In conventional setups involving collisions on an inertially moving platform M, two equal-mass projectiles (m_1 and m_2) ejected in opposite directions with equal speeds relative to the platform collide with the front and rear walls, respectively. From the platform's frame, the outcomes are symmetric: both projectiles rebound with equal and opposite velocities, and no net momentum is transferred to the platform. However, from the perspective of an external rest frame, this process is energetically asymmetric.

The forward-moving projectile m_1 (in the direction of the platform's motion) possesses higher kinetic energy in the rest frame than m_2, which moves opposite to the platform's motion. When m_1 collides with the front wall, it loses more energy—effectively transferring momentum and exerting **accelerating impulse** to the platform. In contrast, the rearward-moving m_2 has lower rest-frame energy and gains kinetic energy upon rebounding, exerting a **decelerating impulse** on the platform and gain momentum from it. This asymmetry in momentum and energy transfer balances out since increasing the energy of the platform requires more energy than decreasing it, and the interaction is usually explosion which happens instantaneously and over short distance, resulting in no net platform acceleration, but the **individual roles of each impulse** are functionally distinct: one accelerates, the other decelerates.

As mentioned earlier as per kinematic formula:

$$d = v_0 \Delta t + \frac{1}{2} a (\Delta t)^2$$

Interactions at higher absolute velocities will have shorter durations than interactions at lower velocities, hence bodies with initial velocity will experience higher durations depending on their direction in the rest frame owing to the initial velocity factor v_0.

That is, the **flow of time for physical processes** — specifically, how long a projectile spends under a fixed-force interaction — is governed not just by local conditions but by **absolute velocity through a universal rest frame**.

So the interaction duration with force that causes positive acceleration –like repulsion upon exiting electromagnetic ring– will be:

$$\Delta t = \frac{-v_0 \pm \sqrt{{v_0}^2 + 2ad}}{a}$$

And since the change in velocity after exiting the ring will be very small at high speeds, we can take the average absolute velocity before and after exiting the ring to conclude the interaction duration – as mentioned earlier–:

$$\Delta t = \frac{d}{v_{avg}}$$

A critical distinction separates this experiment from conventional analyses of explosions or collisions. Standard treatments assume the interacting bodies are initially at rest within a single, shared inertial frame (v_0). Furthermore, the interaction is typically modeled as instantaneous or occurring over a negligibly short distance, ensuring symmetric outcomes that uphold the principle of relativity.

Our proposed setup deliberately violates this foundational assumption. Here, the 'explosion'—the repulsive electromagnetic interaction—occurs while the projectiles are already in motion with significant initial velocities ($v_0 \neq 0$) relative to the inertial frame. This configuration forces a decisive empirical test: will the interaction durations measured within the platform frame be identical, as demanded by Special Relativity and the Work-Energy theorem applied from that inertial perspective? Or will they differ, as predicted by applying the classical kinematic formula using rest-frame velocities (V±u)?

But we have to consider very important nuance, upon spring expansion in the first stage to accelerate both projectiles from rest, the rest frame will see each projectile at different absolute energy, this is because $\mathbf{m_1}$ pushed $\mathbf{m_2}$ rearward and stealthy took energy from it which constitutes most of the transferred energy, so the total energy is the stealthily transferred energy (passive energy) and the exerted energy (spark energy), same goes for impulse, total impulse is passive impulse and spark impulse.

Numerical Example

Parameters:

- Platform velocity (absolute): V=100m/s
- Platform recoil in each recoil: ΔV1 and ΔV2
- Platform's absolute velocity after electromagnet ring interaction for each recoil: V-ΔV1=V_{1f}, V+ΔV2=V_{2f}
- Platform mass: M=100 kg
- Mass: m_1=m_2=1kg
- Initial repulsion/ejection energy between m_1 and m_2 (mechanical explosion, magnetic repulsion or spring expansion ...etc.): $E_{initial}$=100 Joule
- Relative launch velocity for both projectiles: u=10m/s.
- Absolute velocity after initial launch for each projectile: for m_1 u_{i1}=V+u and for m_2 u_{i2}=V-u.
- Relative velocity change after electromagnet ring interaction: Δu_1 and Δu_2.
- New relative velocities for each projectile after electromagnet rings interactions: u_1 and u_2

- Projectiles absolute velocity after electromagnet ring's interaction: V+u+Δu_1=u_{1f}, V-u-Δu_2=u_{2f}
- Platform new absolute velocity after m_1 interaction with its ring – recoil from its side only–: V_{1f}
- Platform new absolute velocity after m_2 interaction with its ring – recoil from its side only–: V_{2f}
- Platform's net recoil: ΔV
- Magnetic ring effective distance: d=0.1m
- Magnetic interaction force: F=500N (we approximate constant repulsion).

How to do the Math:

Standard physics assumes symmetry in the platform frame and uses that assumption to enforce symmetric outcomes by applying equal energy-momentum conservation — but if the underlying dynamics (like interaction time) depend on absolute motion, then the assumption itself is flawed.

In other words:

- Method 1 presumes relativity is true and builds conservation laws accordingly.
- Method 2 tests whether those assumptions hold by calculating actual physical durations and impulses using kinematics tied to a rest frame.

As per our previous analysis, the first method will give approximate value to the total impulse – since it will not consider the anisotropy in the spark impulse and most of the total impulse will come from the passive impulse which will be identical in both projectiles–, while the other method will calculate the value of each spark impulse and conclude the anisotropy in the total impulse. So we will address the problem using two methods to conclude the anisotropy:

1. **First Method: Calculate Total Impulse (Inaccurate):** Applying work-energy principle from inertial frames' perspective method to determine the impulse. This is the standard relativistic/classical expectation. It will calculate the total impulse for both constituents (passive impulse + spark impulse) for each projectile up to very high precision, but it will not reveal the tiny anisotropy.
2. **Second Method: Calculate Spark Impulse (Reveals anisotropy):** Using the work-energy principle from rest frames' perspective method or kinematic equations to calculate the interaction duration under constant acceleration, and then using the resulted interactions' durations to determine the impulse. This will calculate the impulse of one constituent of the total impulse, **the spark impulse only**, we don't care for the impulse quantity of the spark impulse since it will be only small fraction of the total impulse, we only care for the anisotropy value it

will reveal. Then we add and subtract half the anisotropy value to both projectiles to get the final velocities.

Since work-energy principle from rest frames' perspective method will deliver same results like the kinematic formula, so we will solve using one of them, and we will choose the kinematic formula.

First Method:

Work-energy principle from inertial frames' perspective method (classic method which delivers symmetric velocities)

Rest frame energy cost:

1. **For $\mathbf{m_1}$ (forward):**

- Initial absolute kinetic energy (KE) after initial ejection:

$$KE_1 = \frac{1}{2} m_1 (V + u)^2 = \frac{1}{2} * 1 * 110^2 = 6050\, J$$

- Final KE (after repulsion from the electromagnetic ring):

$$KE_1 = \frac{1}{2} m_1 (V + u + \Delta u_1)^2$$

- Energy added by ring's interaction:

$$\Delta E_1 = E_f - E_i = \frac{1}{2} m_1 (V + u + \Delta u_1)^2 - \frac{1}{2} m_1 (V + u)^2$$

$$\Delta E_1 = m_1 (V + u) \Delta u_1 + \frac{1}{2} m_1 (\Delta u_1)^2 \qquad Equation\ (1)$$

$$\Delta E_1 \approx m_1 (V + u) \Delta u_1\ (for\ small\ \Delta u_1)$$

- Conservation of momentum: The total momentum before the interaction equals the total momentum after the interaction:

$$MV + m_1 u_1 = MV_{1f} + m_1 u_{1f}$$

$$u_{1f} = \frac{MV + m_1 u_1 - MV_{1f}}{m_1} \qquad Equation\ (2)$$

- Conservation of energy: The total kinetic energy before the interaction, plus the added energy after the initial launch $E_{initial}$, equals the total kinetic energy after the interaction:

$$\frac{1}{2}MV^2 + \frac{1}{2}m_1{u_1}^2 + E_{initial} = \frac{1}{2}MV_{1f}^2 + \frac{1}{2}m_1u_{1f}^2$$

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + m_1u_{1f}^2 \qquad Equation\ (3)$$

Substituting from equation (2) in equation (3):

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + m_1\left(\frac{M\left(V - V_{1f}\right) + m_1u_1}{m_1}\right)^2$$

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + \frac{1}{m_1}\left(M\left(V - V_{1f}\right) + m_1u_1\right)^2$$

Let $P_{total\_1} = MV + m_1u_1$ (initial total momentum). Then Equation (2) can be written as:

$$u_{1f} = \frac{P_{total_1} - MV_{1f}}{m_1}$$

Substituting into equation (4):

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + m_1\left(\frac{P_{total_1} - MV_{1f}}{m_1}\right)^2$$

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + \frac{1}{m_1}(P_{total_1} - MV_{1f})^2$$

Expanding:

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + \frac{1}{m_1}({P_{total_1}}^2 - 2P_{total_1}MV_{1f} + M^2V_{1f}^2)$$

$$MV^2 + m_1{u_1}^2 + 2E_{initial} = MV_{1f}^2 + \frac{{P_{total_1}}^2}{m_1} - \frac{2P_{total_1}M}{m_1}V_{1f} + \frac{M^2}{m_1}V_{1f}^2$$

Rearrange into a quadratic equation for $V_{1f}(a{V_{1f}}^2 + bV_{1f} + c = 0)$:

$$\left(M + \frac{M^2}{m_1}\right){V_{1f}}^2 - \left(\frac{2P_{total_1}M}{m_1}\right)V_{1f} + \left(\frac{{P_{total_1}}^2}{m_1} - MV^2 - m_1{u_1}^2 - 2E_{initial}\right) = 0$$

To simplify the coefficients:

$$a = M\left(1 + \frac{M}{m_1}\right) = M\left(\frac{m_1 + M}{m_1}\right) = \frac{M(M + m_1)}{m_1}$$

$$b = -\frac{2M(MV + m_1u_1)}{m_1}$$

$$c = \frac{(MV + m_1u_1)^2}{m_1} - (\,MV^2 + m_1{u_1}^2 + 2E_{initial})$$

So, the quadratic equation for V_{1f} is:

$$\frac{M(M + m_1)}{m_1}V_{1f}^2 - \frac{2M(MV + m_1u_1)}{m_1}V_{1f} + \left(\frac{(MV + m_1u_1)^2}{m_1} - (\,MV^2 + m_1{u_1}^2 + 2E_{initial})\right) \quad Equation\ (4)$$

Solving for V_{1f} using quadratic formula:

$$V_{1f} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Once we have the two values for V_{1f} (there will generally be two solutions for a quadratic equation), we substitute each one back into Equation (3) to find the corresponding u_{1f}

$$u_{1f} = \frac{MV + m_1u_1 - MV_{1f}}{m_1} = \frac{M(V - V_{1f}) + m_1u_1}{m_1} \quad Equation\ (5)$$

Calculations as per front ring repulsive interaction with m_1:

Total initial momentum:

$$P_{total\_1} = MV + m_1u_1$$

$$P_{total\_1} = 100\ kg * 100\frac{m}{s} + 1kg\left(100\frac{m}{s} + 10\frac{m}{s}\right) = 10{,}110\ kg.m/s$$

Total initial kinetic energy before m_1 interacts with the ring:

$$KE_{initial\_1} = \frac{1}{2}MV^2 + \frac{1}{2}m_1(V+u)^2$$

$$KE_{initial\_1} = \frac{1}{2}100(100)^2 + \frac{1}{2} * 1(100+10)^2 = 506{,}050\,J$$

After the interaction, the total energy is:

$$KE_{initial\_1} + 50J = 506{,}100\,J$$

Plugging values into equation (4) and (5) we get:

$$V_{1f} = V - \Delta V_1 \approx 99.958639\,m/s \rightarrow \Delta V_1 = 0.04136\,m/s$$

$$u_{1f} = V + u + \Delta u_1 \approx 114.136086\,m/s \rightarrow \Delta u_1 = 4.136\,m/s$$

Relative velocity after $m_1$interaction with ring between $m_1$and the platform:

$$u_{m1\_rel} = 114.136 - 99.959 \approx 14.177\,m/s$$

As we see the relative velocity of m_1 changed after ring's interaction from 10 m/s to 14.177 m/s. but this will be opposed by $\mathbf{m_2}$ impulse

Concluding interaction duration Δt_1:

Using impulse

$$W_1 = F.d = 500\,N * 0.1\,m = 50\,J$$

$$J_1 = F.\Delta t_1 = \Delta P_1$$

For m_1:

$$J_{m1} = m_1((V + u + \Delta u_1) - (V + u))$$

For M:

$$J_M = M(V_{1f} - V)$$

From Newton third law:

$$|J_{m1}| = |J_M|$$

Initial velocities:

V=100 m/s, u=10 m/s

Final velocities:

$$V_{1f} = 99.959\frac{m}{s}, u_{1f} = 114.136\ m/s$$

$$J_{m1} = 114.136 - 110 = 4.136\ kg.m/s$$

$$J_M = 100(99.959 - 100) = -4.136\ kg.m/s$$

$$J_1 = F.\Delta t_1 \rightarrow \Delta t_1 = \frac{J_1}{F} = \frac{4.136}{500} = 0.0082\ s \approx \mathbf{8.28\ ms}$$

2. **For $\mathbf{m_2}$ (backward):**

- Initial absolute kinetic energy (KE) after initial ejection:

$$KE_2 = \frac{1}{2}m_2(V-u)^2 = \frac{1}{2} * 1 * 90^2 = 4050\ J$$

- Final KE (after repulsion from the electromagnetic ring):

$$KE_2 = \frac{1}{2}m_2(V-u-\Delta u_2)^2$$

- Energy removed by the ring:

$$\Delta E_2 = E_f - E_i = \frac{1}{2}m_2(V-u-\Delta u_2)^2 - \frac{1}{2}m_2(V-u)^2$$

$$\Delta E_2 = -m_2(V-u)\Delta u_2 + \frac{1}{2}m_2(\Delta u_2)^2 \qquad Equation\ (6)$$

$$\Delta E_2 \approx -m_2(V-u)\Delta u_2\ (for\ small\ \Delta u_2)$$

- Conservation of momentum: The total momentum before the interaction equals the total momentum after the interaction:

$$MV + m_2u_2 = MV_{2f} + m_2u_{2f}$$

$$u_{2f} = \frac{MV + m_1 u_2 - MV_{2f}}{m_2} \qquad Equation\ (7)$$

- Conservation of energy: The total kinetic energy before the interaction, plus the added energy after the initial launch $E_{initial}$, equals the total kinetic energy after the interaction:

$$\frac{1}{2}MV^2 + \frac{1}{2}m_2{u_2}^2 + E_{initial} = \frac{1}{2}MV_{2f}^2 + \frac{1}{2}m_2 u_{2f}^2$$

$$MV^2 + m_2{u_2}^2 + 2E_{initial} = MV_{2f}^2 + m_2 u_{2f}^2 \qquad Equation\ (8)$$

Same way we conclude:

$$\frac{M(M+m_2)}{m_2}V_{2f}^2 - \frac{2M(MV+m_2u_2)}{m_1}V_{2f} + \left(\frac{(MV+m_2u_2)^2}{m_2} - (\,MV^2 + m_2{u_2}^2 + 2E_{initial})\right) \qquad Equation\ (9)$$

$$u_{2f} = \frac{M\left(V - V_{2f}\right) + m_2 u_2}{m_2} \qquad Equation\ (10)$$

Calculations as per front ring repulsive interaction with m_2:

Total initial momentum:

$$P_{total\_2} = MV + m_2 u_2$$

$$P_{total\_1} = 100\ kg * 100\frac{m}{s} + 1kg\left(100\frac{m}{s} - 10\frac{m}{s}\right) = 10{,}090\ kg.m/s$$

Total initial kinetic energy before m_1 interacts with the ring:

$$KE_{initial\_2} = \frac{1}{2}MV^2 + \frac{1}{2}m_2(V-u)^2$$

$$KE_{initial\_2} = \frac{1}{2}100(100)^2 + \frac{1}{2} * 1(100-10)^2 = 504{,}050\ J$$

After the interaction, the total energy is:

$$KE_{initial\_2} + 50J = 504{,}100\ J$$

Plugging values into equation (9) and (10) we get:

$$V_{2f} = V + \Delta V_2 \approx 100.04136\, m/s \rightarrow \Delta V_2 = 0.04136\, m/s$$

$$u_{2f} = V - u - \Delta u_2 \approx 85.864\, m/s \rightarrow \Delta u_2 = 4.136\ \ m/s$$

Relative velocity after $m_2$interaction with ring between $m_2$and the platform:

$$u_{m2\_rel} = 85.864 - 100.04136 = -14.177\, m/s$$

As we see the relative velocity changed after the ring's interaction from 10 m/s to -14.177 m/s. identical to front ring's interaction absolute change.

Concluding interaction duration Δt_2:

$$W_2 = F.d = 500\ N * 0.1\ m = 50\ J$$

$$J_2 = F.\Delta t_2 = \Delta P_2$$

For m_1:

$$J_{m2} = m_2((V - u - \Delta u_2) - (V + u))$$

For M:

$$J_M = M(V_{2f} - V)$$

From Newton third law:

$$|J_{m2}| = |J_M|$$

Initial velocities:

V=+100 m/s, u= -10 m/s

Final velocity and duration:

$$V_{2f} = 100.04136\ \ \frac{m}{s}, u_{2f} = 85.864\, m/s$$

$$J_{m2} = 85.864 - 90 = -4.136\ \ kg.m/s$$

$$J_M = 100(100.04136 - 100) = 0.04136 \;\; kg.m/s$$

$$J_2 = F.\Delta t_2 \rightarrow \Delta t_2 = \frac{J_2}{F} = \frac{0.04136}{500} \approx 0.0082\, s \approx \mathbf{8.28\, ms}$$

As we notice, using the work-energy principle from inertial frames' perspective method will produce equal final relative velocities, momentum, and interaction durations; $V_{1f} = V_{2f}$, $\Delta u_1 = \Delta u_2$ and $\Delta t_1 = \Delta t_2$,this is incorrect method with approximate results. And we need to calculate the results by subtracting half the anisotropy value from both sides (subtraction for $\mathbf{m_2}$ will increase velocity since its direction is negative) to get the accurate figures.

Second Method:

Using the Kinematic Formula to Calculate Spark Impulse Constituent only to Conclude the Anisotropy (Time-Dependent Impulse):

For $\mathbf{m_1}$:

$$d = u_{i1}.\Delta t_1 + \frac{1}{2}a(\Delta t_1)^2$$

$$a = \frac{F}{m_1} = \frac{500}{1} = 500\, m/s^2$$

$$0.1 = 110\Delta t_1 + 250(\Delta t_1)^2$$

$$\Delta t_1 = 0.0009$$

The measurement should confirm this figure so we can use it in the impulse formula.

Given the interaction time, the change in velocity should be:

$$\Delta u_1 = a.\Delta t_1 = 500 * 0.0009 = 0.45\, m/s$$

The final absolute velocity will be:

$$u_{1f} = 110 + 0.45 = 110.45\, m/s$$

The final relative velocity will be:

$$u_1 = u + \Delta u_1 = 10 + 0.45 = 10.45\, m/s$$

We can also conclude $\Delta t_1$from average velocity:

$$\Delta t_1 \approx \frac{effective\ length}{average\ velocity\ through\ region}$$

$$\Delta t_1 \approx \frac{d}{((V+u)+(V+u_1))/2} \qquad Equation\ (11)$$

$$\Delta t_1 \approx= \frac{0.1}{110.225} \approx 0.0009\ s$$

Calculating impulse:

$$J_1 = F.\Delta t_1 = 500 * 0.0009 = 0.45\ kg.m/s$$

Off course the more practical way to calculate the impulse is by measuring the difference in the projectile velocity before and after interaction with the ring since measuring the time of acceleration might be less accurate than measuring the difference in velocity.

$$J_1 = m_1 \Delta u_1 = 1 * 0.45 = 0.45\ kg.m/s$$

For m_2:

$$d = u_{i2}.\Delta t_2 + \frac{1}{2}a(\Delta t_2)^2$$

$$a = \frac{F}{m_2} = \frac{500}{1} = 500\ m/s^2$$

$$0.1 = 90\Delta t_2 + 250(\Delta t_2)^2$$

$$\Delta t_2 = 0.0011$$

Given the interaction time, the change in velocity should be:

$$\Delta u_2 = a.\Delta t_2 = 500 * 0.0011 = 0.55\ m/s$$

The final absolute velocity will be:

$$u_{2f} = 90 - 0.55 = 89.45\ m/s$$

The final relative velocity will be:

$$u_2 = u + \Delta u_2 = 10 + 0.55 = 10.55\, m/s$$

(Off course we should consider ΔV *to conclude the correct results for* Δu_1 *and* Δu_2*).*

Also:

$$\Delta t_2 \approx \frac{d}{((V-u)+(V-u_2))/2} \qquad Equation\ (12)$$

$$\Delta t_2 \approx \frac{0.1}{89.725} \approx 0.0011\, s$$

Calculating impulse:

$$J_2 = F.\Delta t_2 = 500 * 0.0011 = 0.55\, kg.m/s$$

Calculating impulse by measuring the difference in velocity Δu_2:

$$J_2 = m_2 \Delta u_2 = 1 * 0.55 = 0.55\, kg.m/s$$

Concluding Anisotropy:

$$\Delta u_2 - \Delta u_1 = 0.55 - 0.45 = 0.1\, m/s$$

Calculating the Final Velocities using the Anisotropy:

From the work-energy principle from inertial frames' perspective method we got the following final relative velocities:

$$u + \Delta u_1 \approx 14.136 \rightarrow$$

$$\text{correct final relative velocity for } m_1 = 14.136 - \frac{0.1}{2} = 14.086 \text{ m/s}$$

$$u + \Delta u_2 \approx 14.136 \rightarrow$$

$$\text{correct final relative velocity for } m_2 = -14.136 - \frac{0.1}{2} = -14.186 \text{ m/s}$$

These figures should be corrected to higher accuracy after considering the minute platform recoil.

Now, Platform also experiences equal and opposite impulses:

$$\Delta V = \frac{\Delta P_M}{M} = \frac{F(\Delta t_2 - \Delta t_1)}{M} = \frac{J_2 - J_1}{M} = \frac{0.55 - 0.45}{100} = 0.001\, m/s$$

So the accurate final velocities after platform' recoil will become:

Accurate correct final relative velocity for $m_1 = 14.086 + 0.001 = +14.087$ m/s

Accurate correct final relative velocity for $m_2 - 14.186 + 0.001 = -14.185$ m/s

These two different duration's interactions where $\Delta t_2 > \Delta t_1$ and the difference in relative velocities $\Delta u_2 > \Delta u_1$ will prove the broken symmetry upon measurement for relatively identical velocities inside the platform before the interaction and will lead to different relative velocities after interaction with rings $u_2 > u_1$, the platform acceleration will be minor and will not compensate for this measurable difference.

As we see ΔV is way less than Δu_1 *and* Δu_2, addition and subtraction of its value can be neglected for large mass M.

Since the platform recoiled – gained positive acceleration– from same work in opposite directions owing to different impulses, the vacuum quantum will act as momentum sink, in this case, **momentum is conserved globally not locally**, which marks major departure from standard physics.

Confirmation Using Spark Energy:

We can also confirm the anisotropy by calculating the resulted velocities from spark energy only:

For $\mathbf{m_1}$:

$$\frac{1}{2} m u_{1f} = \frac{1}{2} m(V + u)^2 + E$$

$$\frac{1}{2} u_{1f} = \frac{1}{2}(110)^2 + 50$$

$$u_{1f} = \sqrt{110^2 + 100} = \sqrt{12200} = 110.4536\, m/s$$

$$110.4536 - 110 = 0.4536\, m/s$$

For $\mathbf{m_2}$:

$$\frac{1}{2} m u_{2f} = \frac{1}{2} m(V - u)^2 - E$$

$$\frac{1}{2}u_{2f} = \frac{1}{2}(90)^2 - 50$$

$$u_{1f} = \sqrt{90^2 - 100} = \sqrt{8000} = 89.4427\ m/s$$

$$90 - 89.4427 = 0.5572\ m/s$$

$$Anisotropy = 0.5572 - 0.4536 = 0.1036\ m/s$$

Confirmation Using Relativistic Kinetic Energy Formula:

The relativistic kinetic energy is:

$$KE = (\gamma - 1)mc^2 \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

After adding 50 J energy for $\mathbf{m_1}$, the new kinetic energy is:

$$KE_f = KE_i + 50$$

Solving for u_f:

$$(\gamma_f - 1)mc^2 = (\gamma_i - 1)mc^2 + 50 \rightarrow \gamma_f = \gamma_i + \frac{50}{mc^2}$$

$$\rightarrow \gamma_f = \gamma_i + 5.556 * 10^{-16}$$

For $\mathbf{m_1}$**:**

$$\beta_1^2 = \frac{u_1^2}{c^2} = \frac{12100}{9 * 10^{16}} = 1.344 * 10^{-13}$$

Using Taylor expansion since the $u_1 \ll c$

$$\gamma_1 = 1 + \frac{1}{2}\beta_1^2 = 1 + 6.772 * 10^{-14}$$

For $\mathbf{m_2}$**:**

Final kinetic energy after subtracting 50 J:

$$KE_f = KE_i - 50 = 4050 - 50 = 4000\ J$$

$$\beta_2^2 = \frac{u_2^2}{c^2} = \frac{4000}{9 * 10^{16}} = 9 * 10^{-14}$$

$$\gamma_2 = 1 + 4.444 * 10^{-14}$$

Computing γ_f after adding 50 J:

$$\gamma_f = \gamma_i + 5.556 * 10^{-16}$$

So:

$$\gamma_{f1} = 1 + 6.772 * 10^{-14} + 5.556 * 10^{-16} = 1 + 6.7776 * 10^{-14}$$

$$\gamma_{f2} = 1 + 4.5 * 10^{-14} + 5.556 * 10^{-16} = 1 + 4.5556 * 10^{-14}$$

Computing final velocities:

$$v_f = c.\sqrt{1 - \frac{1}{\gamma_f^2}} \approx c.\sqrt{2(\gamma_f - 1)}$$

Since $(\gamma_f - 1) \ll 1$

For $\mathbf{m_1}$:

$$u_{1f} = 3 * 10^8.\sqrt{2 * 6.7776 * 10^{-14}} = 110.43\ m/s$$

For $\mathbf{m_2}$:

$$u_{2f} = 3 * 10^8.\sqrt{2 * 4.444 * 10^{-14}} = 89.438$$

Table 1: Comparison between m_1 and m_2 after the positive acceleration

Scenario	Spark Impulse J (kg·m/s)	Difference in Relative Projectile's Velocity (m/s)	Interaction Duration Δt
Opposite Direction of Motion Projectile m_2	**0.55**	**- 14.185**	**0.0011 s**
Same Direction of Motion Projectile m_1	**0.45**	**+14.087**	**0.0009 s**

How This Reveals Absolute Velocity (V)

Method One: Using individual interaction duration or interaction time difference

A. Using individual interaction duration:

Work done on $\mathbf{m_1}$ (from the exerted or spark energy only, not from passive energy transfer):

After measuring Δt_1 we can conclude the absolute velocity of the platform V using conservation of energy.

The interaction distance range can be decided on the platform for same distance for both rings since it will be in the inertial frame.

We will use the formula for work from equation (1):

$$\Delta E_1 = m_1(V + u)\Delta u_1 + \frac{1}{2} m_1 (\Delta u_1)^2$$

Given:

$$W_1 = Fd$$

$$\Delta t_1 = \frac{m_1 . \Delta u_1}{F}$$

Then:

$$F = \frac{m_1 . \Delta u_1}{\Delta t_1}$$

$$W_1 = \Delta E_1 = m_1(V + u)\Delta u_1 + \frac{1}{2} m_1 (\Delta u_1)^2$$

$$\frac{m_1 . \Delta u_1}{\Delta t_1} d = m_1(V + u)\Delta u_1 + \frac{1}{2} m_1 (\Delta u_1)^2$$

$$\frac{\Delta u_1}{\Delta t_1} d = (V + u)\Delta u_1 + \frac{1}{2} (\Delta u_1)^2$$

$$\frac{\Delta u_1}{\Delta t_1} d - \frac{1}{2} (\Delta u_1)^2 = (V + u)\Delta u_1$$

$$\frac{d.\Delta u_1}{\Delta t_1} - u.\Delta u_1 - \frac{1}{2}(\Delta u_1)^2 = V.\Delta u_1$$

$$V = \frac{d}{\Delta t_1} - u - \frac{1}{2}\Delta u_1 \qquad Equation\ (13)$$

Plugging in values from earlier calculations:

$$V = \frac{0.1}{0.0009} - 10 - \frac{1}{2}0.45 \approx 100.89\ m/s$$

The approximate value because of approximate calculated value of Δt_1

Work done on m_2 from equation (6):

$$\Delta E_2 = -m_2(V-u)\Delta u_2 + \frac{1}{2}m_2(\Delta u_2)^2$$

But since energy can't be negative and the negative sign indicate the opposite direction only, then:

$$\Delta E_2 = m_2(V-u)\Delta u_2 + \frac{1}{2}m_2(\Delta u_2)^2$$

Given:

$$W_2 = Fd$$

$$\Delta t_2 = \frac{m_2.\Delta u_2}{F}$$

Then:

$$F = \frac{m_2.\Delta u_2}{\Delta t_2}$$

$$W_2 = \Delta E_2 = m_2(V-u)\Delta u_2 + \frac{1}{2}m_2(\Delta u_2)^2$$

$$V = \frac{d}{\Delta t_2} + u - \frac{1}{2}\Delta u_2 \qquad Equation\ (14)$$

Plugging in values from earlier calculations:

$$V = \frac{0.1}{0.0011} + 10 - \frac{1}{2} * 0.55 \approx 100.639\ m/s$$

The approximate value because of approximate calculated value of Δt_2

b. Concluding V using interaction time difference:

1. Measure interaction times (Δt_1, Δt_2) with accelerometers.
2. Compute asymmetry ratio:

$$\frac{\Delta t_2}{\Delta t_1} = \frac{V - u_2}{V + u_1}$$

Solve for V:

$$\Delta t_2(V + u_1) = \Delta t_1(V - u_2)$$

$$V\Delta t_2 + u_1\Delta t_2 = V\Delta t_1 - u_2\Delta t_1$$

$$V\Delta t_2 - V\Delta t_1 = -u_2\Delta t_1 - u_1\Delta t_2$$

$$V(\Delta t_2 - \Delta t_1) = -u_2\Delta t_1 - u_1\Delta t_2$$

$$V = \frac{-u_2\Delta t_1 - u_1\Delta t_2}{\Delta t_2 - \Delta t_1}$$

$$V = \frac{u_1\Delta t_2 + u_2\Delta t_1}{\Delta t_1 - \Delta t_2} \qquad Equation\ (15)$$

Plugging in values from earlier calculations:

$$V = \frac{10.45 * 0.0011 + 10.55 * 0.0009}{0.0009 - 0.0011} \approx -104.95\ m/s$$

The approximation of both values $\Delta t_1 and\ \Delta t_2$ decreased the margin of accuracy furthermore in this result.

Method Two: Analyzing Platform Change in Velocity ΔV:

Using interaction time duration difference

The **asymmetric impulses** on the rings cause a **net acceleration** of the platform:

- m_1's acceleration **decelerates the platform** (like a rocket exhausting forward).

- m_2's deceleration **accelerates the platform** (like a rocket exhausting backward).

From Newton's 3rd Law gives net impulse:

$$F(\Delta t_2 - \Delta t_1) = M\Delta V$$

Net effect: Platform velocity changes by:

$$\Delta V = \frac{F(\Delta t_2 - \Delta t_1)}{M} \qquad \text{Equation (16)}$$

$$\Delta V = \frac{500(0.0011 - 0.0009)}{100} = 0.001\, m/s$$

Since Δu_1 *and* Δu_2 are extremely small at expected high absolute velocities we approximate:

$$\Delta t_1 = \frac{d}{V+u} \text{ and } \Delta t_2 = \frac{d}{V-u}$$

Impulse on m_1:

$$J_1 = F\Delta t_1 = \frac{Fd}{V+u}$$

Impulse on m_2:

$$J_2 = F\Delta t_2 = \frac{Fd}{V-u}$$

Platform recoil:

$$M\Delta V = J_1 - J_2 = Fd\left(\frac{1}{V-u} - \frac{1}{V+u}\right)$$

Simplify the expression inside the parentheses:

$$\frac{1}{V-u} - \frac{1}{V+u} = \frac{(V+u)-(V-u)}{(V+u)(V-u)} = \frac{V+u-V-u}{(V^2-u^2)} = \frac{2u}{V^2-u^2}$$

$$\Delta V = \frac{Fd}{M} \cdot \frac{2u}{V^2-u^2}$$

Multiply both sides by $V^2 - u^2$

$$\Delta V(V^2 - u^2) = \frac{Fd}{M}.2u$$

$$\Delta V.V^2 - \Delta V.u^2 = \frac{2Fdu}{M}$$

$$\Delta V.V^2 = \frac{2Fdu}{M} + \Delta V.u^2$$

$$V^2 = \frac{1}{\Delta V}\left(\frac{2Fdu}{M} + \Delta V.u^2\right)$$

$$V^2 = \frac{2Fdu}{M\Delta V} + u^2$$

The platform concluded velocity from –recoil– acceleration in the direction of motion:

$$\boldsymbol{V = \sqrt{\frac{2Fdu}{M\Delta V} + u^2}} \qquad \textit{Equation } (17)$$

Or:

$$\boldsymbol{V = \sqrt{\frac{2Eu}{M\Delta V} + u^2}} \qquad \textit{Equation } (18)$$

Calculating absolute velocity for the platform:

$$V^2 = \frac{2 * 500 * 0.1 * 10}{100 * 0.001} + 10^2 = 10{,}100$$

$$V = \sqrt{10100} \approx 100.498\ m/s$$

Using heavy projectiles and high energy, then high precision measurement of platform's velocity change via accelerometer – interferometric velocimetry – will conclude the absolute velocity using this formula.

For most accurate results we should use relativistic impulse:

$$F\Delta t = \gamma m \Delta v$$

Experimental Confirmation:
For same setup at different absolute velocity we expect the following results:

- **Predicted signatures:**

- For V=1000 m/s:

  Δt_1=99 μs, Δt_2=101 μs

  Δu_1=0.0495 m/s, Δu_2=0.0505 m/s

  u_{1f}=1010.0495 m/s, u_{2f}=989.9495 m/s

- For V=400 km/s:

  Δt_1=0.24999 μs, Δt_2=0.25001 μs (difference of 20 picoseconds)

  Δu_1=0.0001250 m/s, Δu_2=0.0001249 m/s

Limitations of this setup:

Due to the small differences in measurements at high absolute velocities, we turn to using beams of particles or subatomic particles instead of macroscopic masses as projectiles. Given that Earth's drifting velocity is expected to be around 370 km/s, we can achieve greater contrast in velocities by employing electron or ion beams as projectiles.

In this setup, after splitting the beam in opposite directions, each beam is focused to pass through an aperture in a plate—replacing the ring-shaped electromagnet from the mechanical version. As the beam begins to pass through the aperture, a negative constant current with high voltage is applied to both plates simultaneously to repel each beam further in its direction of motion. Detectors placed at fixed distances on both sides will measure the beams' relative velocities, making the differences measurable and distinct.

Optionally, each beam can be focused through a gas chamber, where the rear beam with higher velocity should produce shorter wavelength emissions upon ionizing the gas—emissions that should not appear in the front chamber.

Owing to the difference in each setup, the experiment has dual designs, the mechanical (macroscopic) and electric (microscopic) setups cater to different velocity regimes, improving detectability. The electron/ion beam version is particularly promising for high-precision measurements.

Why This Works

- **Energy-time duality:** Absolute motion V skews the energy cost of acceleration/deceleration, forcing unequal Δt for equal "u" in the platform frame.
- **Magnetic force as a "ruler":** Fixed F ensures Δt differences directly encode V.

- **No relativistic effects needed:** Pure classical work-energy asymmetry suffices.

Conclusion

By measuring the **interaction time asymmetry** ($\Delta t_1 \neq \Delta t_2$) while observing a**symmetrical relative velocities changes in m_1 and m_2** in the platform frame, this experiment:

1. **Reveals absolute motion** (V).
2. **Operates at non-relativistic speeds** (testable with existing tech).
3. **Provides a direct laboratory test** of frame-dependent energy conservation.

Alternative Mathematical Method to Conclude Δu_1 and Δu_2:

We also can calculate the change in projectiles velocity after interaction with the linear accelerator using the following method.

Since adding the same amount of energy to two projectiles moving at different absolute speeds results in different velocity changes.

The kinetic energy of a mass m moving at speed v is:

$$KE = \frac{1}{2}mv^2$$

After adding a fixed amount of energy ΔKE to the object, its new velocity is:

$$KE_f = KE_i + \Delta KE = \frac{1}{2}mv_i^2 + \Delta KE \rightarrow$$

$$\frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 + \Delta KE$$

$$mv_f^2 = mv_i^2 + 2\Delta KE$$

$$v_f^2 = v_i^2 + \frac{2\Delta KE}{m}$$

$$v_f = \sqrt{v_i^2 + \frac{2\Delta KE}{m}}$$

After interaction with the linear magnetic accelerator:

$$\Delta v = v_f - v_i = \sqrt{v_i^2 + \frac{2\Delta KE}{m}} - v_i \quad Equation\ (19)$$

As we notice, this is nonlinear formula → same ΔKE → different Δv at different v_i

In practical scenario $\Delta KE \ll \frac{1}{2}mv_i^2$, then $\frac{2\Delta KE}{m} << v_i^2$ and we can use binomial expansion:

$$\sqrt{v_i^2 + \frac{2\Delta KE}{m}} = v_i\sqrt{1 + \frac{2\Delta KE}{mv_i^2}} \approx v_i\left[1 + \frac{1}{2}.\frac{2\Delta KE}{mv_i^2}\right]$$

$$v_f = v_i + \frac{\Delta KE}{mv_i} \rightarrow$$

$$\Delta v \approx \frac{\Delta KE}{mv_i} \quad Equation\ (20)$$

This equation shows that:

- The velocity change Δv depends on the initial speed v_i .
- Because of the square root, Δv decreases as v_i increases, even if ΔKE and m are constant.

In simple terms:

The faster something is already moving, the less its speed increases for a given energy input.

This is purely a result of KE$\propto v^2$ — it's not relativistic, it's classical Newtonian mechanics.

Applying the formula on the projectiles:

- m= 1 kg
- ΔKE=50 J
- $\frac{2\Delta KE}{m} = 100\ m^2/s^2$

For forward projectile $\mathbf{m_1}$ where $u_{i\_1} = 110\ m/s$:

$$\Delta u_1 = \sqrt{110^2 + 100} - 110 = 0.4536\ m/s$$

For forward projectile $\mathbf{m_1}$ where $u_{i\_2} = 90\ m/s$

$$\Delta u_2 = \sqrt{90^2 + 100} - 90 = 0.5538\ m/s$$

$$Anisotropy = \Delta u_2 - \Delta u_1 = 0.5538 - 0.4536 = 0.1002\ m/s$$

This formula assumes we know the absolute velocity and that's why it's not useful, but it calculates the exact anisotropy we seek to prove. It explains why the asymmetry exists: because kinetic energy is quadratic in velocity, so equal energy inputs produce unequal velocity changes depending on initial speed.

Key takeaway:

- The same energy input produces a larger velocity change at low speeds and a smaller change at high speeds.
- This creates a measurable asymmetry in mechanical systems with absolute motion.
- In the Orontes Experiment, this helps explain why the backward-moving projectile gains more relative speed — and why this can be used to detect absolute motion.