[Atoms] Manuscript ID: atoms-83432 - Minor Revisions

Lin Dong <phydonglin@gmail.com> Tue, May 12, 2015 at 9:56 PM
To: Lin Dong <phydonglin@gmail.com>
Cc: Chuanzhou Zhu <ricezhuchzh@gmail.com>, Han Pu <hpu@rice.edu>

Hi all,

The atoms reviewers have got back to me. In case you can't view the comments, I am posting them here, and we need to "revise the manuscript according to the reviewers' comments and upload
the revised file within one week" and follow " Use the version of your manuscript found at
the above link for your revisions, as the editorial office may have made
formatting changes to your original submission. Any revisions should be
clearly highlighted, for example using the "Track Changes" function in
Microsoft Word, so that they are easily visible to the editors and reviewers.
Please provide a short cover letter detailing any changes, for the benefit of
the editors and reviewers." -- from editor's email.

Review Report Form

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	High	Average	Low	No Answer
Originality / Novelty	( )	(x)	( )	( )
Significance of Content	( )	(x)	( )	( )
Quality of Presentation	( )	(x)	( )	( )
Scientific Soundness	(x)	( )	( )	( )
Interest to the readers	( )	(x)	( )	( )
Overall Merit	( )	(x)	( )	( )

OpenReview
(x) I would not like to sign my review report
( ) I would like to sign my review report

English Language and Style
(x) English language and style are fine
( ) Minor spell check required
( ) Extensive editing of English language and style required
( ) I don't feel qualified to judge about the English Language and Style

Comments and Suggestions for Authors

This manuscript considers the properties of a spin-1/2 atom in the presence of the photon fields associated with a ring cavity in the full regime from weak to strong coupling. The authors consider both the static energetics of the system by solving the nonlinear energy equation anaytically, as well as a full Master equation approach in the presence of both cavity pumping and leakage. Overall, the results are genuinely interesting. That said, there is significant overlap in the presented calculations with previously published results by the authors (Ref. 19 in the present manuscript). While there is new work, in my estimation only about 30% of the results are different from those in this previous paper. I am stating that the science is solid but thin, so I leave it to the editors to decide if there is sufficient new work contained in the present manuscript to warrant publication.

In addition, I have several smaller but important comments that the authors should consider before submitting a final mansucript, in order of appearance.

- The authors replace the photon and atomic field operators by their averages. Both of these are only valid in the limit of very large numbers. While I can believe that the cavity contains many photons, there is only one single particle. Why would this (BEC approximation) be even remotely valid?

- In Eq. (2) \kappa is inserted by hand?

- I don't understand why the negativity, which is to measure the entanglement between the atom and photon, is a useful or interesting quantity to calculate. What is it telling me about the system

that I didn't otherwise know? And last on this topic, why does the entanglement weaken in the limit of large k?

Date & Signature

Date of manuscript submission 07 Apr 2015 22:19:48

Date of this review 13 May 2015 04:29:30

Review Report Form

	High	Average	Low	No Answer
Originality / Novelty	(x)	( )	( )	( )
Significance of Content	(x)	( )	( )	( )
Quality of Presentation	( )	(x)	( )	( )
Scientific Soundness	(x)	( )	( )	( )
Interest to the readers	(x)	( )	( )	( )
Overall Merit	(x)	( )	( )	( )

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English Language and Style

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( ) Extensive editing of English language and style required
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Comments and Suggestions for Authors

Report on Atoms-83432:

Using both the mean-field theory and the full quantum mechanical Master equation approach, the authors theoretically investigated the photon-induced spin-orbit coupling in ultracold atoms inside optical cavity.

They have found: cavity-assisted spin-orbit coupling dramatically modifies atomic dispersion relation; intriguing dynamical instabilities exist in the system; atom's back-action onto cavity field also leads to non-trivial atom-photon coupling that is fundamentally different from either the system with classical-laser induced spin-orbit coupling in the absence of the cavity or the Jaynes-Cummings model where the atomic center-of-mass motion is neglected.

The authors conclude that the synthesis of cavity quantum electrodynamics and center-of-mass is not a trivial combination and interesting new physics emerges in this setting. These interesting results may have potential applications in all-optical information processing and quantum information networks.

The manuscript reports a significant advance and offers incremental improvement to existing work in the references. Unlike hot atoms, however, cold atoms' center-of-mass motion in general can no longer be neglected in this atom + cavity system, as the center-of-mass momentum of a cold atom will be significantly affected by photon recoil from emission and absorption of even a single photon. The

similar back-action works (feedback dressing, optical bistability) have been studied in an optical ring cavity [Phys. Rev. A 86 (6), 063820 (2012)]. The authors should make a comparison between their work and such previous literatures in atomic medium or atomic-like medium [Scientific Reports 4, 3619 (2014)].

After such improvement, I could recommend publication of the manuscript in Atoms.

Date & Signature

Date of manuscript submission
07 Apr 2015 22:19:48

Date of this review
01 May 2015 14:25:12