MATHEMATICAL PHYSICS
Submitted: SEPTEMBER 2020

INTERACTIVE SIMULATION OF APPLICATIONS OF PERTURBATION THEORY

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ABSTRACT—- In this era of advancement ,we very well acknowledge the use of Quantum Mechanics in varied Technological Fronts like Atomic clocks, GPS Navigation, Telecommunication, Cryptography and Super Powerful Computers. This Document presents an overview of the Simulation proposed ,that is, Applications of Perturbation Theory and approximating the error between the Theoretical and Experimental Values (as referenced). As we are already aware that perturbation theory is a set of approximation methods directly related to mathematical perturbation for describing a complicated Quantum System such as Harmonic Oscillator , Stark Effect , Infinite Potential Well, Electron-Photon Interaction.Therefore, Perturbation Equations can be very well Computed and Visually represented in the form of Contour graphs through Matlab Simulink and can further be compiled using Python or Javascript in order to fabricate an Interactive Simulation as a Final Result.

Keywords— Perturbation Theory, Stark Effect, Harmonic Oscillator, Mathematical Models, Matlab Simulink, Interactive Simulation.

I MOTIVATION

The primary motivation is to represent Theoretical Analysis, that is Perturbation Theory, in our case, in the form of visual representation for multiple parameters for a clearer perception of the concept.

*Literature Review:*We analyzed the following resources aligning with our topic of study to gain a holistic understanding:

- ☐ Time Independent and Degenerate Perturbation Theory [1].
- ☐ The Zeeman and Stark Effect with respect to Energy Level Plots [2].
- ☐ Stark Resonance for Hydrogen Atom using Perturbation Theory of the Schrodinger Equation. [3]
- ☐ Time Dependent Perturbation Theory.[4]
- ☐ 3D Plot Generation in Matlab.[5]
- ☐ Comparison between the Experimental Results and Theoretical Calculations with respect to Stark Effect.[6]

II PLAN OF ACTION

Identifying valuable Resources and Data: Figuring out relevant resources with aligning experimental data i.e.parameter shift in the Equations considered.

Analyzing Mathematical Models : Considering different Mathematical Model-Equations like Degenerate/Non-Degenerate Perturbation Theory for Critical Analysis of the Application Considered.

Summarizing Final Results : Stating viable Application of Perturbation Theory and Presenting the Interactive Simulation prepared.

III ACKNOWLEDGEMENT

The authors wish to Thank Dr. R K Sinha

(Department of Applied Physics, DTU)

We hope we have provided a satisfactory proposal.

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3. DC strong-field Stark effect: consistent quantum-mechanical approach A V Glushkov and L N Ivanov
4. Perturbation Theory by Chris-Kriton Skylaris
5. https://in.mathworks.com/help/matlab/visualize/creating-3-d-plots.html
6. https://www.researchgate.net/publication/241012069_Stark_Effect

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