The Quantum Theory of the Laser Applied to: Bose Condensation, Radiation from a Black Hole, the Fr"olich Condensate and COVID-19 Virus Dynamics

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The original motivation for developing the quantum master equation for the laser was provided by Glauber [1], who said:

> The only reliable method we have of constructing density operators, in general, is to devise theoretical models and to solve the equation of motion for the density operator. These assignments are formidable ones for the case of the laser oscillator and have not been carried out to date in quantum mechanical terms. The greatest part of the difficulty lies in the mathematical complications associated with the nonlinearity of the device. ... It seems unlikely, therefore, that we shall have a quantum mechanically consistent picture of the frequency bandwidth of the laser or the fluctuations of its output until further progress is made with these problems.

In the present talk, the laser quantum master equation analysis [2] will be shown to provide a useful tool for describing the Bose condensate as an "atom" laser [3] on the one hand and the radiation from atoms falling into a black hole [4] on the other. Furthermore, the dynamics of various problems in biophysics such as Fröhlich [5] condensate of collective motion in proteins [6] and calculating the binding energy of the COVID-19 virus to the ACE sites in the body [7], will also be discussed using the quantum theory of the laser formalism.

References

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