Electron Musical Chairs: The Rabi Oscillation

(QuTIP Edition)

by

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INTRODUCTION

CONTEXT

The Statistical Nature of Light – Object Measured

Rabi Oscillations – Property Measured

Quantum Dot – Experimental Production of the Object to be Measured

Unbalanced Mach-Zender Interferometer – Measurement Process of Object to Obtain Information on the Property

Lindblad and/or Bloch-Redfield Master Equations – Analytic Theory

Of the multiple modes proposed for quantum computation; one of the first was quantum optics. It is a natural choice for candidacy due the photon’s high mobility and durability. That is to say that it weakly interacts with its environment. However, despite this, it is because of these strengths that it also lacks. It is difficult to achieve successful photon-photon interactions, when the photons are highly mobile and will withstand external interactions. This has another consequence, in that it is difficult to create nonlinear gates, especially when most optical tools are linear in nature. To remedy this, through the combined efforts of Knill, Laflamme, and Milburn; the KLM/linear optical quantum computing (LOQC) was born; and it seeks to make optical quantum computing a reality.

The KLM/LOQC protocol outlines three distinct criteria that must be attained in order to have a successful optical system:

1. Heralded single photon sources with strict mode and bandwidth characteristics - with emphasis on heralded

A heralded photon source is able to generate entangled pairs of photons. This solves the difficulty of creating entanglement reactions between photons.

1. High-efficiency number resolving single photon detectors

The exact method is not outlined, but the detector counts the number of photons incident on the detector. Upon measurement, the photon is destroyed, as such any state information is not discernable.

1. Construction of complicated optical circuits exhibiting both classical and quantum interference effects

We will be addressing the first of three criteria in this thesis. While we have achieved a heralded source in spontaneous parametric down conversion (SPDC). Is it possible for us to do better?

(Throw in a picture) Before we continue, I wish to outline the basic premise behind SPDC. This non-linear optical tool takes in a single photon input, incident upon a crystal, and outputs entangled photon pairs. The sum of the momenta and energies of the photon pairs total to the initial momentum and energy of the incident photon, which follows in accordance to conservation laws.

Intuitively expect once electrons are excited by laser that that was the end of the story, however what actually happens is an oscillatory excitation and de-excitation of the electron that is dependent on the pulse length of the laser.