



## Three Questions: How and Why Newton's Third Law Must be Extended/Generalized?

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Original law "To every action there is always opposed an equal reaction.

Reaction = - Action

Extended/generalized law: Reaction -Q Action, Q is coefficient of proportionality

### Q. 1 How some experiments need to be conducted for complete confirmation of Newton's third law?

Ajay: Newton [1] stated the law in the Principia (1686),

Action = - Reaction (2)

The definition and equation of the law is universally applicable for all projectiles and targets.

He gave three applications of the law briefly as outlines/basic introduction. In first two applications action/reaction were expressed in terms of force, and third application of the law leads to conservation of momentum. Newton did not give any mathematical equation or detailed justification of the law.

The first two applications involve falling and rebounding bodies. Newton did not mention about these experiments due to conceptual limitations. In school level text books these are taught qualitatively.

These experiments involve weight (mg). The acceleration due to gravity, is determined for first time in 1888, and weight in 1901.

Thus weight was defined 215 years after enunciation of Newton's law of gravitation in 1686.

So it was not possible for scientists to perceive experiments. Thus law got established. Now the experiments are theoretically feasible and scientists have accurate equipment to check them. So these experiments are needed for confirmation of the law.

### Q 2. So the experiments regarding falling and rebounding bodies are feasible and need to be conducted for complete understanding of the law. What are the factors which may bring the proposed limitations of the law?

Ajay: The shape of bodies (projectile and target) are main factors which would pave way for demonstrations of limitations. For the same MASS (say 1KG) the shapes of bodies of RUBBER (say) may be different e.g.

- **Shapes of bodies:** Spherical, semi-spherical, umbrella shaped, triangular, square, hexagonal, polygon, cone, long thin pipe, flat, irregular or any feasible typical shape, orientations (angle of fall) etc.
- **Various bodies:** Wool, wood, cloth, spring, steel, rubber, clay, kneaded flour, chewing gum, sponge, typical plastic, porous material, air/fluid filled artifact, super ball, sky ball, or any other typical body etc.
- **Characteristics of bodies:** Inherent composition, nature, flexibility, elasticity, plasticity, rigidity, magnitude, size, distinctiveness of interacting bodies or mode of interactions of bodies, unsymmetrical distribution of mass in body and other relevant factors like surfaces on which bodies interact.

When bodies fall then action i.e. force (weight, mg or 9.8 newtons), is the same (rubber, say). So reaction must be same in magnitude and opposite in direction (-9.8 newton). The bodies must rebound to the same height they fall. Only then Reaction = - Action.

As already mentioned definition of the law and eq.(1) is universally applicable.

But bodies of different shapes rebound to different heights at qualitative level in macroscopic experiments. Thus law is not justified.

In the experiments the energy may be lost as heat energy (mass x specific heat x rise in temp.), sound energy etc., this can be taken in account. Also area of constant for spherical and flat body is significant. These factors can be minimized.

These experiments can be conducted for other bouncy bodies such as super ball and sky ball (they have bounciness many times the rubber ball).

The various scientists have found these experiments original and recommended for experiments [2-11].

### Q 3. If in sensitive experiments, the deviation are observed from Newton's third law in some cases, then how the deviations would be explained?

Ajay: The deviations can be explained by extending the definition of the law within domains of Newtonian Mechanics as

$$\text{Reaction} = Q \text{ Action (2)}$$

Where Q is coefficient of proportionality. It takes in account various factors (like shape etc.) which are not taken in account. These experiments may be conducted establishing specific laboratory or using existing facilities of ISRO, DRDO, HAL etc. for shorter time.

### Bibliography

1. Newton I. Mathematical Principles of Natural Philosophy. Book I, Middle Temple Gate in fleet street, London 1 (1729): 19-20
2. Sharma A. *Acta Ciencia Indica* 25.3 (1999): 113.
3. Sharma A. in American Association of Physics Teachers, SM 18 Washington DC, USA. presented as, Role of Characteristics of Bodies in Newton's Third Law of Motion , July 28-Aug.1 (2018): 150-151.

4. Report of Director National Physical Laboratory (Council of scientific and Industrial Research, New Delhi). Theme of report: "The shape of bodies is not taken in account by Newton's Third Law of Motion. Thus originality of thought is not denied. If, proven, yes the opportunity is huge. The investigator may re-submit the project with details of experimentations and list of required instrumentations" (2019).
5. Gordon R. Shape and characteristics of body may play significant role on presentation at SM 18 of American Association of Physics Teachers, Washington. Theme of Report "The experiments may lead to final confirmation either in original or generalized form of Third Law of Motion. The Association wishes him all the best in pursuits" (2018).
6. Sharma A. The Principia's Third Law of Motion: Revisited and Generalized Proceedings of 105th Indian Science Congress 2018. *Physical Sciences* 145 (2018): 153-154.
7. Sharma A. Third Application of Principia's third law of motion and role of shape of bodies Proceedings of 107th Indian Science Congress 2020 ,*Physical Sciences PH 056* (2020): 106-107.
8. Carlo Rovelli. as Editor in comments (limitations of third law may be highlighted within domains of classical physics). The theme of comments "Finally, your paper has a genuinely physical part investigating possible discrepancies from classical Newtonian physics in its domain of validity" (2018).
9. Editor Current Science, dated 25 June 2019 on paper dealing with generalized form of third law of motion. "Whereas the first two are definitive and lay the foundation of mechanics, the third law certainly suffers from ambiguities and so the author deserves congratulations for the study of this issue".
10. Various scientists suggested the shape based experiments for different bodies in view of Newton's third law which have not been reported in literature.
11. Garwin L. "Kinematics of an Ultraelastic Rough Ball". *American Journal of Physics* 37 (1969): 88.

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