OPEN ACCESS

Katalyst Publishing Group

Research Article

Journal of Current Trends in Physics Research and Applications

The Time and Space Aspects of Forces and their Relations

Sándor Főfai*

Physist, Budapest, Hungary

***Corresponding author:** Sándor Főfai, Physist, Budapest, Hungary, E-mail: fofaisandor@gmail.com

Received Date: 27 May, 2020
Accepted Date: 03 June, 2020
Published Date: 04 July, 2020

Citation: Sándor Főfai (2020) The Time and Space Aspects of Forces and their Relations. J Cur Tre Phy Res App 1(1): 102

Introduction

In this paper I'd like to elaborate on the time and space aspects of forces and at the same time highlighting the main misunderstandings generated by the unsettled relations between energy and momentum from the arguments of Leibnitz against Newton, to the derailment of theoretical physics in the last century.

The main problem as I see it is, that while forces are manifested in various interactions, neither their type, nor the aspect of their effects are properly defined and separated.

In the next few pages I try to categorize some of the main forces through their interactions accentuating the differences between their time and space aspects.

I would like to give some historical background information too, to show how the concept of force momentum and energy evolved while their basic relations remained unsettled.

Basic terms and their interpretations

In order to define the relations between forces, I think some kind of classification is needed to eliminate ambiguities.

The main classifications of forces in my interpretation:

F – The classical Newtonian force acting on inert bodies by accelerating them.
P – Power is the force acting on passive resistance doing work on them by constant velocity.
F"(Δt)(Δx) – Acting force is the force with its time (t) and (x) distance parameters.
e.g. F"(1s)(0.5m)=5N means 5 Newton acting through 0.5m in 1 second.
Acting force can be derived from (p) momentum and (W) work: F"$(t)(x)= p/t = W/x$

Resistance (forces)

Resistance force F' can be calculated from the acting force: $F'=F/v$ or $F^i= F/a$
- where $v=\Delta x/\Delta t$, $a=2\Delta x/\Delta t^2$,
F' - Passive resistance is in fact the outer or environmental resistance cumulating in space
characterized by the speed of effects traveling in space.
F^s - Static resistance absorbs forces in a given short distance or time, it can be characterized by its absorbing capacity of energy and momentum. (not discussed in this paper)
F^c - Active resistance is in fact contra force. (not discussed in this paper)

The aspects of forces

The time aspect of forces against inert bodies

In 1686 Sir Isaac Newton derived the time aspect of forces in his famous laws defining force by its acceleration effect on masses in 1 second time.
Newton determined force as the product of mass and its acceleration: ***F=ma***
- where 'F' is force, 'm' is mass and 'a' is acceleration.

According to Newton 1N force can accelerate 1kg mass to 1m/s speed in 1 second time.
Cumulated force in time can be derived from Newton's Law: ***p=Ft=mv*** – where 'p' is the momentum and 'v' is the reached speed.
Momentum expresses the cumulated force which can accelerate the given (m) mass to the reached (v) velocity in 1 second time.
Impulse expresses the change of momentum: $I=\Delta p=F\Delta t$
The space aspect of forces against inert bodies
The space aspect of forces against inert bodies through 0.5m – Vis Viva
Gottfried Leibniz studied the impact of fallen bodies between 1676 and 1689, and proposed the concept of 'Vis Viva' (V_V) meaning 'living force', an effect causing quadratic change in the velocities of accelerated bodies. Leibnitz's formula: $V_V = mv^2$

Leibnitz believed that this force is more important than the one defined by Newton, and concluded that "force is rather to be estimated from the quantity of the effect that it can produce."[1].

Leibnitz reached his conclusion by measuring the lengths of the impacts of falling bodies so in fact he described the impact of forces in space. However Vis Viva can be derived from Newton's equation by expressing Δt with the reached v speed in 0.5 meter distance:
$a=v/\Delta t$; $\Delta x=a\Delta t^2/2$; → if $\Delta x=0.5m$, then $\Delta t=1/v$ → $a=v^2$ → $F=ma=mv^2=V_V$
Vis Viva expresses forces which can accelerate the given (m) mass to (v) velocity in 0.5meter distance.

The space aspect of forces against inert bodies through 1m – Kinetic Energy

In 1741 ***Daniel Bernoully*** found that *Vis Viva* = **½mv²**.

In 1807 ***Thomas Young*** renamed 'Vis Viva' by introducing the term 'energy'. He pointed out that the object that falls from a height twice as great as another identical object has a value of energy twice as great.

Bernoully's formula can also be derived from Newton's equation by expressing Δt with the reached v speed in 1 meter distance:

$a=v/\Delta t$; $\Delta x=a\Delta t^2/2$ → if $\Delta x=1$ then $\Delta t=2/v$ → $a=v^2/2$ → $F = ma = ½mv^2 = E_k$

Kinetic energy expresses the cumulated force in 1 meter which can accelerate the given (m) mass to the reached (v) velocity through 1 meter distance.

The momentum-energy conservation of inert bodies:
The absorbed forces of an inert body equals with its potential momentum in time and with its potential energy in space, where potential momentum and energy express the accelerating ability of the body in time and space.

The energy of a given body can be derived from its momentum and vice versa: EK=½vp

To illustrate the relation between force, momentum, Vis Viva and energy I introduce the concept of 'acting force', which is force with its time (t) and space (x) parameters.

The next example (Table1), where 1N force accelerates an inert body through 40 meter in 4seconds shows that the cumulated effect of a force equals with 4N effecting for 1 second (Momentum) or with 40N effecting through 1m (Energy) or with 80N effecting through 0.5m (VisViva):

Table 1:

Acting Force F"(t)(x)	F (N)	Δt (s)	Δx (m)	$a=2\Delta x/t^2$ (m/s2)	v=aΔt (m/s)	m=F/a (kg)	p=Ft=mv (Ns)	$E=½mv^2$ (Nm)	$VV=mv^2$ (Nm)
F"(4s)(80m) =	1	4	40	5	20	0,2	4	40	80

Theoretical mistakes caused by the ignored relation between Momentum and Energy

Infinite Mass and Momentum with finite Energy in Special Relativity

In 1905 ***Albert Einstein*** claimed that the famous ***E=mc²*** equation is a consequence of his Relativity theory. (The equation was invented earlier by Nikolai Umov in1873, by ***Henri Poincaré*** in 1900, and by ***Olinto de Pretto*** in 1903).

Einstein was accused of plagiarism because many physicists believed that the equation was not Einstein's own idea.

The first problem with Einstein's interpretation is that it contradicts the relations between mass, momentum and energy, namely that infinite relativistic mass and momentum, cannot be related to finite Energy. The relativistic mass, momentum and energy according to Einstein's interpretation:

$$\lim_{v\to c} m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} = \infty; \qquad \lim_{v\to c} p = \frac{m_0 v}{\sqrt{1-\frac{v^2}{c^2}}} = \infty; \qquad \lim_{v\to c;\phi\to 180^\circ} L = L_0 \frac{1-\cos(\phi)\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} \quad (=\infty; \neq mc^2)$$

where: L=Energy of light, ϕ=angle of movement, c=speed of light, p = relativistic momentum, m = relativistic mass, m0 = mass in rest [2].
Because finite energy cannot be derived from infinite momentum and mass the E= mc² equation is not a consequence of Special Relativity.

The mathematical contradiction of Einstein's derivation

Einstein's equation for relativistic energy results infinite value instead of mc2 because of Lorentz's factor (when 'v' approaches 'c' – the speed of light).

A non-relativistic derivation of $E=mc^2$: Let's presume a photon leaves an object with the speed of light, decreasing the (M) mass with its (m) mass equivalence (figure 1.).

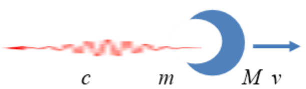

figure 1: A red photon leaves the blue mass with c speed while accelerating it to v speed

Total kinetic energy of the mass-energy transformation:
$\boldsymbol{E=mc^2/2+Mv^2/2}$

If $M \to m$ then $v \to c$ and $E \to mc^2$; $c\ m\ M\ v$
If $m << M$ then $v \to 0$ and $E \to mc^2/2$;
$\boldsymbol{E = kmc^2}$ where $0{,}5 \le k \le 1\ c$
(This derivation results the same equation suggested by N.Umov in 1873)

The contradiction of Heisenberg's uncertainty principle

In 1927 ***Werner Heisenberg*** stated that it is mathematically impossible to determine simultaneously the Δx position and Δp momentum of an electron because of his formula [3]: $\Delta x \Delta p \ge \boldsymbol{h}$ - where 'h' is the Planck constant (for simplicity the 'not reduced' one)

Heisenberg made a basic mistake when he used a wrong relation between momentum and energy (h expresses the energy of electromagnetic waves).
The correct formula: $\Delta \mathbf{p} \Delta x = \boldsymbol{h}$

The relation between position, momentum and energy excludes any uncertainty regarding their mutual determinations because they are the time and space aspects of the same force affecting mass. Planck's energy quantum must have a mass equivalent, without modifying the relation between momentum and energy.

In 1923 ***Arthur Holly Compton*** used the above relation in his experiment to determine the shift in wavelength and the scattering angle of the X-rays by assuming that each scattered X-ray photon interacted with only one electron. The experiment was successful. In Compton's formula Δx= Δλ=λ'-λ, p=mc.

$$\lambda' - \lambda = \frac{h}{m_e c}(1 - \cos\theta)$$

where λ= the initial wavelength, λ'= wavelength after scattering, h= the Planck constant, me= the electron rest mass, c= speed of light, θ= the scattering angle.

(Compton's experiment took place some years earlier than Heisenberg published his theory, so the uncertainty principle was experimentally disproved before it was invented.)

The space aspects of forces against outer (passive) resistance: Work and Energy

In 1829 ***Gaspard De Coriolis*** named the force effecting through a distance 'work'.

In 1843 ***James Prescott Joule*** on the base of 'Vis Viva' estimated the work equivalent of heat to raise the temperature of a pound of water by one degree Fahrenheit. Work means forces against passive resistance which can be defined rather by speed than by acceleration. (passive resistance increases by distance till the active force against it reaches constant speed) The unit of work and energy was named after Joule: ***J=Nm***

1J=1N effecting through 1m distance

Work (W) expresses passive resistance force through x distance.

W=F'x – where F' is passive resistance cumulating in space.

Dividing work with time we get Power: P=W/t=F'v - the unit of Power is ***Watt: W=Nm/s***

Power is in fact the active force against passive resistance: P=F

If v=1m/s then F'=P=F

The ratio between power (force) and resistance is expressed by the speed of effect: P=F'v

In many cases active forces are not separated from resistance forces.

Work Momentum identity: *P=F; P=W/t → Pt=Ft=p=W*

Momentum expresses work on accelerated inert bodies.

Energy expresses total force exerted to do work: E = Px =F'v2t (P=F'v; x=vt)

Energy is not the total work as interpreted many times, but total force used up to achieve the work. The same work can be done with different powers (forces) consuming different energies. The next example (Table 2.) shows the achieved work and consumed energy of 2N force effecting against passive resistance by traveling 40 meter in 4 seconds:

Table 2

Force against passive resistance	F (N)	t (s)	x (m)	v=x/t (m/s)	F'=F/v (N)	W=F'x (Nm)	P=W/t=F N(m/s)	$E=Fx=Wv=F'v^2t$ (Nm)
F^P(4s)(80m)=	2	4	40	10	0,2	8	2	80

The power of radiation – Force with constant velocity
Historic background

The power of radiation – Force with constant velocity Historic background

In 1897 ***Joseph John Thomson*** proved by the deflection of cathode rays that these rays are actually a stream of negatively charged particles called electrons. At the same time he determined the ratio of the charge to the mass of electrons: Q⁄m = $1.75882*10^{11}$ C/kg

In 1900, ***Max Planck*** empirically derived a formula for 'black body radiation' by assuming that energy change can take place only in a minimal increment proportional to the frequency of its associated electromagnetic wave. He calculated the proportionality constant (h), from experimental measurements:

E =hf – where (f) is the frequency of radiation; (h) is Planck constant ($6.62607015*10^{-34}$ Js).

(The energy of radiation is calculated for 1second because *f=n/t*, where *n* is the number of waves)

Calculating the mass equivalent of an electromagnetic wave:

The energy of an electromagnetic wave: $E=h=F\lambda=mhc^2\Delta t$

- where λ=Δx and m_h is the mass equivalent of the Planck constant

Because the frequency of electromagnetic waves is given for 1 second Δt=1s.

The mass equivalent of an electromagnetic wave: mh=h/c²=7.37 * 10⁻⁵¹ kg (c≈3*10⁸m/s)

Energy – mass equivalence of radiation:

$$E = mc^2 = fm_h c^2 = fh = \frac{hc}{\lambda} \rightarrow \mathrm{m}\lambda = \frac{h}{c}; \mathrm{m} = \mathrm{fm_h}$$

Calculating the mass equivalent of the electron

In 1909 ***Robert A. Millikan*** and ***Harvey Fletcher*** measured the force of the (e) elementary electric charge in their "oil drop experiment" by counterbalancing the force of charge with gravity: e ≈ $1.60217662*10^{-19}$ C. The 'official' mass of electron was derived later from this charge and Thomson's rate:

me=e/(Q/m) ≈9.1*10⁻³¹kg

Thomson's rate was defined by high voltage radiations against resistance (air, hydrogen) so it defines powerful particles.

In 1962, ***Brian Josephson*** predicted that if a junction of two superconductors is driven at (f) frequency, then its current-voltage curve will result constant (V) voltage at the values of 'nhf/2e', where 'n' is an integer and 'e' the elementary charge (≈ $1.60217662*10^{-19}$ C).

His prediction was verified experimentally by Irwin Shapiro in 1963:

$$V = \frac{hf}{2e}; \quad \text{Josephson constant } K_J = \frac{2e}{h} = 483597.9 \ \ GHz/C$$

The mass equivalent of an electron derived from Josephson constant:

me= ½$m_h K_J$ = 1.78*10⁻³⁶kg

This mass is much smaller than the one calculated by Thomson's rate.

Particle masses calculated by radiations differ as a consequence of different frequencies, resistance and speed, so these parameters should be given when publishing values. So the proper determination of the mass of an electron calculated by Josephson constant:

me= 1.78*10^-36^kg (f =2.418*10^14^Hz)

$m_e = 1.78 \cdot 10^{-36}$ kg ($f = 2.418 \cdot 10^{14}$ Hz)

The frequency equivalence of the official mass of electron: $f=m_e/m_h = 1.23*10^{20}$ Hz

Thomson made his experiments with X-rays.

Conclusion

Newton didn't respond to Leibnitz's idea, Bernoulli didn't try to find the reason why his result was half of the one suggested by Leibnitz, and the theoreticians of the 20th century antiquated Newton by ignoring the basic relations between the effects of forces in time and space.

With the ignored relations the theoretical world became limitless, where infinitely great masses can come into being from nothing (called singularities) in a moment (Big Bang theory), creating a relativistic university with passages shorten than the distance between two points (wormholes), asynchronous time periods (time dilation) with the possibility of time travel. However a world without the correct relations of forces operating it, is only a world of fantasy.

References

1. George E. Smith (2006) The Vis Viva Dispute: A Controversy at the Dawn of Dynamics. Physics Today 59: 31-36.
2. Einstein A (1905) Annalen der Physik 18: 639.
3. Heisenberg W (1927) Über den anschaulichen Inhalt der quantentheoretischen Kinematik and Mechanik. Zeitschrift für Physik.