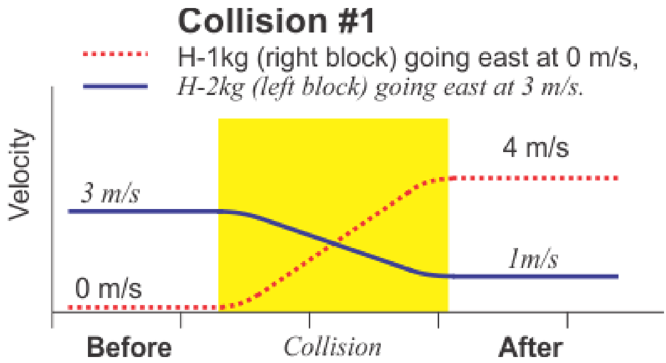
Deductions of the Space-sci Sherlocks



How Impulse and Momentum Control Collisions

Professor Du-Ane Du

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

Three sisters, Pico, Hectii, and Tera, the "Space-sci Sherlocks," are traveling through the Asteroid Belt. They explore asteroids, perform motion experiments, and deduce how impulse and momentum control collisions.
—Excerpted from *Murdered Energy Mysteries*, Part 3, Chapter 13, by Du-Ane Du, (Amazon, Kindle, ebook 2018, paperback 2021).

Hi Grandma Aaret,

this is Hectii, you missed a funny experiment.

Today, we visited an asteroid, and Tera pushed too hard on a magnetic collision block—and the block drug her along the surface of the asteroid—it was funny to watch!

I recorded the entire experiment, and I'll attach a video so you can laugh along—even Tera thought it was funny once she had a chance to see it.

Pico did a great job deriving a new collision model, which we call the Two-Force Collision Model. It's for bounce-apart (elastic) collisions between molecules and objects like magnetic collision blocks.

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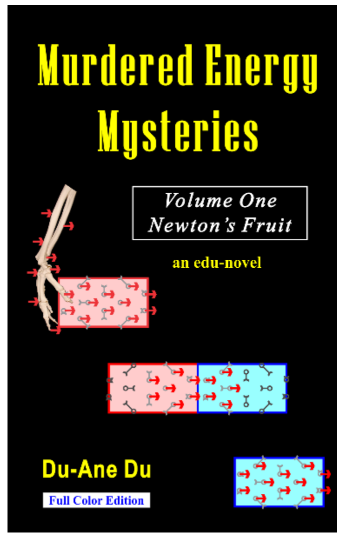

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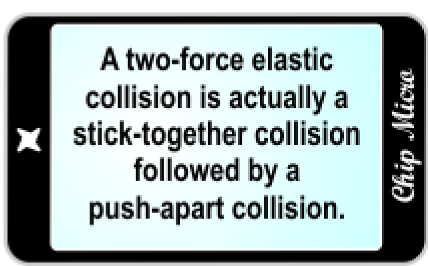


Here's a quick summary of Pico's Two-Force equations:

Two-Force Collisions
"Conservation" of V-Momentum
with Newton's Third Law

v-momentum before

= middle v-momentum $-im\Delta\rho_{TLeft} + im\Delta\rho_{TRight}$

= v-momentum after

Data before collision:

Left object, mass: $\boldsymbol{m_L}$

Left object, velocity: $\boldsymbol{v_{1L}}$

Right object, mass: $\boldsymbol{m_R}$

Right object, velocity: $\boldsymbol{v_{1R}}$

Final results after collision:

Left object's final momentum:

$$\boldsymbol{m_L v_{2L} = 2m_L\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - m_L v_{1L}}$$

Left object's final velocity:

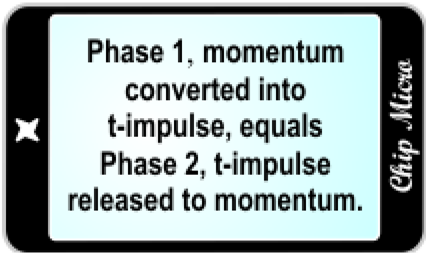
$$\boldsymbol{v_{2L} = 2\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - v_{1L}}$$

Right object's final momentum:

$$\boldsymbol{m_R v_{2R} = 2m_R\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - m_R v_{1R}}$$

Right object's final velocity:

$$\boldsymbol{v_{2R} = 2\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - v_{1R}}$$



Two-Force Collisions
"Conservation" of V-Momentum
with Newton's Third Law

v-momentum before

= middle v-momentum + $^{\mp}im\Delta\rho_{TL}$ + $^{\pm}im\Delta\rho_{TR}$

= v-momentum after

Before:	$m_L v_{1L} \; + \; m_R v_{1R}$
During:	$= \left[m_L v_{1L} + {}^{\mp}im\Delta\rho_{TL}\right] + \left[m_R v_{1R} + {}^{\pm}im\Delta\rho_{TR}\right]$
Middle:	$= (m_L + m_R)v_{Middle} + \left[{}^{\mp}im\Delta\rho_{TL} \; + \; {}^{\pm}im\Delta\rho_{TR}\right]$
During:	$= \left[m_L v_{Mid} + {}^{\mp}im\Delta\rho_{TL}\right] + \left[m_R v_{Mid} + {}^{\pm}im\Delta\rho_{TR}\right]$
After:	$= \; m_L v_{2L} \; + \; m_R v_{2R}$

That's a lot of equations, but they can be very useful. Here is the starting data that Daddy and I took while we were flying over one of Pico's experiments. The magnetic collision blocks were moving to the right, with one approaching the other from behind, as they were about to collide:

$$Left\!: m_L = 20\,kg$$
$$Left\!: v_{1L} = 116\,m/s$$

$$Right{:}\ m_R = 1\ kg$$
$$Right{:}\ v_{1R} = 106\ m/s$$

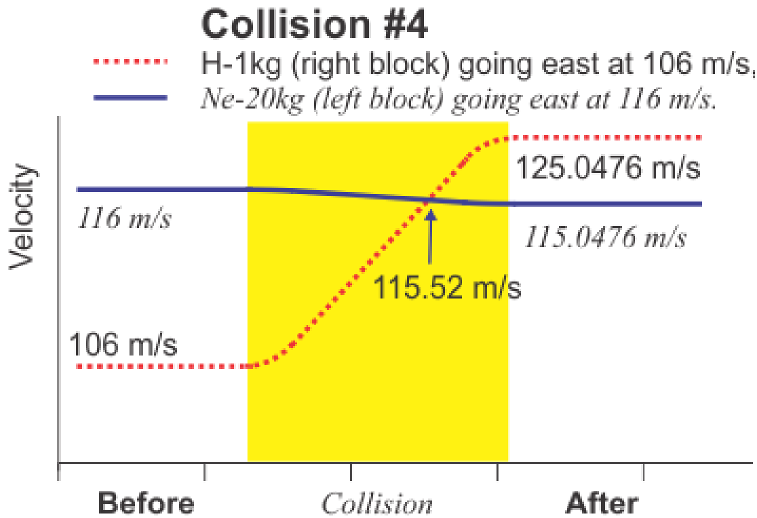
Now I'll calculate the predicted final velocity that the right block will have after the two blocks bounce apart. (This is what the shortcut equations are good for).

$$v_{2R} = 2\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - v_{1R}$$
$$v_{2R} = 2\left[\frac{(20\ kg_L \times 116\ m/s_{1L} + 1\ kg_R \times 106\ m/s_{1R})}{(20\ kg_L + 1 kg_R)}\right] - 106\ m/s_{1R}$$
$$v_{2R} = 2\left[\frac{20 \times 116 + 1 \times 106)}{(20+1)}\right] - 106$$
$$\mathbf{v_{2R} = 125.0476\ m/s}$$

The shortcut equation for the final velocity of the left block works the same way. After the blocks bounce apart, the left block will have a velocity of:"

$$v_{2L} = 2\left[\frac{(m_L v_{1L} + m_R v_{1R})}{(m_L + m_R)}\right] - v_{1L}$$
$$v_{2L} = 2\left[\frac{(20\ kg_L \times 116\ m/s_{1L} + 1\ kg_R \times 106\ m/s_{1R})}{(20\ kg_L + 1 kg_R)}\right] - 116\ m/s_{1L}$$
$$v_{2L} = 2\left[\frac{20 \times 116 + 1 \times 106)}{(20+1)}\right] - 116$$
$$\mathbf{v_{2R} = 115.0476\ m/s}$$

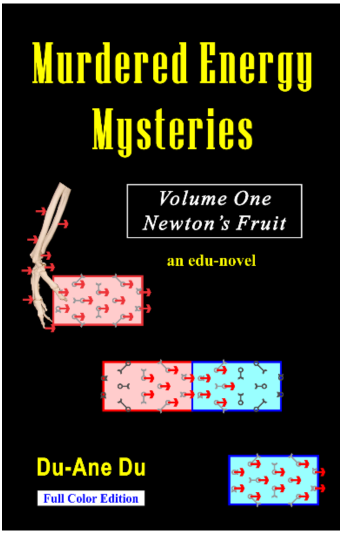
Isn't that great! But are our predictions correct? During the experiment, Chip recorded the actual velocities of the two blocks. Check out this graph:



Our equations worked great! The final velocities were exactly what we predicted. Where did these equations come from? I'll have Chip transcribe one of our earlier experiments. Daddy had taken us to explore a nearby asteroid. Pico and I did some push-apart experiments while Daddy and Tera rode the rocket-ski to the other side of the asteroid. Here is what Pico and I discovered:

> "You're saying the total amount of v-momentum didn't change?" Tera said, surprised.

"I see what you mean," Pico said. "In the experiment with two Ne-20 blocks, before I hit the release button the velocity was zero and the v-momentum was zero, which means they weren't moving. After I hit the button the block on the left moved leftward at a velocity of –1.0 m/s and a v-momentum of –20 ρ, while the block on the right moved rightward at a velocity of 1.0 m/s and a v-momentum of 20 ρ."



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"Which means, the increases in v-momentum were equal in size," Tera said.

"But opposite in direction," Pico interjected. "So in a way, the net v-momentum was still zero. You know, the v-momentum values cancel because one is positive, and one is negative."

"Fabulous, sisters," Hectii said mechanically, as she activated her data-input gloves and started tapping the tiny keys that surrounded each finger. "But that only explains half of the story. Newton's third law suggests that impulse comes in action-reaction pairs. That means the amount of impulse experienced by the leftward block was equal to the amount of impulse experienced the rightward block. Check this out:"

Newton's Third Law

For every action, there is an equal
and opposite reaction:

|−impulse left side| = |+impulse right side|

$$|^{-}im\Delta\rho_{\,L}| = |^{+}im\Delta\rho_{\,R}|$$

"I understand," Tera expressed. "Compression-Stored Impulse is released in action-reaction pairs!

"Precisely," Hectii confirmed. "Equal but opposite reactions, equal but opposite force-rates, and equal but opposite absorption of the impulse."

"What about the conservation fact of r-s-t momentum?" Pico said. "Shouldn't the compression-stored impulse that's been trapped in the compressed magnetic fields equal the impulse produced when the fields expand?"

"How about this," Hectii said, as she keyed information into her data-input gloves:

Equality of Trapped/Released Momentum

impulse trapped/stored = impulse released

$$total\ im\Delta\rho_{\,trapped} = |^{-}im\Delta\rho_{\,L}| + |^{+}im\Delta\rho_{\,R}|$$

*The absolute value symbol | | is also a reminder that trapped impulse is omnidirectional as long as it is stored, but the t-impulse becomes directional when released.

"Look at this, Sis," Pico merrily articulated, as she activated her data-input gloves and began keying. "If we drop the absolute value symbols, we can merge this equation with the v-momentum equation. I'll write it in several forms:"

"Conservation" of V-Momentum with Newton's Third, Expansions

v-momentum before $-im\Delta\rho_{TLeft}$ $+im\Delta\rho_{TRight}$ = v-momentum after

Before: $(m_L + m_R)v_1 + [\,^{-}im\Delta\rho_{TL} + \,^{+}im\Delta\rho_{TR}]$

During: $= [m_L v_1 + \,^{-}im\Delta\rho_{TL}] + [m_R v_1 + \,^{+}im\Delta\rho_{TR}]$

After: $= m_L v_{2L} + m_L v_{2R}$

Shortcut equations:

Left momentum after: $m_L v_2 = m_L v_1 + \,^{-}im\Delta\rho_{TL}$

Left velocity after: $v_{2L} = (m_L v_1 + \,^{-}im\Delta\rho_{TL})/m_L$

Right momentum after: $m_R v_2 = m_R v_1 + \,^{+}im\Delta\rho_{TR}$

Right velocity after: $v_{2R} = (m_R v_1 + im\Delta\rho_{TR})/m_R$

"Hurry," Tera said as the rocket-ski rounded the asteroid's horizon. "Daddy says it's Pico's turn to ride the rocket-ski. Seeing the opposite side of this asteroid is fascinating."

"Hooray!" Pico said. "For our next experiment, we'll put the Ne-20 magnetic block on the left, and the H-1 magneticc block on the right. Each compressed magnetic field will be set to produce 20 ρ of impulse."

"In your last experiment, the initial velocity was zero," Hectii said.

"Then this time we'll throw the blocks and release them by remote control," Pico said, as she pushed the two blocks eastward.

As the blocks passed Hectii, Hectii reached out and tapped the release button. “There isn’t a remote control on these blocks,” Hectii said with a laugh.

The blocks sprang apart, and the girls used the strings to bring the blocks to a stop.

“Initial velocity, east 5.0 m/s,” Chip wrote on their visor displays. “After expansion, the Ne-20 block traveled eastward, 6.0 m/s, H-1 block, westward, –15 m/s.”

“Chip,” Hectii said, her voice filled with disappointment. “You were supposed to keep the after-expansion data a secret.”

“It’s ok,” Pico sweetly consoled, as she keyed. “The before equation looks like this:”

Before expansion:

$$(m_L + m_R)\, v_{1\,(Before)} + [\,{}^{-}im\Delta\rho_{TL} + {}^{+}im\Delta\rho_{TR}]$$

$$(1kg_L + 20kg_R)5m/s_1 + [\,{}^{-}20\rho_{TL} + {}^{+}20\rho_{TR}]$$

$$(1_L + 20_R)5_1 + [\,{}^{-}20_{TL} + {}^{+}20_{TR}]$$

$$(1_L \times 5_1) + (20_R \times 5_1) \quad + [\,{}^{-}20_{TL} + {}^{+}20_{TR}]$$

After expansion (combine left & right):

$$[\,m_L v_1 + {}^{-}im\Delta\rho_{TL}\,] + [\,m_R v_1 + {}^{+}im\Delta\rho_{TR}\,]$$

$$[1kg_L \times 5m/s_1 + {}^{-}20\rho_{TL}] + [20kg_R \times 5m/s_1 + {}^{+}20\rho_{TR}]$$

$$[1 \times 5 + {}^{-}20]_L + [20 \times 5 + {}^{+}20]_R$$

$$[\,{}^{-}15\rho_L] + [\,{}^{+}120\rho_R]$$

“X-plosive job,” Hectii commended.

"But what does it mean?" Tera questioned. "Can you use your equations to predict what the final velocities were supposed to be?"

"That's what the extra short-cut equations were for," Pico said, as she continued keying. "The calculations to predict the final velocity of the left block look like this:"

Left velocity after:
$v_{2L} = (m_L v_1 + im\Delta\rho_{TL})/m_L$
$v_{2L} = (1kg_L \times 5m/s_1 + {}^{-}20\rho_{TL})/1kg_L$
$v_{2L} = (1 \times 5 + {}^{-}20)/1$
Final velocity of H-1 block (left) = –15 m/s
was written on their visor displays.

"That's amazingly accurate," Tera proudly exclaimed. "Remember? Chip said the H-1 block had a final velocity of –15 m/s, just like your equation predicted."

"Now do the right side," Hectii encouraged.

"It looks like this:"

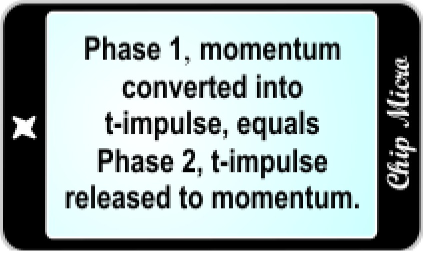
Right velocity after:
$v_{2R} = (m_R v_1 + {}^{+}im\Delta\rho_{TR})/m_R$
$v_{2R} = (20kg_R \times 5m/s_1 + {}^{+}20\rho_{TR})/20kg_R$
$v_{2R} = (20 \times 5 + {}^{+}20)/20$
Final velocity of Ne-20 block (right) = 6.0 m/s
was written on their visor displays.

"We're back," Tera said, as the rocket-ski came to a stop near the girls. "Your equations are wonderful, Pico, both predictions were exactly correct."

"There're more magnetic collision-blocks in the extra box," Pico said.

"We should test every possible combination," Hectii said.

So that's where we began, Grandma, and after doing push-apart experiments, we found that stick-together experiments had the exact opposite mathematics. That enabled us to merge the two sets of equations into the Two-Force Collision Model that I showed you earlier.



Our experiments with the magnetic collision blocks seem to verify that Pico's Two-Force Collision Model is a phenomenal match for the kind of collisions that atoms and molecules experience. But is it perfectly correct? I wish we had a way to test a group of gas molecules. Maybe we'll do that next!

That's all from the Gravity Spa for now, tell Grandpa Proge hello, hello, hello, from your three favorite granddaughters.

Love always,

Pico, Tera, Daddy—and ME! Your Hectii!

CONCLUSION: More research needs to be done into the relationship between mechanical energy and other theoretical forms of energy. Many common beliefs may actually be philosophical myths.

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, see:
Murdered Energy Mysteries,
an edu-novel

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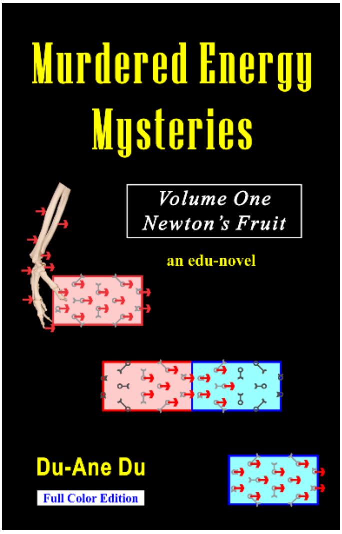

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