Re: Accelerating a particle and photons

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- *From*: Mark Fergerson <nunya@xxxxxxxx>
- *Date*: Mon, 02 Jan 2006 19:50:04 −0700

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srp wrote:

> Ron Baker, Pluralitas! a écrit :
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> > "srp" <srp2@xxxxxxxxxxxxxxxx> wrote in message news:43B96DC3.1090606@xxxxxxxxxxxxxxxxxxx
> >
> > > Ron Baker, Pluralitas! a écrit :
> > >
> > > > "srp" <srp2@xxxxxxxxxxxxxxxx> wrote in message news:43B96044.5020402@xxxxxxxxxxxxxxxxxxx
> > > >
> > > > > vze2vt56@xxxxxxxxxxx a écrit :
> > > > >
> > > > > > If I oscillate a charged particle with some frequency f, generating EM radiation of that frequency.
> > > >
> > > > Conditional yes.
> > > >
> > > > > Maybe not that simple. Oscillating a charged particle at a "mechanical" frequency f in no way implies that the EM radiation emitted will have that frequency.
> >
> > Why not?

Really? Suppose you have a charged object (say a pith ball on the end of a wooden stick) and you cause it to have motion described by x = cos(2*pi*t), y = 0, z = 0, −oo < t < oo. (You could also suppose the charge is 9e−31 Coulombs.) The photons don't have a frequency of 1Hz?

They bloody well better (assuming there are any photons to begin with; just saying you're waving a charge around is not adequate. You must specify if conditions allow free EM waves to form and escape.) Er, either of you ever built an antenna?

What frequency do they have?
(And how many of them are there?)

It depends which direction you look at it from, and how large a view you take. Assuming, etc.

I have no idea if photons would be released in such a case.
I was talking about charged particles, like electrons.

Sigh.

Then did you really have an idea about the OP's question.
The OP was not asking specifically about electrons.

Well, read back yourself. He was specifically talking about "a charged particle", and to my knowledge, electrons are charged particles.

How is the pith ball not a charged particle?

Because it is a pith ball, made up of I don't know how many atoms that can be ionized. A pith ball is not a charged particle, it can only be a charged pith ball.

The charge on the pith ball is an electron.

I doubt that the charge on a charged pith ball would
be a single electron.

Why not? In the Millikan oil drop experiment, is the oil drop not a "charged particle"? It's a composite particle, but that just localizes it better than say a single electron.

What do you think the pith ball being "charged" means in the first place? It too is a composite particle, but so what?

Disregard the pith ball if you like.
You cause an electron to have the motion described above. What frequency do the photons have?

They would have the frequency of the energy released each time the electron stops in one direction before it starts accelerating in the reverse direction.

In other words, it will depend on the velocity you will impart to the electron to maintain the oscillating motion. If the oscillation is stable, the photons will all have the same frequency.

They can't; kT. Close though...

How many of them are there?

It depends which direction you look at it from, and how large a view you take.

As many as there will be changes in direction of the electron during the experiment.

Do you not see that the direction of motion of the charge affects how many photons an observer will see, depending on the observer's orientation WRT that motion? Assuming, etc.

Also, is the observer in motion WRT that cewnter-of-oscillation of the charge? That affects the observed frequency. Assuming, etc.

How about the electromagnetic field? Does it have a frequency? Is it different than the photons?

Well, yes and no. It is not that simple.

If the EM field is the result of coherent EM emission like lasers, I guess a frequency could theoretically be assigned.

You can only get coherent radiation from many sources (IOW many oscillating charges), not from one.

You cannot assign "a frequency" to the field from a single oscillating charge, but you can get as close as kT allows.

What about the electromagnetic field for an electron with the cos() motion described above?

Note the the cos() function represents a to and fro motion in reality.

Can you offer a guess on that?

Possibly.

I can see a charged particle in motion, so the fields will be composite, meaning that the composite fields will be made up of the fields of the electron itself plus the fields of the energy carrying it (the energy that gives it its velocity).

I see that the latter will increase as the velocity increases and moving on as a free photon as the electron stops, leaving the latter behind. The electron will maintain its own intrinsic fields.

Can you name a few of the factors determining whether or not photons will be emitted?

(hint; "near field" and "far field")

For photons, a frequency can be
definitely be associated.

Does this mean no photons are emmitted until I change
the particle's direction?

Yes, a photon will be emitted each time the particle stops prior
to reaccelerating in the reverse direction (this is called
"bremsstrahlung"), but the frequency of the released photon will
be that of the energy that sustained the velocity the electron
had peaked at before stopping.

Sigh. It means you may detect a photon if you stand in the right place
WRT the charge's direction of motion, assuming etc.

Suppose an electron is going .9 c and we slow it down
to 1 m/s. It doesn't stop. No photon? No radiation?

Yes a photon would be emitted with the energy in excess of that
required to maintain a 1 m/s velocity.

Sigh. There are equations for that, but we need to know the rate of
deceleration, among other things.

Previously you said the (one?) photon is emitted when it 'stops'.
Are you now saying it is emitted when the ac/deceleration
stops?   i.e. at the moment when d^2 x / dt^2 becomes 0 and
not when dx/dt becomes 0?

Since the electron moves at a velocity determined by its energy
in excess of its rest mass, it cannot move at any velocity lower
than the energy that it possesses. For it to slow down, it has
lose the energy in excess of that required to maintain the new
lower velocity. If its stops completely, it has to lose all
of its energy in excess of rest mass.

So if you brake an electron from .999999c to 1m/s linearly over
a period of 10 years there is no radiation/photon until
exactly the end of that 10 years?

I don't know. Hypothetical. Impossible to do.

Horseshit; the galactic magnetic field does it all the time. Oops, did I give something away?

We do not have the technology to follow linearly an electron moving at near light speed to start with, let alone slowly braking it from .999999c to 1m/s over a period of 10 years in the process.

And that one photon
will have millions of eV energy?

I have no idea. Hypothetical. It couldn't be more anyway than the energy that was required to maintain it at .999999c to start with if no outside factor cause it to lose any for other causes.

Sigh.

Mark L. Fergerson

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