RESONANCE AND REVIVALS I. QUANTUM ROTOR AND INFINITE-WELL DYNAMICS

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Space-time structure of exploding quantum wave packets exhibit a resonate beating phenomena. Such ”super-beats” were called ”revivals” by J. H. Eberly in connection with numerical studies of Jaynes-Cummings models of atom-in-cavity quantum electrodynamics. The term revival refers to the ability of an initial localized wave packet to dramatically ”un-explode” after a period of decoherent quiescence and then more-or-less repeat the process.

Analogous revival dynamics can be seen most clearly in a simple 1D rotor or Bohr-ring atomic model, and this provides what is perhaps the clearest understanding so far of the underlying wave mechanics. In this model the main revival and its multitude of sub-revivals repeat perfectly. For this model it is possible predict the space-time location of each revival peak and rank its coherence using a Farey-sum formula so named after a geologist who studied tidal resonance in the early 1800’s. Moreover, it is possible to calculate the phases of individual revival peaks using overlapping Cyclic (Cn) group character tables.

The resulting interference patterns clearly exhibit all factors of each integer n below a certain Farey-threshold determined by spatial width of the initial packet.

A subsequent talk will discuss the revivals observed in Morse oscillator vibrational potential models.