Re: Seeming paradox

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* *From*: "PD" <TheDraperFamily@xxxxxxxxx>
* *Date*: 7 Apr 2007 07:20:32 −0700

On Apr 7, 5:37 am, Eyal Lotem <eyal.lo...@xxxxxxxxx> wrote:

> Hi.
> My explanation is a little long, but I think it is simple, and I tried making it as clear as I can. It should only take a few minutes to explain, and I am greatly puzzled by this. Thank you!
>
> I was wondering about an apparent discrepancy in simple low−speed Newtonian physics.
>
> The source of the issue is that Kinetic Energy, being a function of the squared velocity, is relative to the viewer's speed (because the velocity is relative to the viewer's speed), while other forms of energy (for example potential energy in a spring) are not relative to the viewer's speed.
>
> A mind experiment can be used to explain the apparent paradox, and I'd be grateful if someone explained the underlying mistake in their assumptions:
>
> The 3 ships.
>
> 3 ships of the same weight are flying at the same velocity in space, each carrying 2 heavy ball weights attached to a spring.
>
> The springs are a form of "engine" that can shoot out the heavy balls in order to push forward the ship.
>
> Initially, the 3 ships are all in the same state.
> Then, two of the ships fire out one of the heavy balls (releasing energy E), resulting in their acceleration to the speed of V, relatively to the ship that did not fire.
>
> Then, one of the two ships fires out another heavy ball (releasing energy E), resulting in its acceleration to the speed of V', relatively to the ship that did not fire.
>
> Now, looking at the experiment as a whole, we can say that the ship who fired 2 balls gained twice the kinetic energy of the ship who fired 1 ball (and is a little lighter now that it does not contain both balls) − and

> therefore should travel a little faster than sqrt(2)*V (i.e V' >= sqrt(2)*V).

There's your mistake. The energy released, E, does not all go into the rocket ship. The energy release goes into both the rocketship and the cannonball. How much goes into each is straightforward to calculate, but you need to invoke conservation of momentum to do so. Interestingly, how much additional velocity the rocketship gains as a result *changes* from the first release to the second release.

I suggest you go online and look for "conservation of momentum" and "inelastic collisions" and work some examples to see how it goes, and then apply it to this case. You'll be surprised.

PD

> However, if one examines the two events *separately*, the conclusions seem to be altogether different.
>
> If the experiment of the 2 ships is done separately from the one of the 3 ships, or at least examined separately, then we can "forget" that the 2 ships already accelerated to the speed of V. Then it would seem that if one of the two ships is firing E energy, it should accelerate by more than V (since its lighter) compared to the ship that isn't shooting its available ball.
>
> So a viewer who viewed the whole experiment would think that the ship speeds are 0, V, and a bit more than sqrt(2)*V.
>
> A viewer who viewed just the part with two ships, one of which shoots another ball, would think that the two ship speeds are 0, V.
>
> That is a paradox, because the relative speed between the last 2 ships is a bit more than V*(sqrt(2)−1) by one viewer, and a whole V*1 by the other viewer!
>
> The same spring energy (according to any viewer) converts to kinetic energy that has a different meaning in velocity, depending on the viewer!
>
> How is this possible?
>
> Thanks,
> Eyal

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