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On possibility of dynamical stabilization of inverted quantum oscillator in time periodical and space uniform field

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Statement of the Problem: The trajectory of classical particle in field of inverted harmonic oscillator (IHO) U(x)=-ω2x2/2 additionally driven by sinusoidal force of F(x,t)=F0sin(Ωt+ϕ) may occur in ideal bounded in time t forever though unstable for certain phase ϕ depending on initial conditions (IC) x0, p0 and the parameters above. The phenomenon is called dynamical stabilization and it may be observed for any superposition of stabilizing sinusoids with varying Ωs too. It is of great interest to learn whether this stabilization takes place In quantum domain where IHO model is traditionally used for description of different tunneling phenomena and decay of unstable species in field of laser radiation and so on. The nonstationary Schroedinger equation (NSE) occurs integrable for starting wave function ψ(x,t=0) of generalized Gaussian type. But quantum IC may be fitted only approximately for such ψ(x,t=0) with almost macroscopic x-spreading σ0=212—225 of featured units. Analytical and numerical calculation show that the half width of wave packet σ(τ=ωt) behave in non-monotonous way first collapsing to common minimum of about ½ and then irreversibly and unlimitedly broadening due to exponential law. As in classical case for certain phases ϕ(Ω/ω, σ0) the packet center ξav(τ) didn't leave immediately the domain of stationary point for of stationary point but first oscillated near it for about two natural "periods" with the phase serving as bifurcation point. So the stabilization occurred only for this short time and was especially featured for large Ω/ω-ratios. For general phases ϕ the center leaved quickly to infinity almost without oscillations just like in classical case. It's worth to note that this case corresponds to σ0 →∞ not to 0 so there arises certain problem with universal correspondence principle. Analogous dynamical stabilization takes place also in spin systems subjected to alternating magnetic field and for some atoms which cease their ionization in intense laser field.

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