The New Law of Motion – Revisited

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In a previous paper[1] a new law of kinematics was proposed: given an inertial frame, in every elastic collision, it will always be the case that after an elastic collision the higher kinetic energy body will lose kinetic energy and the lower kinetic energy body will gain kinetic energy. The arguments given came from similar arguments in Special Relativity with different observers in different inertial frames of reference and thermal equilibrium concepts. In this paper, we give a proof of this law that is more in line with simple conservation laws and mathematical logic.

Lab Frame

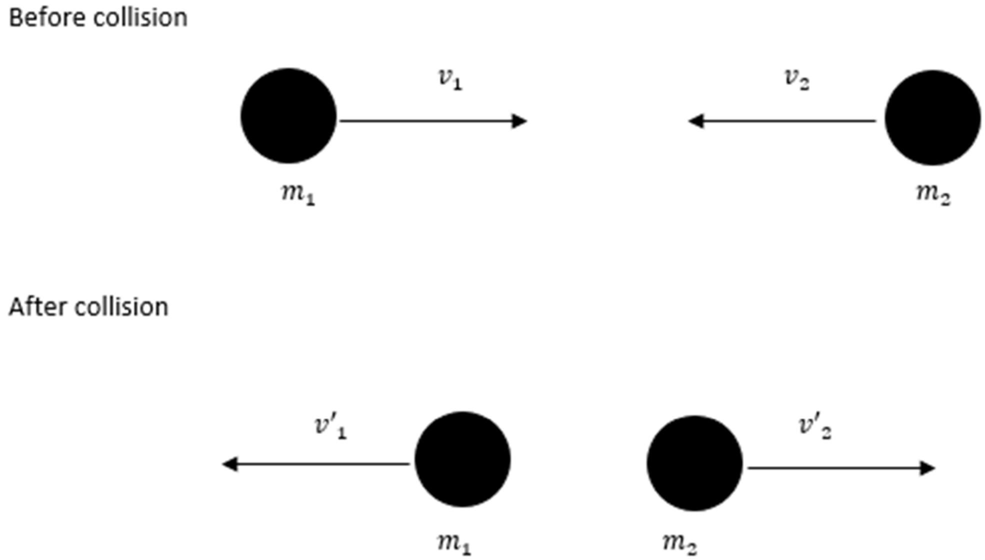

Figure A

We consider that m_2 has the greater kinetic energy. In this elastic collision (no spin), the new law of kinematics states that m_2 will lose energy, and consequently, m_1 will gain energy.

Conservation of kinetic energy:

$$KE_1 + KE_2 \;=\; KE'_1 + KE'_2$$

$$½\, m_1 v_1{}^2 + ½\, m_2 v_2{}^2 = ½\, m_1 v'_1{}^2 + ½\, m_2 v'_2{}^2$$

Proposal: if $KE_2 > KE_1$ then $KE'_2 < KE_2$

Consider: If $KE_2 > KE_1$

Then $½ m_2 v_2{}^2 > ½ m_1 v_1{}^2$

Or, $v_2{}^2 > \frac{m_1}{m_2} v_1{}^2$

(1) Therefore, $v_2{}^2 = \frac{m_1}{m_2} v_1{}^2 + k$ where $k > 0$

At first we don't know where the energy goes, or which particle will gain or lose energy. Suppose no energy is gained or lost during this elastic collision by m_2 ($KE'_2 = KE_2$), then we can say,

(2) $v'_2{}^2 = v_2{}^2$

We will show that given $KE_2 > KE_1$, this supposition is not possible. And the only alternative is $KE'_2 < KE_2$.

Substituting the above result (1) into (2), we get

$$v'_2{}^2 = \frac{m_1}{m_2} v_1{}^2 + k$$

Therefore we have

(3) $v'_2{}^2 < \frac{m_1}{m_2} v_1{}^2$

Multiply both sides by ½m_2,

$$(½m_2)v'_2{}^2 < (½m_2)\frac{m_1}{m_2} v_1{}^2 (= ½m_1 v_1{}^2)$$

Which means that,

$KE'_2 < KE_1$

Therefore

(4) $KE'_2 + \alpha = KE_1$ where $\alpha > 0$

From $KE_2 > KE_1$ (the condition on this elastic collision)

(5) $KE_2 = KE_1 + \beta$ where $\beta > 0$

Substitute (5) into (4)

$KE'_2 + \alpha = KE_2 - \beta$

$KE'_2 - KE_2 = -\alpha - \beta$

Since α and β are both greater than zero, we get

$KE'_2 - KE_2 < 0$,

QED

Conclusion: we reiterate that the body with the higher kinetic energy (m_2) will lose energy in a perfect elastic collision (no spin), and by the conservation law of energy, the body with the lower kinetic energy (m_1) will gain energy. This result has been used to derive at the molecular level the second law of entropy – in a bath of hot and cold water, heat will flow from hot to cold - without the need of making use of micro-states as in Boltzmann's entropy[2].

[1]Joseph Palazzo, A New Law of Kinematics, 2016-08-29, https://vixra.org/abs/1608.0392.

[2] Ibid.