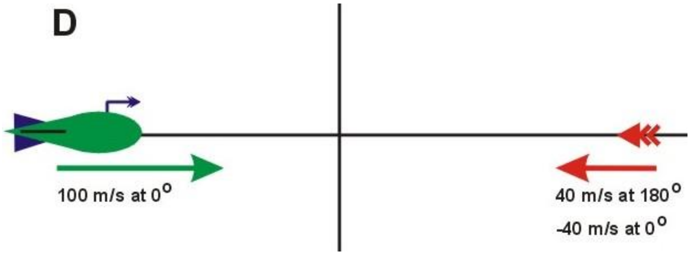
Relative-Motion Test for Unit Reliability



2. Puzzling the Unreliability of Joules KE as a Scientific Unit

Professor Du-Ane Du

www.Wacky1301SCI.com, *"Looking at serious science, sideways!"*

> The second of three puzzle sets that use relative motion to deduce which units are not reliable for scientific comparisons: (1) the reliability of *m*, *s*, *m/s*, **(2) the unreliability of joules of kinetic energy**, (3) the reliability of ρ [*kgm/s*] of impulse and momentum. (1st month of a physics class.)
> —By Du-Ane Du, Author of *Murdered Energy Mysteries*, (Amazon, Kindle, ebook 2018, paperback 2021).

In the mid 1800's James Prescott Joule proposed that all known forms of energy were mathematically equivalent. Joule and his contemporaries focused on standard-linearized forms of energy such as heat-energy, chemical-energy, and electric-energy. They were able to demonstrate that standard-linearized forms of energy are indeed equivalent to one another.

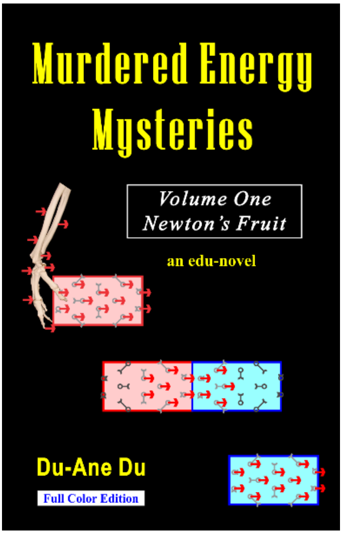
However, work done often involves non-standard multi-linear joules, and kinetic energy involves non-standard multi-parabolic joules. No scientist has ever successfully demonstrated that multi-parabolic joules and multi-linear joules are mathematically equivalent to standard-linearized joules.

Before the law of conservation for energy can be considered completely valid, the units of joules KE and joules Work Done must first pass the parallax/relative-motion test for unit reliability. (See Relativity Puzzle #1, "Puzzling the Reliability of *m*, *s*, and *m/s* as Scientific Units", and Relativity Puzzle #3, "Puzzling the Reliability of ρ, [*kgm/s*] as Scientific Unit", www.Wacky1301SCI.com)

Parallax/Relative-Motion Test of Joules KE Reliability

Before starting, we should note that this puzzle set will focus exclusively on joules of kinetic energy. Joules of heat-energy and joules of work-done have different mathematical characteristics from those of kinetic energy. Therefore any conclusions reached will apply only to joules of KE. (The relativity concepts used in this puzzle set are appropriate for the first month of a physics class.)

Our exploration of joules of kinetic energy begins with two astronauts named Stan Stationary and Nancy Nearing. Stan is standing on a motionless asteroid located deep in space. Nancy will approach Stan's asteroid at a variety of velocities. Stan Stationary will place C-11 rocket engines into a variety of toy rockets, and he will launch the rockets at a variety of angles. The challenge for us will be to calculate the rocket's KE-gain as measured from the perspective of Nancy's Doppler laser.



According to the manufacturer, the C-11 engine has an impulse rating of 10 ρ, or 10 kgm/s, which means each rocket should always gain 10 ρ of momentum for each engine burned. According to the rules of the parallax/relative-motion test, Nancy's calculation of the kinetic energy provided by the engine must match a

Symbols

$im\Delta\rho$ – impulse

$10\ \rho = 10$ kgm/s

$10\ \rho = 10$ N*s

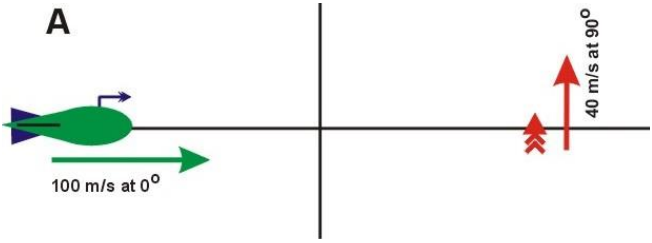
$5\ \rho/\mathrm{s} = 5$ N

fixed range, as establish from Stan's perspective. (See Relativity Puzzle #1, "Puzzling the Reliability of Velocity Units.") If the value is outside the established range, then kinetic energy is being "created", and the unit of *joules* or *J* is invalid for scientific comparisons. (KE-joules values can have situational uses that do not involve comparisons.)

It is important to understand that these puzzles are an indirect proof. *According to the rules of indirect proofs, if Nancy has one single result outside Stan's parallax range, then the theoretical conservation laws for kinetic energy and work energy are situational, not universal.*

Moreover, when the rocket is launched at 0 degrees and 180 degrees, the full width of the range must always be the same as Stan's stationary range. If the moving range ever grows or shrinks, then the *joules* or *J* units for kinetic energy and work energy are unreliable--they should not be used for scientific comparisons, and the proposed universal law of conservation for energy must be situational only. (Note, finding that the universal law of energy conservation is false for kinetic energy does not nullify the fact that standard-linearized heat-energy, chemical-energy, electric-energy, and light-energy are all conserved. See related articles at www.Wacky1301SCI.com)

Scenario 1A: Nancy Nearing's Doppler laser beam will serve as the X-axis of our reference graph. Nancy is gliding toward Stan Stationary's asteroid at a velocity of 100 m/s at 0°. Nancy's Doppler laser is pointed so that Stan is "south" of the laser-beam. Stan places a C-11 engine in a rocket and aims it at an angle of 90°. Stan radios Nancy and tells her the rocket has a mass of 0.25 kg. As Stan launches the rocket, what will Nancy record as the KE gain caused by the toy rocket's engine?



To solve the puzzle, we first note that Nancy Nearing is approaching Stan Stationary's asteroid at a velocity of 100 m/s, which means Nancy perceives Stan's toy rocket as having a starting velocity of –100 m/s. In other words, Nancy thinks Stan and the toy rocket are approaching her. (Note that because Stan is on a stationary asteroid, the starting velocity of the toy rocket before each launch will always be –100 m/s).

Next, we use the Newton's-first-law equation to calculate the final velocity of the toy rocket, and the rocket's parallax range as seen from Stan Stationary's perspective:

$$mv_{final} = mv_{initial} + im\Delta\rho$$

$$(0.25\ kg)v_{final} = (0.25\ kg)\left(0\frac{m}{s}\right) + \ 10\ kg\frac{m}{s}$$

$$(0.25\ kg)v_{final} = 10\ kg\frac{m}{s}$$

launch velocity = 40 m/s at 90 degrees

$$Parallax\ KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$KE = \frac{1}{2}(0.25\ kg)(40\ \frac{m}{s})^2 - \frac{1}{2}(0.25\ kg)\left(0\ \frac{m}{s}\right)^2$$

Parallax KE = ±200 J, or ±200 kgm²/s²

Nancy's Doppler laser can only measure the X-component of the toy rocket's motion. We can use the cosine equation to calculate the X-component of the rocket's forward velocity:

$$X\text{-}component = M_{Resultant} \times cos(\emptyset)$$

$$X\text{-}component = (40.0\frac{m}{s})cos(90°)$$

X-component = 0 m/s, rightward

Nancy is traveling +100 m/s at 0°, so her Doppler laser will record the rocket's velocity as:

rocket's net velocity = (Rocket-X) – (Nancy Nearing)

$$rocket\ velocity = (0\frac{m}{s}) - (+100\frac{m}{s})$$

rocket velocity = –100 m/s, or 100 m/s moving closer

Finally, we can calculate the kinetic-energy gain produced by the toy engine as seen from Nancy's perspective:

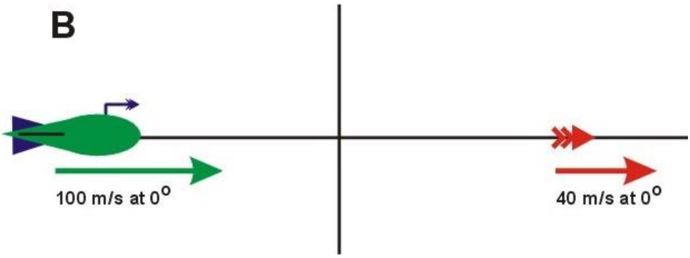
$$\Delta KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$\Delta KE = \frac{1}{2}(0.25\ kg)(-100\ \frac{m}{s})^2 - \frac{1}{2}(0.25\ kg)\left(-100\ \frac{m}{s}\right)^2$$

$\Delta KE = 0\ J$, or $0\ kgm^2/s^2$

This value is within the parallax range of ±200 J.

Scenario 1B: Nancy continues to approach at a speed of 100 m/s. Stan Stationary rotates the launch pad so the next rocket is launched at an angle of 0° relative to the Nancy's laser-beam.



Based on our earlier calculations, we know that Stan's toy rocket will have a final velocity of 40 m/s at 0° and a parallax range of ±200 J. The rocket is flying rightward along the X-axis, therefore the X-component of the velocity will have a magnitude of 40 m/s.

Next, we calculate the final velocity as detected by Nancy's Doppler laser:

$$rocket's\ net\ velocity = (Rocket\text{-}X) - (Nancy\ Nearing)$$

$$rocket\ velocity = (+40\frac{m}{s}) - (+100\frac{m}{s})$$

rocket velocity = –60 m/s, or 60 m/s moving closer

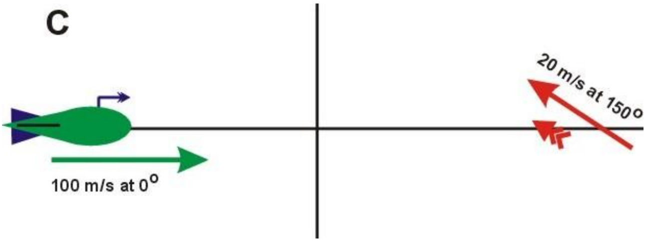
Notice that Nancy perceives the rocket as moving closer, even though the rocket is moving rightward to our perspective. Now we can calculate the kinetic-energy gain, or work energy, as seen from Nancy's perspective:

$$\Delta KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$\Delta KE = \frac{1}{2}(0.25\ kg)(-60\ \frac{m}{s})^2 - \frac{1}{2}(0.25\ kg)(-100\ \frac{m}{s})^2$$

$$\Delta KE = 800\ J$$

Scenario 1C: Now Stan Stationary rotates the next rocket so it launches at an angle of 150°.



As before, Nancy's Doppler laser can only measure the X-component of the rocket's velocity. The rocket has a final forward velocity of 40 m/s at 150°, and the cosine equation will give us an X-component of:

$$X\text{-component} = M_{Resultant} \times cos(\emptyset)$$

$$X\text{-component} = (40.0\frac{m}{s})cos(150°)$$

X-component = –34.64 m/s

Next, we calculate the toy rocket's final velocity as detected by Nancy's Doppler laser:

rocket's net velocity = (Rocket-X) – (Nancy Nearing)

$$\text{rocket velocity} = (-34.64\frac{m}{s}) - (+100\frac{m}{s})$$

rocket velocity = –134.64 m/s, or 134.64 m/s moving closer

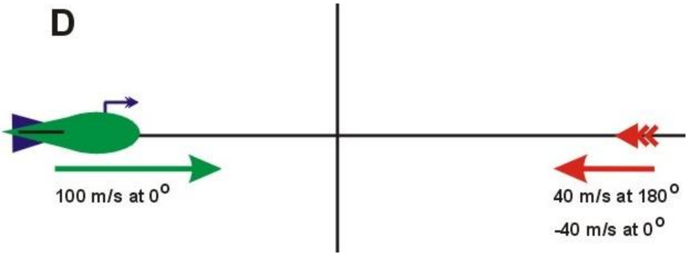
Finally, we calculate the kinetic-energy gain as seen from Nancy Nearing's perspective:

$$\Delta KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$\Delta KE = \frac{1}{2}(0.25\ kg)(-134\ \frac{m}{s})^2 - \frac{1}{2}(0.25\ kg)(-100\ \frac{m}{s})^2$$

ΔKE = 1016 J

Scenario 1D: Stan Stationary rotates the launch pad so his next 0.25 kg rocket is launched at an angle of 180°.



Remember that a final velocity of 40 m/s at 180° is the same thing as –40 m/s at 0°. Once again, the toy rocket is flying along the X-axis. This means the X-component of the rocket's velocity is –40 m/s.

Our calculations for the toy rocket's final velocity as detected by Nancy's Doppler laser are:

$$\text{rocket's net velocity} = (\text{Rocket-X}) - (\text{Nancy Nearing})$$

$$\text{rocket velocity} = \left(-40\,\frac{m}{s}\right) - \left(+100\,\frac{m}{s}\right)$$

$$\textbf{rocket velocity = –140 m/s, or 140 m/s moving closer}$$

Now we can calculate the kinetic-energy gain from Nancy Nearing's perspective:

$$\Delta KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$\Delta KE = \frac{1}{2}(0.25\;kg)\left(-140\;\frac{m}{s}\right)^2 - \frac{1}{2}(0.25\;kg)\left(-100\;\frac{m}{s}\right)^2$$

$$\Delta KE = 1200\ J$$

Comparison with Stan's Parallax Range

The manufacturer of the C-11 rocket engine designed it to produce an impulse/momentum-gain of 10 ρ. This measurement is not a vector, and it is not a predictor of kinetic-energy gain.

Fuel stores impulse, and engines produce impulse. According to the "Six Duality Laws for Momentum-Energy" (see articles at www.Wacky1301SCI.com), kinetic energy and work energy are "speedy impulse." And speedy-impulse is: (average velocity)(impulse).

As the impulse is released from the fuel, the rocket begins to move, and it "acquires" or "creates" kinetic energy, in accordance with the equation:

$$\Delta KE = (\frac{v_2+v_1}{2})(im\Delta\rho)$$

This "creation" of kinetic energy is directly related to the average velocity of the rocket during the fuel burn. The faster the velocity, the quicker the rocket "creates" kinetic energy.

With that in mind, the parallax range for each experiment must be based on the average velocity as seen from the stationary observer (Stan). Stan's measure of the kinetic-energy gain was:

$$Parallax\ KE = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$KE = \frac{1}{2}(0.25\ kg)(40\ \frac{m}{s})^2 - \frac{1}{2}(0.25\ kg)\left(0\ \frac{m}{s}\right)^2$$

Parallax KE = ±200 J, or ±200 kgm^2/s^2

We now need to compile a data table that compares Stan's stationary data to the kinetic energy data compiled from Nancy's moving perspective:

Nancy Nearing’s KE Calculations vs Stan Stationary’s Parallax Range		**E**
Stationary View	**Nancy Nearing is moving at 100 m/s, 0°**	
	KE calculated by Nancy	
	Scenario 1A	**0 *J***
	Scenario 1B	**+800 *J***
	Scenario 1C	**+1016 *J***
	Scenario 1D	**+1200 *J***
Parallax Range	**Moving Range**	
±200 *J*	**±1200 *J***	

Notice that because Nancy is moving, she has concluded that the C-11 engine produces a kinetic energy gain of as much as 1200 J. This conclusion does not match Stan’s stationary range of ±200 J for the C-11 rocket engine.

While one test cannot provide absolute proof, this single example does suggest that the (non-standard multi-parabolic) KE-joules unit is unreliable with respect to relative motion. Now we need to explore additional puzzles, using a wider range of relative velocities, and using different rockets and engines.

(Note: kinetic energy always involves non-standard multi-parabolic joules. These joules units should not be confused with the standard linearized joules units associated with heat-energy, chemical-energy, electric-energy, and light-energy.)

PUZZLES FOR FURTHER RESEARCH AND UNDERSTANDING

3) **Scenario 3:** The D-12 rocket engine is designed to produce 20 ρ, or 20 kgm/s, of impulse/momentum-gain.
    a. If Stan Stationary places a D-12 engine in a 0.25 kg rocket, what will the rocket's final velocity be after the engine burns?
    b. What is the stationary KE gain? This is the parallax range that all values should be within.
    c. Nancy Nearing is approaching Stan's asteroid at a velocity of 500 m/s at 0°, and Stan launches the rocket at an angle of 0°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
    d. Nancy is approaching Stan's asteroid at a velocity of 500 m/s at 0°, and Stan launches the rocket at an angle of 70°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
    e. Nancy is approaching Stan's asteroid at a velocity of 500 m/s at 0°, and Stan launches the rocket at an angle of 180°. What is Nancy's calculation of the kinetic energy gain produced by the engine?

4) **Scenario 4:** The D-12 rocket engine is designed to produce 20 ρ, or 20 kgm/s, of impulse/momentum-gain.
   a. If Stan Stationary places a D-12 engine in a 0.50 kg rocket, what will the rocket's final velocity be after the engine burns?
   b. What is the KE gain as seen from Stan's view? This is the parallax range that should never be exceeded, regardless of the observer's motion.
   c. Nancy Nearing is approaching Stan's asteroid at a velocity of 1,000 m/s at 0°, and Stan launches the rocket at an angle of 0°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
   d. Nancy is approaching Stan's asteroid at a velocity of 1,000 m/s at 0°, and Stan launches the rocket at an angle of 120°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
   e. Nancy is approaching Stan's asteroid at a velocity of 1,000 m/s at 0°, and Stan launches the rocket at an angle of 180°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
5) Develop a comparison table for the Stan's parallax range for the D-12 engine, and Nancy's calculations during Scenario 3b, 3c, 3d, and during Scenario 4b, 4c, and 4d.

<table>
<tr><th colspan="3">Scenarios 3 & 4.
Nancy Nearing’s KE-gain Calculations vs
Stan Stationary’s Parallax Range</th><th>F</th></tr>
<tr><th colspan="2">Nancy Nearing
moving at
500 m/s, 0°</th><th colspan="2">Nancy Nearing
moving at
1,000 m/s, 0°</th></tr>
<tr><td>3B</td><td></td><td>4B</td><td></td></tr>
<tr><td>3C</td><td></td><td>4C</td><td></td></tr>
<tr><td>3D</td><td></td><td>4D</td><td></td></tr>
<tr><th colspan="2">Stan’s Parallax Range</th><th colspan="2">Stan’s Parallax Range</th></tr>
<tr><td colspan="2">±____________ J</td><td colspan="2">±____________ J</td></tr>
</table>

6) The manufacturer rated the D-12 engine as able to consistently produce ±20 ρ, or 20 kgm/s, of impulse/momentum-gain. This rating is not a predictor of kinetic energy.
   a. What was Stan Stationary’s parallax range for the kinetic-energy gain experienced by the rocket?
   b. Did Nancy Nearing’s calculations while traveling at 500 m/s match Stan’s parallax range?
   c. Did Nancy’s calculations while traveling at 1,000 m/s match Stan’s parallax range?
   d. Does this suggest that non-standard multi-parabolic joules of kinetic-energy gain is a reliable unit of measure for scientists to use for comparisons, on a regular basis?

7) **Scenario 7:** The E-9 rocket engine is designed to produce 30 ρ, or 30 kgm/s, of impulse/momentum-gain.
    a. If Stan Stationary places an E-9 engine in a 0.25 kg rocket, what will the rocket's final velocity be after the engine burns?
    b. What is Stan's stationary view of the KE gain? This is the parallax range that all values should be within.
    c. Nancy Nearing is approaching Stan's asteroid at a velocity of 5,000 m/s at 0°, and Stan launches the rocket at an angle of 0°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
    d. Nancy is approaching Stan's asteroid at a velocity of 5,000 m/s at 0°, and Stan launches the rocket at an angle of 30°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
    e. Nancy is approaching Stan's asteroid at a velocity of 5,000 m/s at 0°, and Stan launches the rocket at an angle of 180°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
8) **Scenario 8:** The E-9 rocket engine is designed to produce 30 ρ, or 30 kgm/s, of impulse/momentum-gain.
    a. If Stan Stationary places an E-9 engine in a 0.10 kg rocket, what will the rocket's final velocity be after the engine burns?

   b. What is the KE gain as seen from Stan's view? This is the parallax range that should never be exceeded, regardless of the observer's motion.
   c. Nancy Nearing is approaching Stan's asteroid at a velocity of 10,000 m/s at 0°, and Stan launches the rocket at an angle of 0°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
   d. Nancy is approaching Stan's asteroid at a velocity of 10,000 m/s at 0°, and Stan launches the rocket at an angle of 160°. What is Nancy's calculation of the kinetic energy gain produced by the engine?
   e. Nancy is approaching Stan's asteroid at a velocity of 10,000 m/s at 0°, and Stan launches the rocket at an angle of 180°. What is Nancy's calculation of the kinetic energy gain produced by the engine?

9) Develop a comparison table for the Stan's parallax range for the E-9 engine, and Nancy's calculations during Scenario 7b, 7c, 7d, and during Scenario 8b, 8c, and 8d.

Scenarios 7 & 8. **Nancy Nearing's KE-gain Calculations vs Stan Stationary's Parallax Range**			**G**
Nancy Nearing moving at 5,000 m/s, 0°		**Nancy Nearing moving at 10,000 m/s, 0°**	
7B		8B	
7C		8C	
7D		8D	
Stan's Parallax Range		**Stan's Parallax Range**	
±____________ J		**±____________ J**	

10) The manufacturer rated the E-9 engine as able to consistently produce ±30 ρ, or 30 kgm/s, of impulse/momentum-gain. This rating is not a predictor of kinetic energy.

a. What was Stan Stationary's parallax range for the kinetic-energy gain experienced by the rocket?

b. Did Nancy Nearing's calculations while traveling at 5,000 m/s match Stan's parallax range?

c. Did Nancy's calculations while traveling at 10,000 m/s match Stan's parallax range?

d. Does this suggest that non-standard multi-parabolic joules of kinetic-energy gain is a reliable unit of measure for scientists to use for comparisons, on a regular basis?

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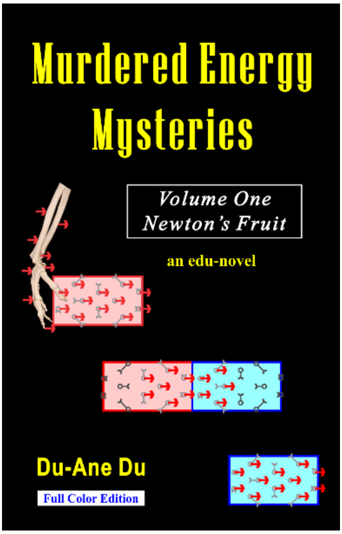

Examine or purchase at Amazon.com

Murdered Energy Mysteries seeks to increase understanding of the various forms of momentum and momentum transfer, as well as the various forms of energy and energy transfer. The lack of understanding on the part of the scientific community is substantial, and more research needs to be done.

—Du-Ane Du, author of the edu-novel *Murdered Energy Mysteries* (Amazon, Kindle, e-book 2018, paperback 2021.)

More information, visit www.Wacky1301SCI.com