) (21)

The similar equation is obtained when results are drawn from third application of third law of motion.

Thus it is concluded that under some conditions the **'third application of third law of motion'** and elastic collision in one dimensions **(equations obtained from simultaneous applications of law of conservation of momentum and law of conservation of kinetic energy)** lead to similar results.

But action and reaction are not equal in numerous other cases , just like applications of third law of motion the nature , characteristics , shape and size of projectiles and targets are significant in these cases. These are also significant in equations of elastic collisions mentioned above.

Thus experimental predictions of conservations laws are true under certain conditions ONLY.

3. In conservation Laws.
Idealizations to generalization

The law of conservation of momentum directly follows from the third law of motion. In the derivation we simply consider bodies with their masses moving and colliding with velocities, as under ideal conditions. We do not mention the nature and various characteristics of bodies, their shape, size etc. However these are realistically very significant factors for consideration

We simply consider bodies on the paper and do calculation under ideal mathematical conditions. However practically on the experimental front situation is very different.

Thus it must be mentioned these calculations are only under ideal conditions. However experimentally and technically, the experimentalists and technocrats take all these facts in account, so mathematician and theoreticians must do the same. Thus in Newton's law there must be a factor which accounts for properties, shape and size of bodies. It serves as basis for generalization of third law of motion.

4. Impact of Classical Mechanics on other branches of physics.

Thus law of conservation of momentum based on third law of motion may be subjected to experimental confirmations.

This fact should be taken in account in other branches of physics Quantum Mechanics, Nuclear Mechanics, Solid state Physics, Relativity or every branch of physics/science where conservation laws are regarded as precisely true.

However in classical mechanics these laws are subjected to questions and may not be regarded as precisely true unless quantitatively confirmed. Thus we should conduct such experiments without any prior bias, if some inadequacies are found; then it implies that law of conservation of momentum must be subjected to scrutiny in other branches of physics/science also.

Due to acceptance of preciseness of conservation laws as such till date, it is possible that considerable \ experimental or theoretical data is neglected; that data does not fit within current scientific framework.

Thus this study in classical mechanics opens many scientific possibilities in all branches of science. The scientists working in various fields would appreciate the same.

5. Newton's Third Law of Motion Generalized
In Rocket Propulsions

Calculation of speed of rocket when it ejects fuel is not CONFIRMED quantitatively. We have equation based on third law of motion. We have rocket equation [**Tsiolkovsky rocket equation**, or **ideal rocket equation**]

$V_f = V_e \ln (M_0/M_f)$

V_f : final velocity of rocket,

V_e: is the exhaust velocity relative to the rocket

M_0 : initial total mass

M_f : mass after propellant is burnt

Third law of motion will be confirmed, if various parameters are calculated and experimentally final velocity of rocket is consistent with right hand side of equation. Now M_0 is known, thus we should only know the value of M_f . Thus theoretical value of V_f can be easily calculated.
Now this theoretically calculated value of V_f (theoretical) can be compared with experimentally measured value of V_f (experimental)
If the third law holds good then
V_f (theoretical) = V_f (experimental)

Thus for quantitative validity of third law
(i) We need to experimentally measure V_f at any instant
(ii) We need to experimentally measure of M_f at any instant

Thus if experimentally value of V_f coincides with theoretical prediction as in eq.(1), then Newton's third law is quantitatively valid. If due to ANY reason experimental and theoretical values do not coincide, the rocket equation should not be regarded as QUNATIATTIVELY valid.

Above deduction {V_f (theoretical) = V_f (experimental)} **should be confirmed for every rocket propellant**

"There are four main types of chemical rocket propellants: solid, storable liquid, cryogenic liquid and liquid monopropellant. Hybrid solid/liquid bi-propellant rocket engines are starting to see limited use as well."

There are also other types of rockets which use different propellants such inert propellants. The rocket equation must be confirmed in each case independently.
It is not justified that without quantitative observation equation is regarded as QUANTITATIVELY correct.

Request for data ISRO AND NASA

Number of times author asked data i.e. experimental value of velocity of rocket measured, and theoretical value of velocity i.e. calculating M_f , at some instant. But this data was not provided. Scientifically rocket equation should not be regarded as quantitatively true unless confirmed for every possible propellant.

Reported failure of Third Law in proposed Rockets movement

It is in experiments in new type of Rocket fuel using Electromagnetic waves
Thus there is no backward emission, but forward motion of model of rocket, failure of third law of motion.

Electromagnetic Drive, is a propulsion system first proposed by British inventor Roger

Shawyer back in 1999. It generates thrust due to movement of electromagnetic waves within cavity and does not produce any backward emission required by Newton's third law of motion. According to Shawyer's calculations, the EM Drive could be so efficient that it could power us to Mars in just 70 days. So it would be of exceptional and cheapest technology for rocket launching useful for mankind.

NASA scientists confirmed above prediction and published in peer review paper in journal Propulsion and Power
https://www.sciencealert.com/it-s-official-nasa-s-peer-reviewed-em-drive-paper-has-finally-been-published

The EM Drive reported by NASA produced thrust, 1.2 ± 0.1 mN/kW whereas currently used in rocket propulsion used Hall Thruster produce thrust 60 millinewtons per kilowatt,
NASA'S exact paper
https://arc.aiaa.org/doi/10.2514/1.B36120

In my first article published in 1999 I have proposed breakdown of Newton's third law of motion through theoretical analysis in classical physics. If my proposal for generalized form of third law of motion is accepted, then it would another shot in hands of scientists, for rocket **launching using EM drive. It would be of immense use for mankind.**

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Technological aspect of Generalization of Third Law of Motion.

Many thanks for message dated 12 April 2018 . I have tried to needful , kindly see.
At the moment main stress is to establish quantitative inadequacy of Newton's Third Law of Motion.

"Once the quantitative inadequacy of Newton's third law of motion is established, then the Generalized form of Newton's Third Law of Motion will valid automatically. It will cause significant changes in basic understanding of every branch of physics and science in general. Thus main stress is on establishing the quantitative inadequacy of the law."

Should be think to send a project to DST, CSIR or any other funding agency which alone I cannot do. In any other information is needed from my end will be provided .

Part I

1. Generalized form various branches of Physics /Science

The law of conservation of momentum is direct result of the Third Law Of Motion. Thus this law directly and through law of conservation of linear momentum is applicable to all branches of physics i.e. quantum mechanics, nuclear physics, electrodynamics , particle physics , solid state physics, mathematical physics etc.etc. Thus the experts of various fields of physics can judge whether there is any need of re-analyzing the data.

It is possible that considerable theoretical and experimental data is set aside that can be adjudged in view of generalized form of law. But it can only be done if they have alternative in hands.

The laws are also formulated/speculated for future or can be preserved purposely.

Looking at the deflection of galvanometer for first time in 1831, none could have perceived that it would be basis of electricity which could change a night to day. Even Einstein's *Annus mirabilis* papers were published un-reviewed in 1905; after decades their importance was realized.

However the generalized aw can discussed in many cases in experiments a macroscopic level.

2. Launching of Rocket

Marts Rover https://www.youtube.com/watch?v=K3BhgkFeiS0

PSLV (Animation by Rajender Prasad)
http://nzclip.com/nzplay/Nzclip-india39-s-pslv-launching-NzFiCFj4fcrWQ.html

The aim of critical analysis of these two videos (rocket is launched) , is to check equation [**Tsiolkovsky rocket equation**, or **ideal rocket equation**]

$V_f = V_e \ln (M_0/M_f)$

V_f: final velocity of rocket,

V_e: is the exhaust velocity relative to the rocket

M_0 : initial total mass

M_f : mass after propellant is burnt

The third law will be precisely true if velocity of satellite is according to mass of the fuel burnt out as in above equation. In spite of letters to ISRO and NASA no such information (V_f is final velocity at any instant, corresponding to mass of fuel burnt) is provided.

Unless above equation is precisely confirmed, the third law of motion must not be quantitatively regarded as true in this regard.

(a) Electromagnetic Drive

If such reaction less drive is finally confirmed that rocket can move without solid/liquid fuel (

with microwaves without exhaust) , then it will support generalized form of third law of motion. Many such experiments are being conducted. Here is a video but not fully scientifically justified that Chinese scientists have produced such drive, news was given by Chinese State Television .

https://www.youtube.com/watch?v=vwP5bPIQ8Mo

The technical details are not provided, may be they want to keep it secret or some other reason. Such experiments are being conducted by scientists at various places. Even it was rumor that US defense is applying EM drive in armed forces. Anyhow success of such experiments will support the Generalized Form of Third Law of Motion.

NASA has published peer review paper indicating possibility of such EM Drive.

" NASA scientists confirmed above prediction and published in peer review paper in journal Propulsion and Power
https://www.sciencealert.com/it-s-official-nasa-s-peer-reviewed-em-drive-paper-has-finally-been-published

The EM Drive reported by NASA produced thrust, 1.2 ± 0.1 mN/kW whereas currently used in rocket propulsion used Hall Thruster produce thrust 60 millinewtons per kilowatt,
NASA'S exact paper
https://arc.aiaa.org/doi/10.2514/1.B36120

Statistical Physics

The violation of Newton's third law of motion has been reported in statistical physics experiments. When their effective interactions of mesoscopic particles are mediated by a non-equilibrium environment, then law become *inconsistent*. Ref.

Ivlev AV. Statistical Mechanics where Newton's Third Law is Broken. Physical Review X. 2015, pp. 1-10.

Thus the generalization of third law of motion is useful in many respects.

Part II

However the law can be critically discussed in many cases in experiments at macroscopic level.

Simplest description of experiments

Proposed experiments to confirm generalized form (Reaction =Q Action)

Q coefficient of proportionality depends upon properties, shape and size of body.

The first two examples given by Newton imply 'Action' and 'Reaction' be expressed in terms of 'Force' and third example indicates 'Action' and 'Reaction' must be expressed in terms of 'velocity'.

THESE SIMPLE EXPERIMENTS REQUIRE HIGHLY TECHNOLOGICAL EQUIPMENTS.
The third law can be checked at macroscopic level for final confirmation and authenticity in either way. There can be many experiments but two are quoted.

(a) Firing toy gun under controlled conditions, and determining recoil velocity.
Equipments : Toy gun , loaded with bullet , table (surfaces wood , glass etc.), equipments to measure velocity (inter ferometric or other equipments with good precision).

Consider a toy gun of Mass M is placed on the table. A bullet of mass m is triggered with remote control and moves with velocity v (momentum of the bullet, mv).

According to third law
Action = Reaction
mv =MV or V (recoil of gun) = mv/M
This experiment can be confirmed on
(a) Floor
(b) Wooden Table
(c) Glass Table
Then we can find under which conditions the third law of motion is obeyed .
Definitely it will confirm the characteristics of the system, which is basic tenet of the Generalized form of Third Law of motion.

The velocities of bullet can be measured with inter ferometric methods (as we measure the speed of cricket ball)
Link (for help)
Measurement of Velocity o bodies by inter ferometric methods
http://iopscience.iop.org/article/10.1088/1742-6596/582/1/012041/pdf

And various references therein or we can perceive some simple but precise method.

(b) Simple experiments in determining effect of SHAPE of bodies.

Requirements and equipments: Bodies of rubber of different shapes , mass 100gm.
Shapes : sphere, semi-sphere, triangle, square, long pipe , cone, flat or any distorted shape etc.
Instruments to measure time, in which different bodies travel at different time.
equipments to measure velocity (inter ferometric or other equipments with good precision.

(i) Take bodies of various shapes of rubber, mass 100gm (say) . The shapes may be sphere, semi-

sphere, triangle, square, long pipe , cone, flat or any distorted shape etc. The action is same as mass is same. The material is same i.e. RUBBER in all experiments.

(ii) The spherical ball and other bodies if thrown at wall or dropped at earth (say distance travelled is 1m or 2m, say), then action is same. Then all bodies must rebound in same time to original point, only then reaction would be same.
Measurements: The times taken by bodies to fall on the ground , and rise to original point be measured .
Time taken to reach floor/target (t_1)=Action
Time take to rebound to original point (t_2) = Reaction
It third law of motion is correct
(**{Action = Reaction; universally i.e. for all bodies, under all conditions, everywhere},**
then times must be equal , $\mathbf{t_1 = t_2}$

(iii) But it is not justified even at macroscopic level. The rubber ball (SPHERE) rebounds quickly than others, some may not rebound at all . Many mature scientists and editors of the journals have asked me to give exact time of rebound (after experimentally measuring them) for various bodies having same composition but of different, SHAPE and SIZE. Thus initially bodies of rubber (same mass and material) can be considered. Then bodies of different materials and shapes can be used for completeness.

(vi)These experiments have serious implications on various equations of elastic collisions as properties are also neglected in these cases also, hence on CONSERVATION LAWS.
IN THIS CASE MASS (100gm) , COMPOSITION (rubber) OF VARIOUS BODIES IS SAME; ONLY SHAPE IS DIFFERENT.

3. Dropping of rubber and steel ball (mass 100gm) on the same surface
Equipments : Steel ball , rubber ball , equipments to measure velocity , height etc.
The rubber and steel balls may be dropped vertically or horizontally (on narrow , long frame like billiard ball or with specific alternations suited for experiments.

(i) Both the bodies of rubber and steel has same mass, dropped from same height hence same action.
(ii) The rubber ball may be dropped from height of 1m then action is mgh . If rubber body also rises to same height, then action =reaction. Then Newton's law is justified.

(iii) However the steel ball (having same action as that of rubber ball thrown from same height) does not rise to same height? In previous case (rubber ball) ball rose to same height, the action =reaction. But it is not so here. Thus is due to inherent characteristics of bodies.

These are the experiments which can be conducted to confirm inadequacy of Newton's Third Law of Motion. **The Generalized form will have validity even inadequacy of Newton's third law of motion is confirmed in ONE EXAMPLE.**

The final verdict lies in experiments, there are sufficient arguments in favor of experiments. Any other information from my end will be provided.

Once the quantitative inadequacy of Newton's third law of motion is established , then the Generalized form of Newton's Third Law of Motion will valid automatically. It will cause significant changes in basic understanding of every branch of physics and science in general. Thus main stress is on establishing the quantitative inadequacy of the law.

Should be think to send a project to DST, CSIR or any other funding agency which alone I cannot do. In any other information is needed from my end will be provided . Thanking you in anticipation.

Yours faithfully

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