The Kinetic Energy (K.E.) in Terms of Linear Momentum in Physics: Introducing the Supradip's Ener-mentum Factor — With Detailed Discussion and Significance

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Abstract : In Physics, the terms – Kinetic energy (K.E. or sometimes as K simply) and linear momentum (p) is very useful and significant. This entire RESEARCH work in Physics, done 'Fully SOLO' by the author — Supradip Das Dalal. It is achieved within a record-making few HOURS timeframe (which is obviously less than a day and actually it is even less than 3 to 3.5 hours also). Supradip executed this thing in so little time with his rigorous hard work, never give up mindset, a little bit smart work, discipline and dedication. It presents a Formulated analytical perspective on this fundamental relation by introducing The Supradip's Ener-mentum Factor (S_p) which relates the KINETIC ENERGY with the MOMENTUM. The step-by-step mathematical derivation, dimensional analysis, significance of S_p , and detailed discussion are clearly & comprehensively presented here.

Keywords in this research:
Kinetic Energy, Linear Momentum, Supradip's Ener-mentum Factor S_p ,
Supradip Das Dalal factor in Kinetic energy & momentum , Physics , Dimensional Analysis, Fully SOLO, done within few hours, record making outstanding dedication, Factor, detailed discussion, significance

Introduction :
In PHYSICS, linear momentum and kinetic energy are two important parameters used to describe the dynamical state of a system. While Kinetic energy and linear momentum have their own formulas , it also can be bridged where the term relating the kinetic energy and the momentum can be found. In this research, I , Supradip Das Dalal , introduced a new factor which will be known as - The Supradip's Ener-mentum Factor (S_p) [the factor to relate the momentum with the mass and in other way to broadly relate the kinetic energy with the momentum that is why it will be known as Ener-mentum , i.e. , Energy Momentum , or generally to say , the kinetic energy and Momentum]. So this things will be at discussed in this research, which Supradip has done Fully SOLO within just a few hours which is approximately 3 to 3.5 hours. Supradip Das Dalal is Young Researcher. In this research the kinetic energy and the linear momentum will be here. Ok!!

Literature Review:
The relationship between work, motion, and inertia has long been a cornerstone of Physics. Historically, the concept of vis viva (living force) was discussed , which later evolved into modern kinetic energy structure (K.E. = (1/2) m v^2) through the formalization of the work-energy theorem. In parallel, the "quantity of motion" — known today as linear momentum (p = mv) — governed strictly by conservation laws in isolated systems.
So these establishes the conventional algebraic link between these two foundational quantities as :
K.E. = (p^2) / 2m
The Prior literature focuses primarily on solving recoil and scattering problems by substituting velocity directly.
There remains a pedagogical and analytical opportunity to decouple this quadratic relation into a direct linear product of momentum and a characteristic velocity-dependent scale. This research addresses that exact space by isolating the part (p/2m) as an independent analytical parameter or factor — The Supradip's Ener-mentum FACTOR (S_p) — providing a clean, direct bridge between The Kinetic energy and the Momentum (K.E. = p × S_p) in Physics.

Objectives:
The primary OBJECTIVES of this research are given below: -
Formalize the Factor: Mathematically define and INTRODUCE The Supradip's Ener-mentum Factor (S_p) as an independent parameter or factor linking kinetic energy (K or K.E.) and linear momentum (p).

Perform Dimensional Analysis: Verify the dimensional consistency of S_p and establish its physical correspondence to instantaneous velocity (v/2).
Linearize Kinetic Energy: Formulate the standard quadratic relation (K.E. = (p^2) / 2m) into this : K.E. = p × S_p
Analyze Equal-Momentum Dynamics: Demonstrate via comparative derivation and numerical analysis with a few examples (if possible) why lighter bodies retain a larger share of kinetic energy when the momentum is conserved. Ok!! (Also I will try to show or visualize the things with a few images if possible)

System description & assumptions:
System Description —
The system consists of classical bodies with its mass (m) undergoing a motion at the velocity (v).
Core Assumptions —
The total mass will not vary, and will stay constant
Those distortion, or rotations type of those problems, and thermal dissipations etc. are neglected here.
Friction, air drag etc. are taken as zero during momentum evaluation for ease.
These are the things that have to be assumed here for it.

Theory & Derivations:
Fundamental Definitions
Linear Momentum (p): Linear momentum is a measure of how much motion a moving object has, calculated by multiplying its mass by its velocity.
In everyday terms, it is the combination of how heavy an object is and how fast it is moving. The measure of the quantity of motion in a moving body.
Formula: p = m × v
SI Unit: kg × m/s
Dimension: [M L T^(-1)]

Kinetic Energy (K.E. or sometimes as just K): It is simply the ENERGY of motion. Any object that is moving has kinetic energy. The work capacity possessed by a body due to its translational velocity.
Formula: K.E. = 1/2 ×(mv^2)
SI Unit: Joule (J)
Dimension: [M L^2 T^(-2)]

Derivation —
*From the definition of momentum, express velocity v in terms of p: p = m×v
So => it can be said that: v = p/m
Substituting this expression into the kinetic energy equation:
The Kinetic Energy: K.E. = 1/2 × (mv^2)

So — K.E. = 1/2 × m × (p/m)^2
After Canceling one factor of mass (m) gives here: K.E. = (p^2) / 2m

Here , introducing the new factor in the field of Physics to make the things easy and the formula a little bit simpler. It is known as —
The Supradip's Ener-mentum FACTOR (S_p)

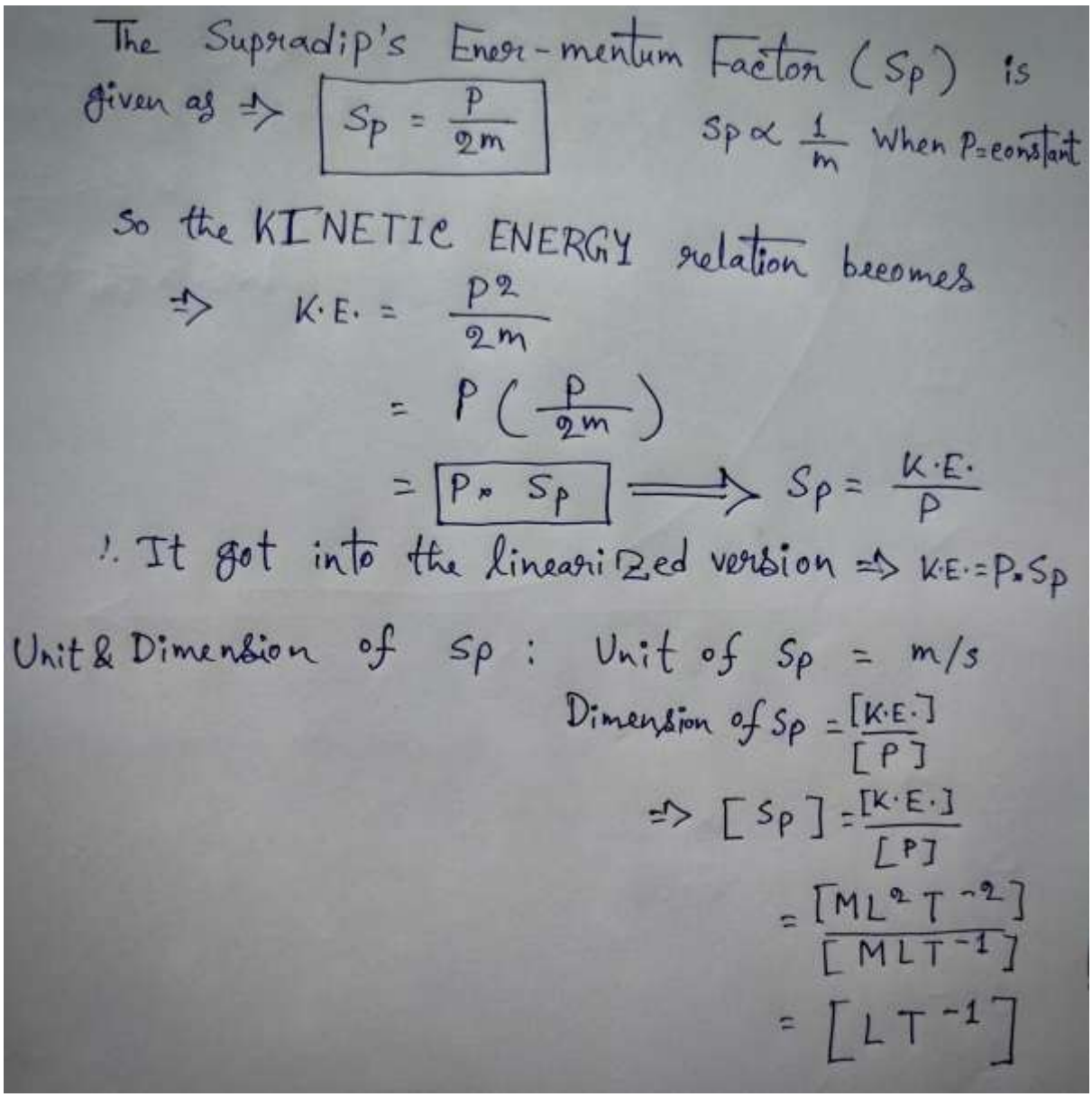
It can be found by doing =>
K.E. = (p^2) / 2m
By grouping it and the classical energy-momentum expression by separating out momentum p and after further calculation, it becomes —
K.E. = p × (p/2m)

Here the (p/2m) is known as S_p , i.e. , The The Supradip's Ener-mentum FACTOR (S_p) [The factor to relate the momentum with the mass and in other way to broadly relate the kinetic energy with the momentum that is why it will be known as Ener-mentum , i.e. , Energy Momentum , or generally to say , the kinetic energy and Momentum] And it is given as :
S_p , that is, S which means Supradip with its subscript as p which means momentum
So — S_p = p/2m

So The hence becomes:
K.E. = p × (S_p)
So it is the linearized energy equation that is found here.
Energy-Momentum Ratio Form in a clean way:
Doing Rearranging gives the primary defining relation: S_p = (K.E.) / p
It signifies the meaning of the term 'Ener-mentum' — Energy and Momentum as it already got established in the form of Supradip's Ener-mentum FACTOR (S_p) in this equation after re-arrangement here.

So ladies and gentlemen, here is the actual Definition of —
The Supradip's Ener-mentum Factor :
1) Supradip's Ener-mentum Factor (S_p) is defined as the direct ratio of an object's translational kinetic energy (K) to its instantaneous linear momentum (p). Physically, it represents the energy content carried per unit of momentum, corresponding directly to half the instantaneous linear velocity (v/2) of the body.
2) When a body possesses unit linear momentum (p = 1 kg × m/s in S.I. unit), the factor simplifies strictly to: S_p = 1/(2m)
Under this condition, Supradip's Ener-mentum Factor (S_p) is DEFINED as the reciprocal of twice the mass of the body. It quantifies the kinetic energy acquired by a system per unit momentum in inverse proportion to its total inertia.

*Physical Dimensional Verification/analysis:
[S_p] = [K.E.] / [p]
= [M L^2 T^(-2)] / [M L T^(-1)]
= [L T^(-1)]



And now the photo where — Supradip Das Dalal VISUALIZING the Research fully SOLO with Slingshot (Gulti) & Rock (Stone) :



Images (Ok Done)

Methodology :

The systematic procedure to evaluate the dynamical state, calculate the classical kinetic energy, and determine The Supradip's Ener-mentum Factor (S_p) in Physics , follows these methodology steps:

Identify System Parameters: Record the total mass and instantaneous linear velocity of the moving body.

Compute Linear Momentum: Calculate the linear momentum using $p = m \times v$

Evaluate Supradip's Ener-mentum Factor (S_p): Determine S_p or sometimes can be also said as — Sp using either direct route OK:

Route A (Inertial Route): $S_p = p/2m$

Route B (Velocity Route): S_p = v/2
Calculate Kinetic Energy (K.E. or K or whatever it be said): Compute translational kinetic energy via the linearized product: K.E. = p×(S_p)
Cross-Verify with Classical Formulation: Confirm the result by verifying with the form: K.E. = (p^2) / 2m — to make sure that the numerical value or the final result came out to be CORRECT.
MULTI-BODY Parametric Comparison: For two bodies of masses m_1 and m_2 sharing equal momentum (p), the ratio between obtained as follows:
K1 : K2 = (S_p)1 : (S_p)2 = m2 : m1

It is a very important Ratio introduced through The Supradip's Ener-mentum Factor (S_p or sometimes it can also be: Sp for ease)

Ok so now the Image where — Supradip Das Dalal (Mr. S.D.D.) Visualizing all about his research while showing thumbs up in an amazing style also :



Examples:

Example 1: Direct Calculation of Kinetic Energy through S_p

Question: A sports ball of mass m = 0.5 kg is moving with a velocity v = 20 m/s. Find its linear momentum (p), Supradip's Ener-mentum Factor (S_p), and its kinetic energy (K.E.)?

Answer => The linear momentum will be : Linear Momentum (p) = m×v = 0.5×20 = 10 kg × (m/s)

So, the Supradip's Ener-mentum Factor (S_p) will be: The Supradip's Ener-mentum FACTOR (S_p) = p/(2m) = 10/ (2×0.5) = 10/1 = 10 m/s
(Doing Cross check : S_p = v/2 = 20/2 = 10 m/s : Correctly matches)
So, the Kinetic Energy will be : Kinetic energy (K.E.) = p×(S_p) = 10×10 = 100 J
(Done Ok!!)

Example 2: Comparing Two Bodies with Equal Momentum
Question: A light cart of mass m_1 = 2 kg and a heavy cart of mass m_2 = 8 kg have the same linear momentum of p = 40 kg×(m/s). Using S_p, find their KINETIC ENERGIES and their Energy ratio here?
Answer => Find S_p for both bodies:
Body 1: (S_p)1 = p/ (2 m_1) = 40 / (2×2) = 40/4 = 10 m/s
Body 2: (S_p)2 = p/ (2 m_2) = 40/(2×8) = 40/16 = 2.5 m/s
Compute Kinetic Energies
(K.E. = p × S_p):
(K.E.)1 = 40×10 = 400 J
(K.E.)2 = 40×(2.5) = 100 J
Energy Ratio via S_p:
(K.E.)1 : (K.E.)2 = (S_p)1 : (S_p)2 = 10/2.5 = 4
(Matches the inverse mass ratio correctly here :
m_1 : m_2 = 8/2 = 4)
(Done Ok!!)

Dataset :
The detailed data set given below, where the things are there, perfectly Ok:

—: Data Set :—

Serial no./Scenario	Mass (m)	Velocity (v)	Momentum (P=mv)	Supradip's Ener-mentum Factor $S_p = \frac{P}{2m}$	Kinetic Energy K.E. = P.Sp	Standard check $K.E. = \frac{P^2}{2m}$
1. Fast bullet	0.01	400	4	200	800	800
2. Cricket ball	0.16	30	4.8	15	72	72
3. Football kick	0.45	24	10.8	12	129.6	129.6
4. Supradip's slingshot gulti	0.5	20	10	10	100	100 (same as well)
5. Sprinter	60	10	600	5	3000	3000
6. Heavy sled	100	4	400	2	800	800
7. Small car	800	20	16000	10	160000	160000
8. Loaded truck	5000	12	60000	6	360000	360000

Detailed Discussion :

The mathematical derivation and DATASET analysis highlight several fundamental dynamic behaviors that emerge when examining KINETIC ENERGY through the Perspective of Supradip's Ener-mentum Factor (S_p).

Inversion Dynamics Under Constant Momentum: -

When an isolated system conserves linear momentum (p = constant), it establishes that kinetic energy is inversely proportional to mass:

K.E. = (p^2) / (2m)

K.E. — is inversely proportional to — m

(At p = constant) , so the graph will be rectangular hyperbola here actually.

Examining the definition of Supradip's Ener-mentum Factor / Parameter (S_p) under the same condition reveals an identical structural dependence:

S_p = p/(2m)

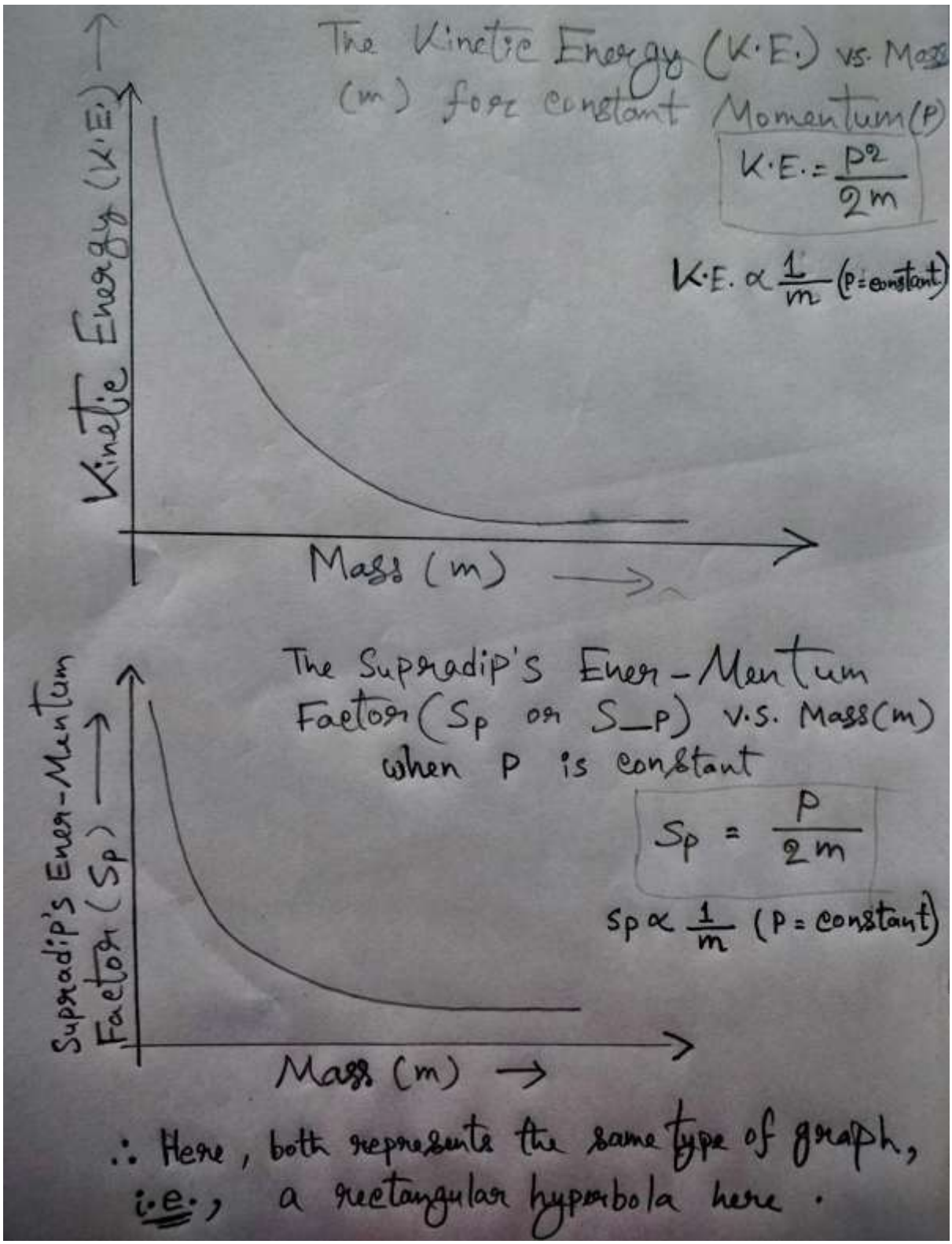
When p = constant, then :

S_p — is inversely proportional to — m

So the graph will be rectangular hyperbola here actually.

Because both K.E. and S_p scale strictly as m^(-1) under fixed momentum, the factor S_p directly mirrors the energy distribution of the system. In any momentum-symmetric event (such as firearm recoil or explosive fragmentation), the body with smaller inertia inherently develops both a larger Ener-mentum Factor and a proportionally greater share of total kinetic energy:

K1 : K2 = (S_p)1 : (S_p)2 = m2 : m1



Linearization of Classical Work Capacity:
By introducing the S_p factor, the expression of Kinetic energy (K.E. = p^2 / 2m) transforms into a clean bilinear product:
K.E. = p×S_p
Here, linear momentum (p) represents the inertial dynamic flux of the body, while S_p serves as the characteristic kinematic scaling factor (v/2). This decouples the quadratic dependence into two readily measurable physical components without losing mathematical rigor here.

Comparison of Dynamic States:

The thing can be further done with various possibilities like — When mass is constant (m = constant) then K.E. is directly grows quadratically and that's why it becomes directly proportional to (v^2) where S_p becomes directly proportional to v and the p is also directly proportional to v here....

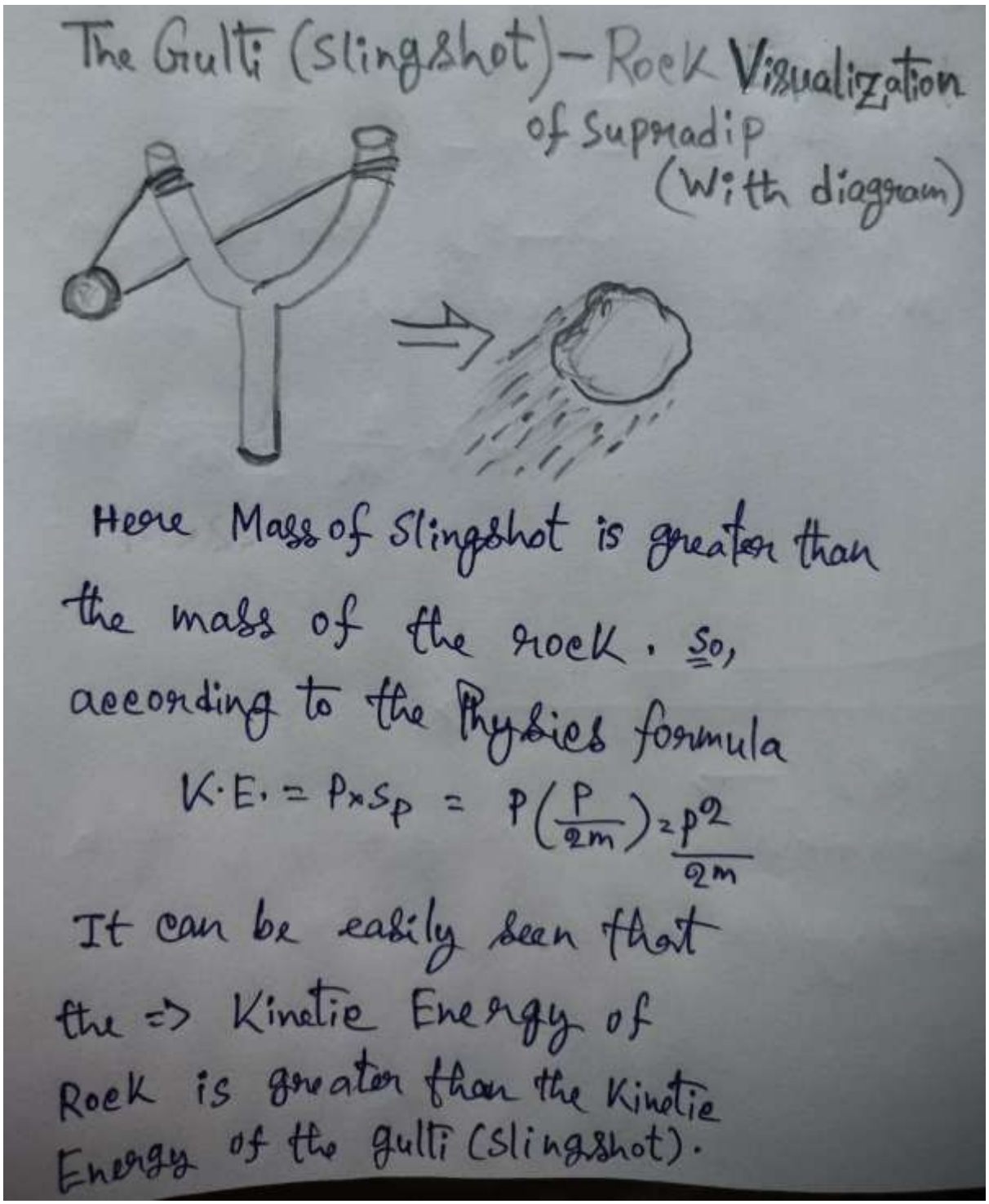
When velocity is constant (v = constant) Then K.E. is directly proportional to p here while the S_p parameter is constant in this case ....

When Momentum has unit value (p = 1 kg × (m/s)), The factor reduces strictly to — S_p = 1/(2m) , functioning as an intrinsic inertial reciprocal property of the chosen mass.

Logical interpretation here:

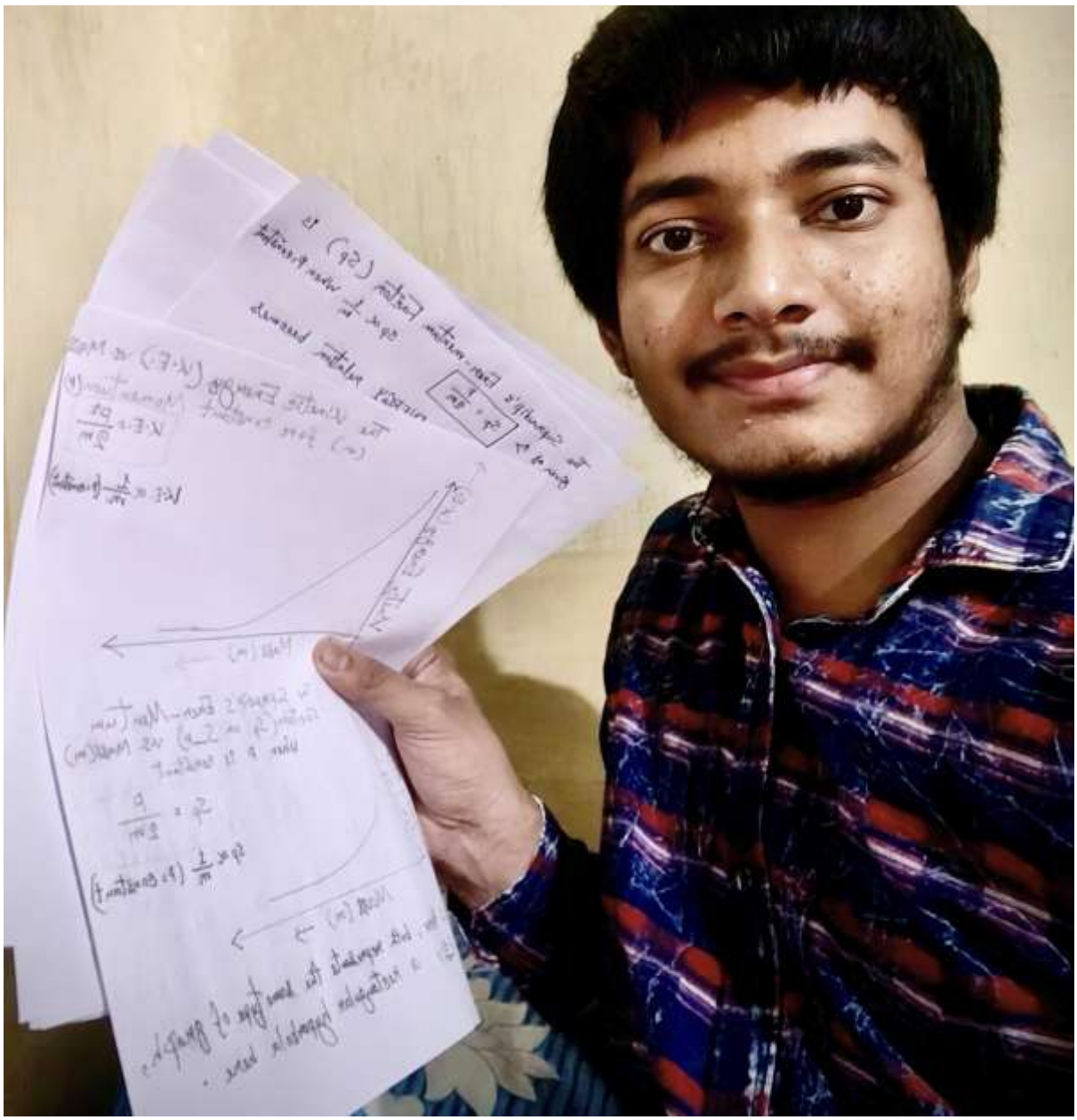
If a slingshot (Gulti) and a rock /stone is taken where the slingshot has greater mass. So according to the formula of The Supradip's Ener-mentum FACTOR: S_p = p/(2m) , it becomes: the S_p Factor of The Rock/stone is greater than that of the slingshot.

From the kinetic energy and the Supradip's Ener-mentum FACTOR ratio form: K1 : K2 = (S_p)1 : (S_p)2 = m2 : m1



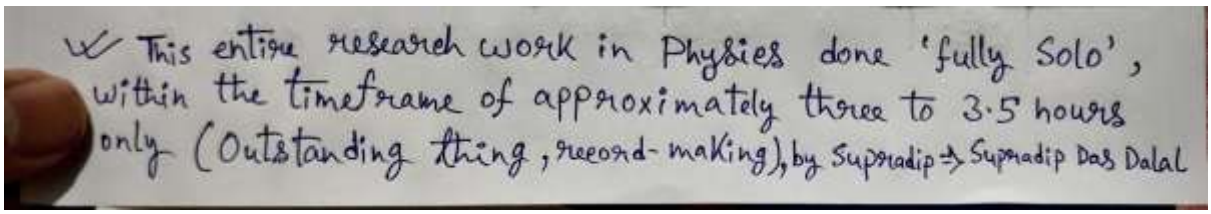
The thing can be said that the body with greater S_p factor here will be the body is the greater kinetic energy logically. So the kinetic energy of the Rock/ Stone will be greater than the Kinetic energy of the Slingshot (Gulti) here. [This visualization is also presented in the form of image and this text is kind of , about that visualization image of: 'The Gulti (Slingshot) — Rock (Stone) Visualization of Supradip (with diagram)' ok]

Ok so now the Image where — Supradip Das Dalal holding his Physics research notes , which significantly shows that he done all these research things FULLY SOLO :



Significance of This:
Linearizes Energy Calculations: Replaces the standard quadratic formula with a direct, single-step multiplication K.E. = p×S_p
Direct Kinematic Link: Explicitly identifies the KineticEnergy-to-momentum ratio as half of the instantaneous velocity (S_p = v/2)
Clarifies Kinetic Energy the Best: Clarifies immediately why lighter bodies deal with the majority of kinetic energy when momentum is conserved.
Overall Pedagogical Clarity: Serves as a transparent teaching tool for students and educators bridging many laws to the work-energy theorem. It is an important Significance here.
Establishes reciprocal thing: It establishes an intrinsic baseline property of mass when evaluated at unit momentum (S_p = 1/2m).

*This entire research in Physics is — Executed 'Fully SOLO' within a rapid record-making 3-to-3.5-hour timeframe approximately, this paper provides a clean, pedagogically, and overall valuable formulation for Physics.



Conclusion:
This research successfully establishes an analytical bridge between linear momentum (p) and kinetic energy (K.E.) through the introduction of Supradip's Ener-mentum Factor S_p = p/2m = K.E. /p . Dimensional analysis confirms that S_p carries the units of velocity (m/s), corresponding directly to half the instantaneous speed of the moving body (v/2). By linearizing the classical quadratic relation into K.E. = p×S_p , the framework simplifies energy calculations and demonstrates that under constant momentum, both K and S_p are strictly inversely proportional to mass (m^(-1)). Executed 'Fully SOLO' within a rapid 3-to-3.5-hour timeframe approximately, this paper provides a clean, pedagogically, and overall valuable formulation for Physics.

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Serway, R. A., & Jewett, J. W.
Physics
Supradip Das Dalal, Supradip's Research notes and solo derivation documentation on The Supradip's Ener-mentum Factor (S_p = p/2m) , maybe etc.

About this Solo Research work and time taken (Outstanding Record) — SDD's feedback here:
This entire 'fully Physics research' work was conceptualized, derived, verified, and formally written FULLY SOLO by the author - Supradip Das Dalal (SDD), working completely independently without co-authorship or institutional collaboration.

This total thing , full research work approximately took very little time which is record making here — Physics Research Total-time approximately taken record-making timeframe SDD: -
Links are given also: –
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