Review of: "Dynamics of Three-Level Laser Pumped by Electron Bombardment"

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Potential competing interests: No potential competing interests to declare.

Main remarks:

General aspect, relation with the state of the art:

- The paper is almost a copy and past of [9], with terms appearing from nowhere between the equations (at least they are not properly justified).
- It covers only a part of the topic covered by [9].
- The fact that a consequent part of the paper is taken from [9] is not well cited. This is at the limit of the scientific deontology.
- The goal of this study is not clear
- When the equations are different from [9], there is no comment or justification why there is a difference (for example, in equations (160), (161), and (165), or in figure 4).
- What is the physics of electron bombardment? Which role does it play in the equations? What are the difference with the pumping procedure given in [9]?

Use of noise operators:

- The introduction of “noise operators” are not well justified. I do not understand why you have the F operators. If it is a coupling with a vacuum to account cavity losses, you do not need such a thing since the term $-\kappa a/2$ already describe the cavity losses in Eq. (5). It looks like that you take into account twice the coupling with the environment.
  You have inserted references before Eq. (5), but they do not justify the equation properly, since F is not considered in these papers.
- The operator F can be introduced if the mode interacts with a heat bath (see Claus Benkert, M. O. Scully, J. Bergou, L. Davidovich, M. Hillery, and M. Orszag,Phys. Rev. A 41, 2756, 1990). If the bath is in the ground state F=0.
- There is a mistake in Eq. (8), you cannot have kappa in this equation, written like that, it is not homogeneous. Same remark for (117).
- A reference that I can suggest concerning : Gardiner, Crispin, Peter Zoller, and Peter Zoller. Quantum noise: a handbook of Markovian and non-Markovian quantum stochastic methods with applications to quantum optics. Springer Science & Business Media, 2004.

Other remarks:

in the abstract:

- Use the present to describe the content of your paper.
- “occurs in the minus quadrature” does not make sense here because quadratures are not defined yet.
- When you use “threshold”, I recommend to be more specific, for example, by using "lasing threshold", or any other adjective that can indicate which kind of threshold you use.
- The last sentence cannot be understood if you have not read the paper. Consider removing it, or modifying it in a way such that the idea of the result is given without introducing numerical quantities.

In the introduction:

- It is not clear what are the goals of your study and what is different from the previous ones.

Section 2:

- k is not introduced in the main text
- You must have a sum over k in Eq. (1), otherwise you have a problem in your equations and you mix equations where the laser is coupled with a single atom or situations when the laser is coupled with several atoms.
- “removing the angular brackets”, above Eq. (35), is not a well-defined mathematical operation.
- You can directly obtain (48)-(52) using the first order cumulant approximation of (38)-(40), without using (35) -(37).

Bibliography:

- Check typos in the bibliography (e.g. in [12])
- Bibliography entries are not always correct in the main text, for example, Fesseha is not the author of [9].
- The number of bibliographic references is quite small. Considering the huge development of the field during the last 50 years, I can expect more bibliographic entries related to this work. Specifically when it deals with mathematical methods and computations.

Another remark:

- If you use dimensionless quantities in numerical simulations, give the normalization scale. For example $\gamma = 0.4$ does not make sense, because it is a frequency. Give the frequency of reference.

Conclusion: This paper is still at an early stage of research and many things must be improved, corrected, and justify with more caution. I have not yet verified Eq. (150) and Eq. (165), which seems to be the novel results, but because of all the problems that we have before in the text, they are not sufficient to argue in favor of the

publication of this paper.