Re: Bras, kets etc.

Source: http://sci.tech−archive.net/Archive/sci.physics/2006−09/msg01452.html

* *From*: "Ron Baker, Pluralitas!" <stoshu@xxxxxxxxxxxxxxxx>
* *Date*: Sun, 17 Sep 2006 04:43:32 GMT

"Timo Nieminen" <timo@xxxxxxxxxxxxxxxxx> wrote in message
news:Pine.LNX.4.50.0609150916020.421−100000@xxxxxxxxxxxx

> On Thu, 14 Sep 2006, Ron Baker, Pluralitas! wrote:
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>> "Timo Nieminen" <timo@xxxxxxxxxxxxxxxxx> wrote:
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>>> On Wed, 13 Sep 2006, Ron Baker, Pluralitas! wrote:
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>>>> "Timo Nieminen"
>>>> <timo@xxxxxxxxxxxxxxxxx> wrote:
>>
>> I was thinking that natural sources would be linearly
>> and not circularly polarized but when I think about it
>> I don't have any particular justification for that idea.
>> And right off hand I'm not sure how one would determine
>> that a photon is circularly polarized.
>
> Generally, since the usual source is uncorrelated atoms or electrons in a solid, natural sources are unpolarised and incoherent. Mathematically, the only difference between linear and circular polarisation is a 90 degree phase shift between the two linear components. I'm inclined to say that circular polarisation is the more fundamental of the two, but I'm biased by a decade of work in optical angular momentum.
>
> A piece of polaroid will tell you whether a source is linearly polarised, and a piece of polaroid with a 1/4−wave plate in front of it will tell you if a source is circularly polarised. I was at a conference where one presenter brought in a box of beetles for show−and−tell (thanks Gorden, it was very cool). Some of the beetles were scarabs, which on account of helical proteins in their wing covers, reflect only one circular polarisation of light. Scarabs, meanwhile, have eyes that can see circular polarisation, so this lets them find their own kind to mate with much more reliably. Look at the box of beetles, they all look pretty much the same. Look at the box of beetles through a circular polarisation filter, and the

scarabs are obvious.

Interesting. I googled a bit and saw a little more on that.
I saw mention that it reflected circularly polarized light
when the incident light was unpolarized. That kind
of supports my bias that natural sources tend not to be
circularly polarized.

However, you can't determine if the incident photon was circularly
polarised with such a filter. All you learn is whether it made it through
the filter or not. An unpolarised photon will do so 50% of the time, and
so will a plane polarised photon.

It's not quite so simple. Magic words to google for are "Stokes
parameters" or "Stokes vector" and "measure" or "measurement". The
classical measurement exploits having lots of photons in the same state,
but the single photon quantum measurement cannot, and you won't know the
incident state without further information.

This is one of the big difference between the classical
description and
the single−photon quantum description. In the former, |a|^2 +
|b|^2 is
the
power before the polaroid, whereas in the latter, |a|^2 + |b|^2
= 1,
since
the photon has a 100% probability of being incident on it.
Classically,
you'd have a power of |a|^2 afterwards, but quantumly, if the
photon
made
it through, it still has a 100% chance of being there, while if
the
photon
didn't make it through, it doesn't exist anymore, and doesn't
have a
wavefunction.

Applying that to an intereferometer would seem to lead
to a contradiction. If it is as you just described then the
photon actually takes one path. How would you then
explain the interference?

OK, the above was written about a pice of polaroid, where a photon with

But the principle should apply equally to beam splitters and
polarizers.

> the "wrong" measured polarisation is absorbed, so there is no

Absorbtion shouldn't be critical. There are polarizers
that reflect rather than absorb the 'wrong' polarization too, esto no?

> interference, but what are are saying is the typical case that people talk
> about with eg two−slit interference or in an interferometer with a
> beam−splitter, where the interference pattern disappears if you put a
> detector (at one slit)/(in one beam path). In "collapse of the
> wavefunction" language, if you don't measure, you don't collapse, and you
> get interference at the end. Measure, and no interference.

Very metaphysical.

(And 'measure' is a synonym for 'detect'.)

> > > > And that phi: you don't mean it to be random
> > > > per
> > > > photon do you. If it were then a laser beam
> > > > would
> > > > lose its coherence going through a polarizer.

> > > Well, you asked about unpolarised light, not a laser beam.
> > > But if you
> > > had
> > > a 45 degree polarised laser beam incident on a |V> polaroid,
> > > then it
> > > would
> > > be 1/2, at random, but that wouldn't do anything to the
> > > coherence. All
> > > of
> > > the incident photons are in the same mode, the transmitted
> > > mode (if you
> > > win the 50% coin toss) has a fixed phase cf the incident
> > > mode, so the
> > > transmitted photons are all in the same mode.

> > So then phi is not random per photon?

Good question. Random over time, yes.

Hmm. How?

Random over photons, I don't know
off−hand.

How could it be random per photon? How could that
not destroy the coherence of a laser beam?

If you detect the photons at different times, then random over
time gives you random over photons. If you check out Hanbury Brown's book,
this is part of the intensity interferometer controversy.

I found this:
http://marcus.whitman.edu/~beckmk/QM/grangier/Thorn_ajp.pdf
In section II D and in the next to last paragraph on page 1212
it seems to describe the mathematical basis of anti−correlation.
I am not familar with the math though.

Will look as time permits, and might comment here later if appropriate.
Otherwise, I'll just read.

Yeah, I was hoping you could explain some of it.
Obviously it is not your job to give physics lessons
to every yahoo on the usenet but I figured you and
I and others would find it interesting.
The math has a similar form to the vectors/bra−kets.
They mention annihilation and creation operators
which I have heard of but don't fully understand.
(But I figure they are similar to things I've already
dealt with.) And then the colons. I wonder what
they mean.

I need to read the rest of what you sent me too.

Which
photons are
absorbed by
the filter?

This is where philosophy
comes into it. One school of
thought would
say
"1/2 them, entirely
determined randomly".

That is easily demonstrated to be false using
a pair
of polaroid filters.

How? With one filter, half of the light makes it through.
With two
filters, the light is no longer unpolarised when it reaches the
second
filter, and the probility of transmission through the 2nd filter
depends
on the angle.

If it was "1/2 of them, entirely determined randomely" before
then the initial polarization of each photon did not matter.
So if they are all |H> after one filter then it still should not
matter at the second filter.

The "1/2" is beacuse the incident light is unpolarised. (It would also be
1/2 for 45 degree diagonally polarised light or circularly polarised
light or 45 degree elliptically polarised light.) After the first filter,
you have polarised light.

Maybe it is a matter of semantics. "entirely determined
randomly" seems to totally discount any incident polarization
(or lack thereof).

With unpolarised light, whether an individual photon has a polarisation
depends on your picture/interpretation of QM.

Interesting. How can an individual photon not
have a polarization if one can say they are polarized
after a polarization filter?

> Again, "both polarisations
> at once", "one polarisation, with 50/50 chance", or "both polarisations,
> but in different universes" etc etc etc.

>> Point of notation: Are the orientations of |H> and |V> chosen
>> to be some constant experimental reference for all possible
>> filters and their orientations that might be in the path
>> or do you define a new |H> and |V> (|H1>, |H2>, etc.) at each filter?

> I was thinking of |H> and |V> in a "lab frame". But you can do either,
> keep the same |H> and |V> basis throughout, or use a separate one for each
> waveplate/polariser. Either approach gives you Malus's law.

OK. To be clear, it should be explicit.

>>>> If the spherical is resolvable to the
>>>> rectangular then
>>>> might there be filters for rectangular modes
>>>> that could
>>>> be used infer the spherical?

>>> Only if you measure phase, which the PMT does not.

>> Interferometry?

> Yes, one can do so to get (relative) phase. But then it's more than just a
> PMT.

That's doesn't cause me any worries.

> −−
> Timo Nieminen − Home page: http://www.physics.uq.edu.au/people/nieminen/
> E−prints: http://eprint.uq.edu.au/view/person/Nieminen,_Timo_A..html
> Shrine to Spirits: http://www.users.bigpond.com/timo_nieminen/spirits.html

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