Physics 381C Project Outline

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I Introduction

- **A** Discussion of high-harmonic generation and its relation to classical chaos.
- **B** The model: sinusoidally driven triangle well.

II Numerical Computation of Radiation Spectra

- **A** Compute the solution to the Time-Dependent Schrödinger's Equation.
  - **1** This can be done by using a PDE solver and an initial condition for the wave-function ...
  - **2** ...or by decomposing the solution into a basis of energy eigenstates for the triangle well and solving for the coefficients of that decomposition. This second method helps avoid any complications caused by the infinite wall in the potential.
- **B** Once the solution is computed, the radiation spectrum can be calculated by taking the Fourier transform of $<\psi(x,t)|\ddot{x}|\psi(x,t)>$.

III Periodic Orbit Theory

- **A** Locate periodic orbits of the classical driven triangle well.
  - **1** This is essentially a shooting problem with two parameters (x_0 and p_0).
  - **2** Only periodic orbits with periods $T = \frac{2\pi n}{\omega}$, where ω is the frequency of the driving force (classical electric field), need to be identified.
  - **3** Periodic orbits need to found up to some specified maximum period ($T_{max} = \frac{2\pi n_{max}}{\omega}$).
- **B** For each periodic orbit calculate the trace of the stability matrix.
- **C** For each periodic orbit calculate the classical action along that orbit.
- **D** This information can then be used to construct a finite-resolution density of states for the quasi-energies (Floquet eigenvalues) of the system.

IV Semiclassical Calculation of Radiation Spectra

- **A** Decompose the initial quantum state into wave packets.

B Propagate these wave packets using a semiclassical propagator (i.e. along classical trajectories).

C When the wave packets return to the nucleus, calculate the probability for a transition back to the initial state and emission of a photon.

D Use this information to compute a radiation spectrum for the system.

E Note: this theory has not yet been fully worked out.

V Classical Chaos

A If time permits, strobe plots of the classical phase space can be computed to show the onset of chaos in the classical system.

B The field strengths at which the classical phase space becomes mixed (part regular, part chaotic) and globally chaotic (no regular motion) should be identified.

VI Conclusion

A What do these results say about the connection between classical chaos and high-harmonic generation?

B What do the results say about the problem of "quantum chaos".