Re: The time it takes to emit one photon

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- *From*: Igor Khavkine <igor.kh@xxxxxxxxx>
- *Date*: Tue, 16 Aug 2005 04:19:37 +0000 (UTC)

On 2005−08−15, nightlight <nightlight@xxxxxxxxxxxxxx> wrote:

> Indeed, the Barut's self−fields predictions do deviate experimentally
> from the predictions of the multiparticle QM (which is obtained as a
> truncated linearization approximation of the Maxwell−Dirac coupled
> fields, hence they are certainly not equivalent). This difference,
> though, turns out to be precisely the radiative corrections, where the
> QM is wrong and the Barut's self−fields ED is right, and where QM needs
> to be superseded by QED to obain the experimentally correct results.
> Barut's self−fields ED agree with the experiments (and QED) here as far
> as he had carried out the computations (equivalent to the QED's alpha^5
> order). So, the QM "works" in the sense of getting the numbers right,
> but only to the extent that the truncated linear approximation of
> Maxwell−Dirac dynamics (which is what the multiparticle QM formalism
> is) works.

I'm curious about Barut's approach. So, perhaps you can help me
understand better the differences and similarities between it and
standard QFT.

First, let me say how I see the connection between non−linear classical
field theory, QFT, many particle quantum mechanics, and classical
particle mechanics.

Quantization
Classical Field Theory <−−−−−−−−−−−−−−−−−> QFT
Classical Limit ^
|
Fock Space |
Construction | Wave Function
| Representation
Classical Quantization V
Particle Mechanics <−−−−−−−−−−−−−−−−−> Many Particle QM
Classical Limit

Let me clarify the two steps that are less known than they should be.
In many particle QM (MPQM), states are represented by wave functions of
3N variables, where N represents the number of particles and may take on
different values. Before taking the classical limit, we fix N and, as

hbar −> 0, we obtain Hamiltonian mechanics of N particles. Fock space construction relates the space of all symmetric (resp. antisymmetric) wave functions to the modes of a number of bosonic (resp. fermionic) quantum harmonic oscillators, one for each mode of the single particle Hilbert space in MPQM. On the other hand, given a QFT with a Fock space and an algebra of field operators, each N−particle state |N> can be expressed as a wavefunction using the formula <N|psi(x)psi(y)...|0> and other similar ones, with psi(x) being field operators and |0> the vacuum state. Note that, in the classical limit of a QFT, a fermionic field must reduce to a Grassmann−valued classical field.

Both Fock space construction and wave function representation are exact equivalences, no approximation here. Not so for the other steps. The classical limit is an approximation, hbar −> 0. And quantization is not always unique, although it is reasonably so for important examples.

My first question is whether Self−Field ED fits into any of the above theory categories, or does it have to be considered separately? If applicable, which one of the arrows does "Carleman linearization" correspond to?

I would also like to know exactly where standard QED and Self−Field ED agree or part ways on experimental predictions. I don't want to discuss measurement theory here. For me, a theory is a black box that takes input parameters and spits out numbers that can be checked with existing apparatus. If a theory does not make a prediction for a measurement that we can't make, that doesn't bother me much. But it will if the measurement can in fact be made.

You mentioned that, since Barut's theory is non−linear, state superposition goes out the window. In that case, does it account for Stern−Gerlach and interference−type experiments? If superpositions are possible for weak fields (in the linear approximation) at what field strength should non−linear effects become visible?

The quantization of electromagnetic excitations (photons) as well as excitations of other fields (electrons, protons, etc.) is intimately related to the Fock space structure of QFT and is seen all around us. Does Barut's theory account for that as well?

QED takes the particle masses and the fine structure constant as input. It outputs a great deal of predictions, including cross sections. Some of which show some of the best known agreemet with experiment. Two examples are the electron's gyromagnetic ratio and the Lamb shift. Does Barut's theory agree with experiments to the same precision as QED? And if written as powerseries in alpha, do the coefficients of these calculated quantities agree between QED and Self−Field ED? Does the agreement break at some power of alpha?

You also mentioned your doubts about the results of Bell's inequality tests. Can Barut's theory produce a prediction for the correlations

measured in these experiments (however these correlations are defined)?
If so, how does the prediction compare to the experimental data? Better
or worse than QM?

Thanks.

Igor

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- ***Follow−Ups***:
    - ***Re: The time it takes to emit one photon***
        - ◊ *From:* nightlight
    - ***Re: The time it takes to emit one photon***
        - ◊ *From:* Eugene Stefanovich

- ***References***:
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