Quantum mechanics of open systems and path integrals

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1. Tunneling splitting in Quantum Mechanics and «Instantons»
    1.1. Path integrals in imaginary time. Extremal solution of the kink type in $V_1(x) = - x^2 + x^4$ and fluctuations nearby. Zero mode and calculation of tunneling amplitude and level splitting
    1.2. Decay of metastable state in unstable potential $V_2(x) = x^2 - x^3$. Imaginary part of the ground state energy and decay rate. Bounce solution, zero mode and negative mode
    1.3. Introduction to Gelfand-Yaglom method

2. Orthogonality catastrophe
    2.1. Bosonized representation
    2.2. Fermi-edge singularity
    2.3. Dephasing in an interferometer and orthogonality catastrophy
    2.4. Introduction into dissipative two-level systems

3. Feynman-Vernon influence functional for density matrix - 1
    3.1. Equilibrium density matrix. Imaginary-time evolution equation and path integral. Partition function
    3.2. Equilibrium density matrix in electric and magnetic fields. Feynman variation principle
    3.3. Equilibrium density matrix in presence of linear coupling to external field. Influence functional in imaginary time representation
    3.4. Polaron problem

4. Feynman-Vernon influence functional for density matrix - 2
    4.1. Non-equilibrium density matrix: two-branches (Keldysh) path integral. Averaging over bath and influence functional. Oscillator bath at the given temperature. Periodicity over imaginary time
    4.2. Influence functional in terms of Keldysh Green functions
    4.3. Bath with linear (Ohmic) dissipation
    4.4. Quantum Langevin equation and its classical limit
    4.5. Classical dissipative dynamics and supersymmetry

5. Dissipation in Quantum Mechanics - 1
    5.1. Examples of physical systems
     - Two-level systems: NH_3 and similar, large spins in molecular clusters, qubits, TLS in metals
     - Narrow band problems: mu-mesons in metals, phase dynamics in Josephson junctions
     - Decay of metastable states in presence of dissipation: phase slip in biased Josephson junctions, electron tunneling to a dirty metal, dislocation's creep in quantum crystal
    5.2. General theory of quantum decay in presence of dissipation
    5.3. From thermal activation to dissipative tunneling. Pre-exponential factor

6. Dissipation in Quantum Mechanics - 2
    6.1. Two-level systems with dissipation
     - Two-level systems with dissipation in imaginary time at weak coupling $\alpha \ll 1$