DIFFERENCES BETWEEN KANT AND NEWTON'S THREE LAWS OF MOTION

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Kant's thick work on the concepts of motion as a part of his transcendental philosophy is found in his critical period publications such as *Critique of Pure Reason* (1781) and *Metaphysical Foundation of Natural Science* (1786). Kant's quest for synthetic *a priori* propositions (judgments) in physics, mathematics and metaphysic and the scientific explanations in his philosophical works make him out to be a philosopher of science[1]. Michael Friedman considers his work on Mechanics to be Newtonian in many ways. Newtonian science has remarkable contribution in the historical development of modern science. It believed that there are some similarities to Newton in Kant's concept of motion and in the formulation of his three laws of mechanics in *Metaphysical Foundation of Natural Science*. Here my aim is to show the differences between Kant's Three Laws of Mechanics and Newton's Three Laws of Motion.

Kant's differences from Newton's three laws of motion

Kant's philosophy of physics* cannot be treated directly without referring to the development of modern science. There lie many differences between the two (philosophy of physics and modern science) though Kant's philosophical enterprises in the subjects of pure mathematics and physics are of no less importance[2]. Kant's philosophy of physics is not meta-physics. Kant's understanding of metaphysics is different from philosophers like Descartes, Spinoza, Leibniz, Locke and Berkeley. By 'Metaphysics' Kant understands a supposed science of the super-natural (super-

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[1] According to Moti Bir Rai, Kant can be considered as a philosopher of Science and this can be known only by comparing him with other philosophers of science. Kant writes that the categories like substance, cause, interaction, etc. are indispensible for both science and everyday life. Philosophically minded scientists like Plank, Einstein, Wyle, Heisenberg, Born, Bohm and others have extensively written on these topics. All these writers refer to Kant. For detail see his, 'Kant as a Philosopher of Science', *Journal of the Department of Philosophy*, Vol. II, University of Calcutta, 1976-77, pp. 87-97.

[2] S.G. Martin considers *Critique of Pure Reason* as one of the finest works of Kant. According to him, Kant's name might not be heard frequently at the present but his early scientific essays were surely sufficient to secure him a permanent place in the history of science. See the author's 'Kant as a Student of Natural Science, *The Monist*, Vol.2, No.1, Oxford University Press, 1925, p.258.

* Here, 'Kant's philosophy of Physics' indicates all his philosophical views on natural science.

natural objects like God, Immortality, Freedom and etc.). Kant's enquiry in *Critique of Pure Reason* shows that metaphysics as a science is impossible because it lacks empirical intuition. On this line of understanding, it is always good to use his philosophical views in the study of contemporary philosophy of physics. Kant has taken many ideas from Newton but it does not mean that his philosophy of science is Newtonian in character[1]. We have a reason to agree with Jr. Gordon G. Britton, when he expresses the following view in his *Kant's Theory of Science*:

> I take this to imply that a transcendental inquiry is not concerned with the correctness of, for instance, Newtonian physics, but rather with the philosophical interpretation to be placed upon it. To put it in a slightly different way, Kant's use of "transcendental" here is designed to make a sharp distinction perhaps for the first time in the history of thought, between scientific and philosophical questions (p.130).

Philosophers dealing with Kant's philosophy of science relate him to Newtonian science. History tells us that it was the Newtonian science that was thought as consistent during the time of Kant. Apart from this notion, no one can ignore the concept of object as impossible without the concept of motion in Kantian philosophy of science[2]. We cannot directly relate (as Michael Friedman thinks) the Kantian concept and formulation of motion to that of the Newtonian formulation. Kant has something different to show to Newtonian mechanics keeping himself confined to the scope of his subject. A similar kind of view is also presented by Eric Watkins in his article *'The Laws of Motion from Newton to Kant'* (pp.312-16). Watkins first mentions Newton's three laws of motion and thereafter compares it with the three laws of mechanics from Kant's *MFNS*[3] (pp.80-84).

In regard to Newton's three laws of motion, S. Chandrasekhar thinks that the consideration of the laws and their corollaries in totality was essential for understanding the laws of motion; and this was well realised by Maxwell who

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[1] Examples for the argument "Kant has taken many ideas from Newton but it does not mean that his philosophy of science is Newtonian in character" and similarities between the two are not included in this particular paper because (it needs to be discussed separately) of a thought that it might divert the main objective of the discussion.

[2] Kant has equalized matter with motion and vice-versa. Physics is incomplete without motion because whatever is movable in space is matter. See his *Metaphysical Foundations of Natural Science*, Translated and Edited by Michael Friedman, New York, Cambridge University Press, 2004, p.15.

[3] MFNS is the abbreviated form of *Metaphysical Foundation of Natural Science* and CPR for *Critique of Pure Reason.*

reformulated Newton's first and second laws of motion to render more precise enunciation[1]. The table given below will help us to find out some differences in the formulation of Newton's three laws of motion and Kant's three laws of mechanics:

	Newton's Three Laws of Motion from Principia	**Kant's Three Laws of Mechanics from MFNS**
The First Law	Everybody continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.	With regard to all changes of corporal nature the quantity of matter taken as a whole remains the same, and is neither increased nor decreased.
The Second Law	The change of motion is proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed.	Every change of matter has an external cause. (Everybody remains in its state of rest or motion in the same direction and with the same velocity unless it is compelled by an external cause to forsake this state).
The Third Law	To every action there is always opposed an equal reaction: or, the mutual action of two bodies upon each other are always equal, and directed to contrary parts.	In all communication of motion, action and reaction are always equal to one another.

In the above table, we get the concept of inertia and momentum in Newton's first law of motion but in Kant's first law of mechanics we get the law of conservation. Kant states that quantity of matter must be conserved throughout the communication of motion but Newton does not. Kant's first law of motion as a statement of the conservation law is a consequence of his First Analogy of

[1] S. Chandrasekhar starts by mentioning how Newton has proceeded to his second lesson to formulate the basis for his entire dynamics in the form of three laws of motion and five corollaries as an essential part of the laws and he did this only after writing the introductory lesson on fundamental notions. The repaired three laws are: (i) Everybody continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it. (ii) The change of motion is proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed. (iii) To every action there is always opposed an equal reaction: or, the mutual action of two bodies upon each other are always equal, and directed to contrary parts. See his *Newton's Principia for the Common Reader* Kolkata, Oxford University Press, 2012, pp. 22-31.

Experience[1]. But Newton's first law of motion is about uniform motion in a straight line. It tells us that velocity of everybody is constant unless changed by force. According to it, acceleration is produced by force. It assumes the existence of force and defines it as the only agent that can produce acceleration. The property offering resisting force in opposition to any body that changes or tends to change its velocity is called inertia.

Newton's second law is about a method of measuring force. Generally, a force is measured by balancing it by a known force as in the operation of weighing a body. For instance, a force '*f*' facing on a mass 'm' for 't' sec and changing its velocity from μ to v. The momentum of a body at any instant is defined as the product of its mass and its velocity, M = mv. We do not get a mention of Newton's first law of motion in Kant's second law of mechanics. Kant provides a different formulation of Newton's law of inertia, citing change of matter and external causality rather than change of motion and forces. This second law of mechanic is also connected to his Second Analogy of Experience[2].

According to Watkins, Kant's third law of mechanics and Newton's third law of motion for all practical purpose are more or less identical. He further adds to it that Kant goes beyond Newton by providing an *a priori* proof of the truth of this law and a satisfactory ontological account of how action and reaction occur[3]. The ontological account provided for the communication of motion (action and reaction) can only be understood from Kant's rationalist metaphysical background. We may quote Moti Bir Rai from his 'Kant as a Philosopher of Science':

When Kant deals with community (action and reaction), he is dealing with the *a priori* conditions of empirical knowledge. To abandon the principle of community is equivalent to giving up belief in gravitation. If material bodies do not gravitate, then

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[1] In all change of appearances substance is permanent; its quantum in nature is neither increased nor diminished. See Kant's *Critique of Pure Reason*, Translated by John P. Mahaffy, London, Macmillan & Co. Ltd., 1958, p.212.

[2] All alterations take place in conformity with the law of the connection of cause and effect. See Kant's *Critique of Pure Reason*, Translated by John P. Mahaffy, London, Macmillan & Co. Ltd., 1958, p. 218.

[3] See Eric Watkins's 'Kant's Justification of the Laws of Mechanics', *Kant and the Sciences*, Edited by himself, New York, Oxford University Press, 2001, p.146.

both Newton and Einstein must be credited with having solved a pseudo-problem. Gravitation is a technical name for what Kant calls reciprocal action (interaction) between and among material bodies. (p.96)

That the views of Kant in his laws of mechanics are divergent from Newton's three laws of motion is also shown by Howard Duncan in his article 'Inertia, the Communication of Motion, and Kant's Third Law of Mechanics' published in *Philosophy of Science* (p. 93-119). According to Duncan,

I. Kant's first law of mechanics is his version of the standard mechanical principle that matter is neither created nor destroyed in natural event. But Newton's view in his first law of motion is different from Kant's first law of mechanics because it is not about the conservation of mass (matter) in the communication of motion (p.100).

II. From a different perspective, Kant's second law of mechanics is the principle of the lifelessness of matter, a principle which Kant thought to be necessary for the possibility of a science of nature. In the second law, Kant rejects the Newtonian force of inertia which carries the connotation of a striving by a body to remain in a given condition. For Kant, inertia signifies merely the complete inefficacy of a body in itself. But Newton's first law does not follow from the lifelessness of matter alone, which means that any change in the state of a body is not self-caused (p.101). Gorden G. Brittan points out in *Kant's Theory of Science* that the so-called 'force of inertia' is for Kant the paradigm of a living force (p.161). According to him, Kant intended to eliminate the concept of inertial force and this elimination has three aspects: i) The inertial force preludes the possibility of mathematical physics. ii) The concept of inertial force is empty. iii) Nothing but the opposite motion of another body can resist a motion, but this other's rest cannot resist a motion.

III. Kant's view of reaction in his third law of mechanics is the motion of a body that is opposed to the motion of another body upon it. It expresses Kant's law of inertia or the lifelessness of matter, a body can have no causal effect upon another, and, therefore, cannot be reactive, unless it is in motion. Thus drawing from his second law, a reactive as well as active body must be in motion;

reaction is the motion of a body and is measurable as moving force. Therefore, Kant's view 'a reactive body can be such even if in a state of rest' is divergent[1] to Newton's view 'inertial force is an essential and active property of bodies' (p. 101-2).

The differences (and divergence) of Kant's formulation of three laws of mechanics from Newton's three laws of motion were due to their different philosophical programmes. Kant's programme was a programme of doing philosophy of science. He was not directly concerned with any kind of experiment and generalisation of the laws but with the consideration of laws of mechanics as synthetic *a priori* judgments. Kant's three laws of mechanic in *MFNS* are related to the 'Analogies of Experience' in *CPR*. The principles incorporate certain categories which are *a priori* and the laws incorporate certain principles which are synthetic *a priori* propositions. When these principles are applied and valid of objects of experience or reality then they become synthetic *a priori* judgments. For Kant, the three laws of mechanics are synthetic *a priori* judgments. His programme in the formulation of the three laws of mechanics was to establish his main project of showing a possibility of synthetic *a priori* judgments in physics. Therefore, the main reason for the above differences between Kant's three laws of mechanics and Newton's three laws of motion was due to Kant's own programme of establishing the possibility of synthetic *a priori* judgments in physics.

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[1] Eric Watkins also states this in another way in his 'The Laws of Motion from Newton to Kant', *Perspective on Science* (Vol. 5, No. 3, 1997, p. 314), "Kant does, parenthetically, restate a principle very similar to Newton's laws of inertia following his own formulation (so that one might think that the difference between the two is due to a looseness in translation from the Latin and is thus merely apparent), but such a principle could be simply an instance of his more general law rather than an equivalent formulation."

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