

# The quantum Rabi model: solution and dynamics

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**Abstract.** This article presents a review of recent developments on various aspects of the quantum Rabi model. Particular emphasis is given on the exact analytic solution obtained in terms of confluent Heun functions. The analytic solutions for various generalisations of the quantum Rabi model are also discussed. Results are also reviewed on the level statistics and the dynamics of the quantum Rabi model. The article concludes with an introductory overview of several experimental realisations of the quantum Rabi model. An outlook towards future developments is also given.

## 1. Introduction

80 years ago Rabi [1] introduced a model to discuss the effect of a rapidly varying weak magnetic field on an oriented atom possessing nuclear spin. The simplest case corresponds to a two-state system. The atom is treated as quantised, and the field is treated as a classically rotating field. The effect of a non-rotating, alternating field was later discussed by Bloch and Siegert [2], who found a shift in the position of the resonance – now called the Bloch-Siegert shift. This shift has been observed in experiments with a driven superconducting qubit [3].

Jaynes and Cummings [4] introduced a similar quantum model in 1963 describing a two-level atom interacting with a quantised mode of an optical cavity. Their initial goal was to study the relationship between the quantum theory of radiation and the corresponding semi-classical theory. Despite its simplicity, the quantum Rabi model was not regarded as exactly solvable. To solve the model, a rotating wave approximation

# [The Quantum Rabi Model Solution And Dynamics Arxiv](#)

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