

Fig. 7.1. Quantile trajectories of the tunnel effect. The upper plot represents the time development of the scattering of an initially Gaussian wave packet by a repulsive potential barrier of height V_0 . The expectation value of the kinetic energy is smaller than V_0 . The small circles indicate the position of the classical particle. The shaded areas under the curves correspond to the probability $P = 0.4$ in the interval $x_P(t) \leq x < \infty$. The line cutting through the plot from the upper left to the lower right is the quantile trajectory for $P = 0.4$. The lower plot presents the quantile trajectories for the value $P = 0.1$ for the top curve and in steps of $\Delta P = 0.1$ for the lower curves up to $P = 0.9$. The thick curve is the same quantile trajectory as the one in the upper plot.

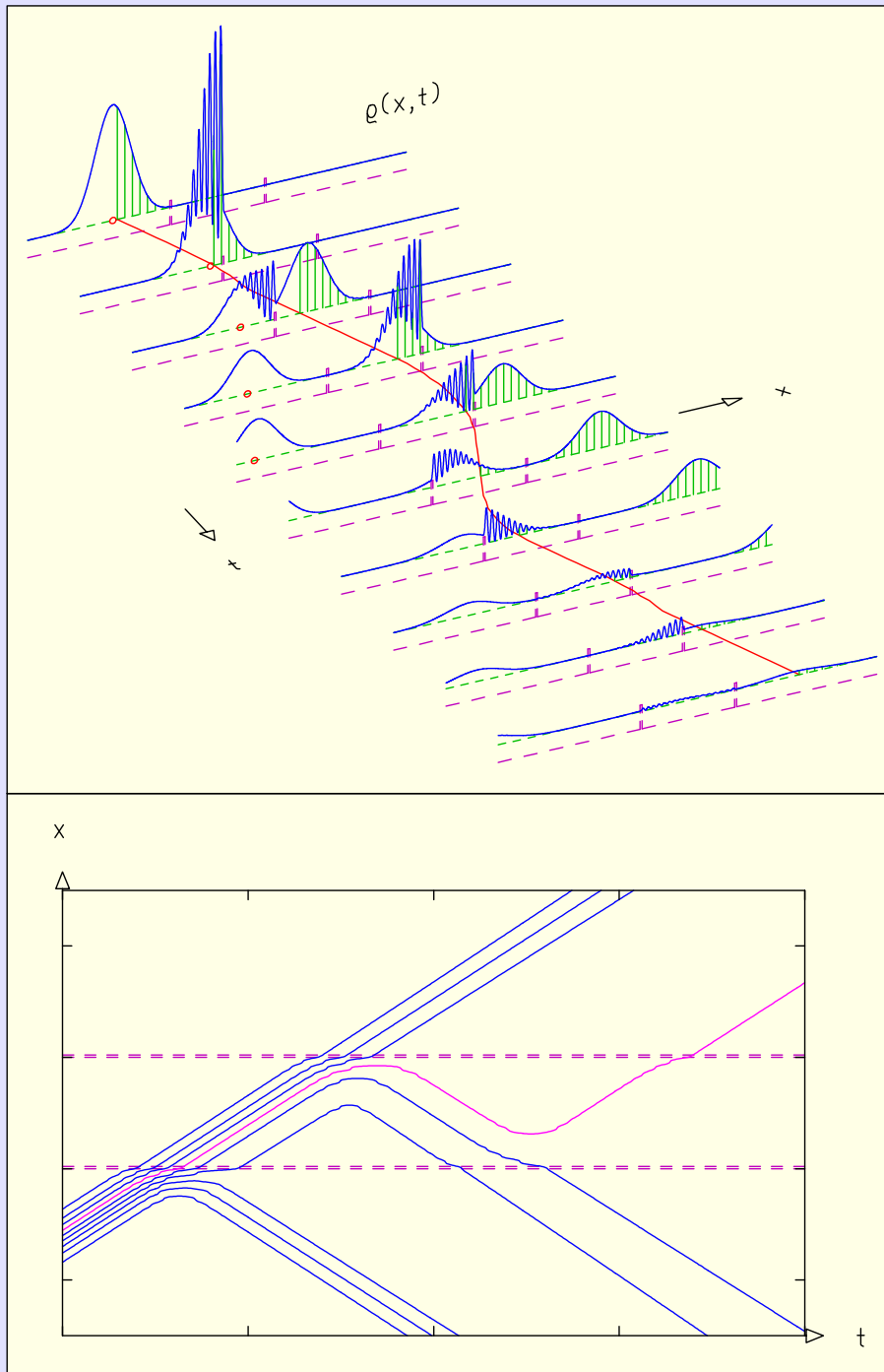


Fig. 7.2. As Figure 7.1 but for a double barrier.

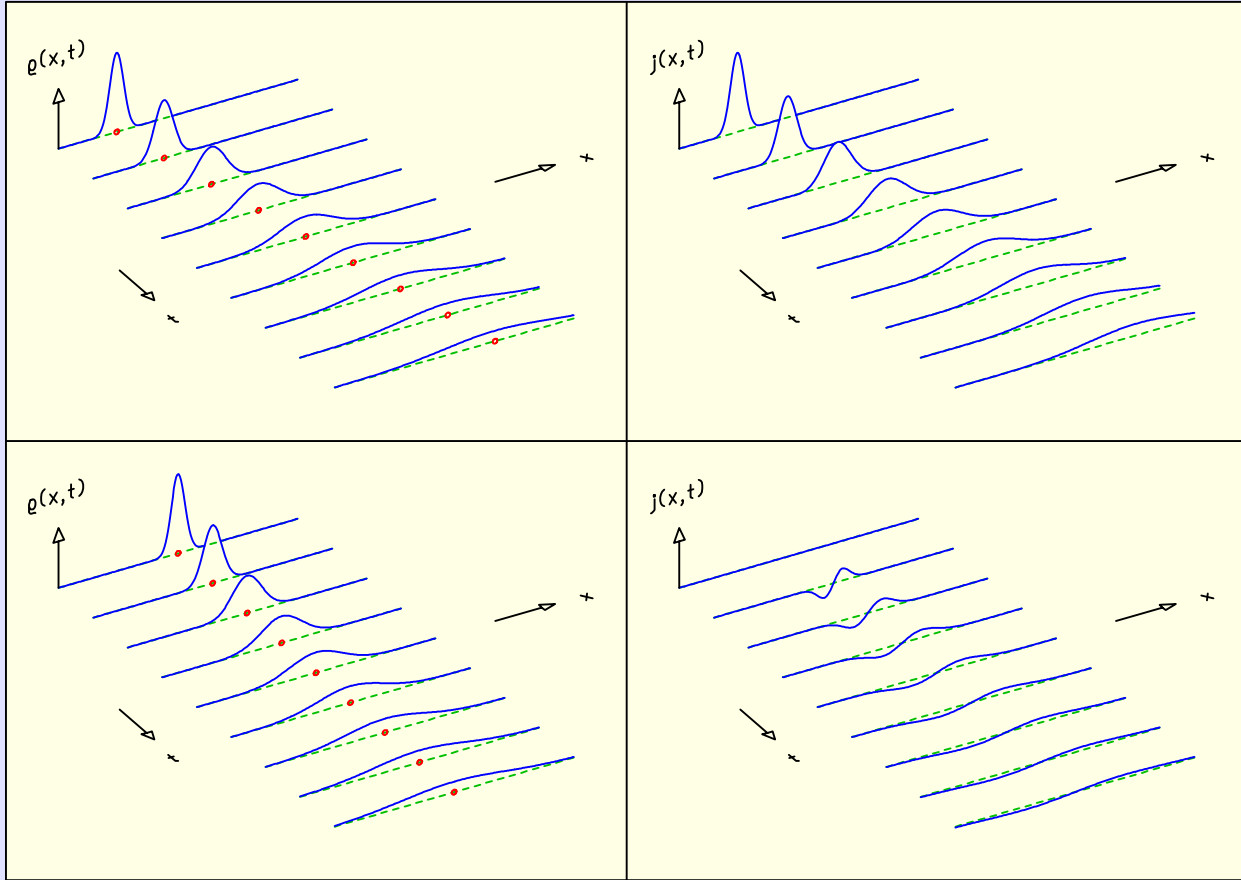


Fig. 7.3. Time development of the density $\rho(x,t)$ and the probability current density $j(x,t)$ of the force-free motion of a Gaussian wave packet. The graphs in the top row refer to a moving wave packet, the bottom row to a wave packet at rest, $\langle x(t) \rangle = \text{const} = 0$. The small circles indicate the position expectation value $\langle x(t) \rangle$ of the wave packet. In the bottom row the change with time of the wave packet is entirely due to its broadening because of dispersion. The probability density remains even with respect to $x = 0$, the current density stays odd, thus, the integral over the current density vanishes.

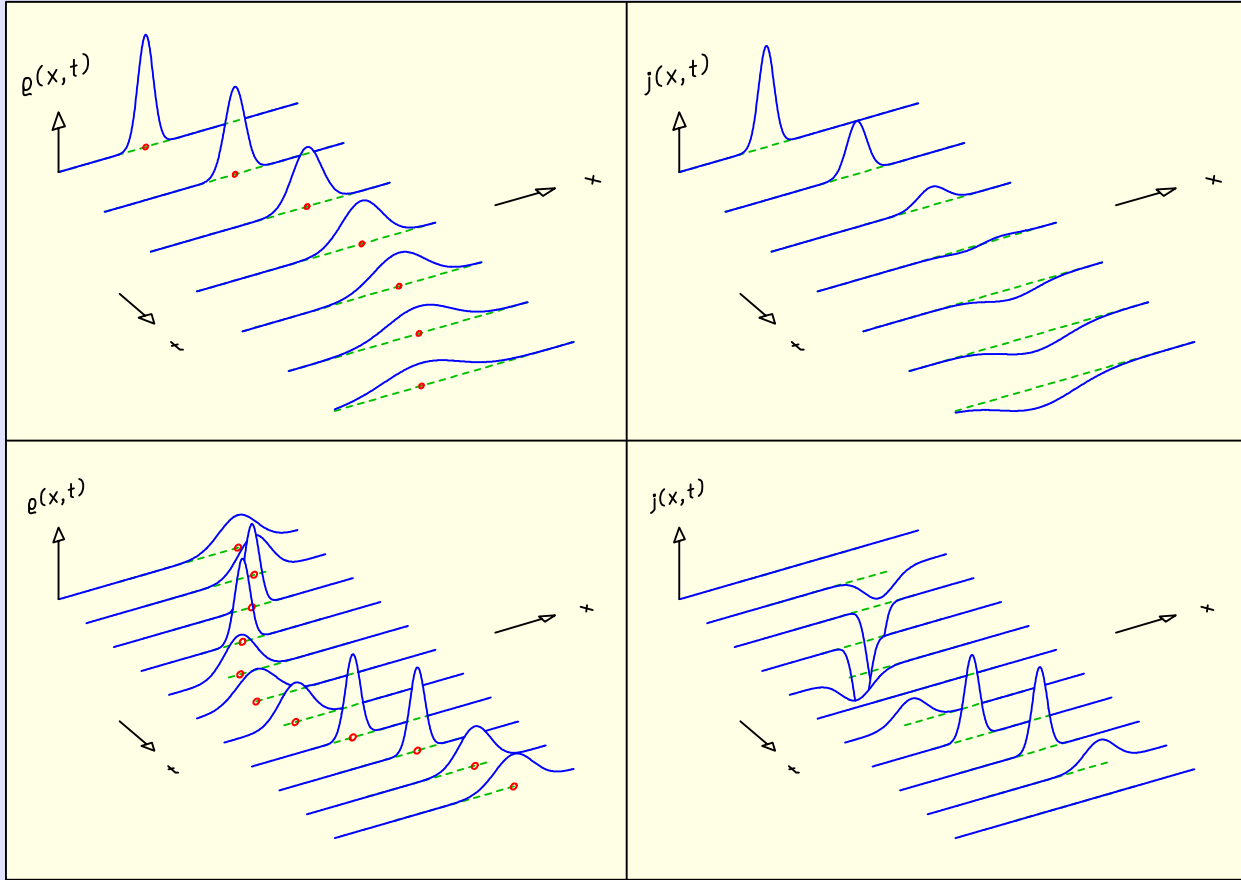


Fig. 7.4. Time development of the probability density $\rho(x, t)$ and the probability current density $j(x, t)$ of a Gaussian wave packet moving under the action of a spatially constant force (top row) and under the action of a harmonic force (bottom row). The small circles indicate the position expectation values of the wave packets. The current density possesses regions of positive or negative values. For the case of a constant force (top row) the wave packet moves to the right for early times; accordingly, the current density is mainly positive. At the turning point (middle of the seven time instants) the current density exhibits regions of positive as well as of negative values. Since the velocity expectation value vanishes at the turning point, the integral of the current density over the whole x axis vanishes. The wave packet in the harmonic oscillator is shown over one time period. Since the initial position expectation value x_0 is positive, the initial velocity expectation value p_0/m vanishes. The current density is mainly negative before it reaches the turning point, thereafter its values are mainly positive.

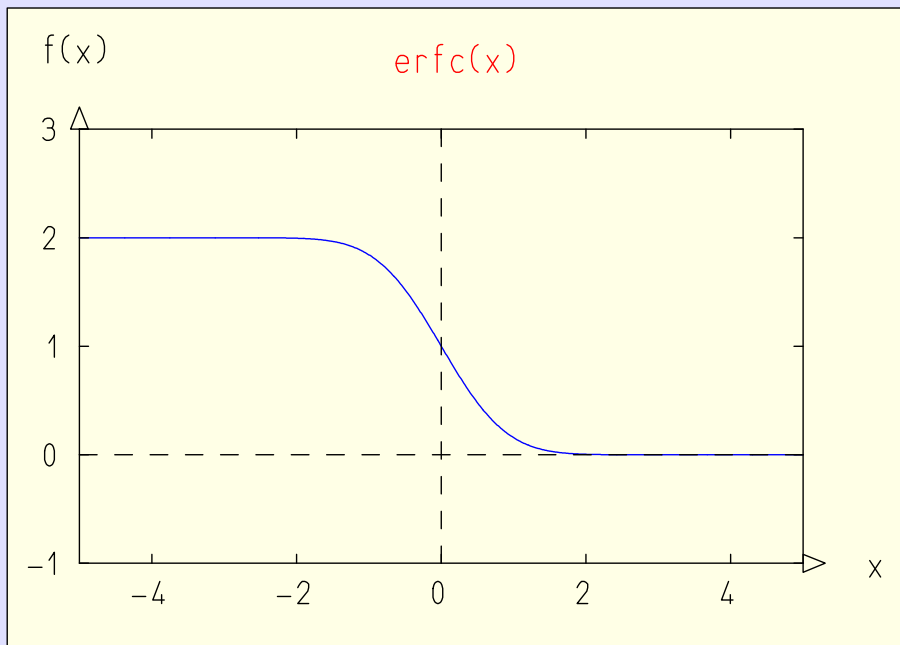


Fig. 7.5. Plot of the (complementary) error function $\text{erfc } x$.

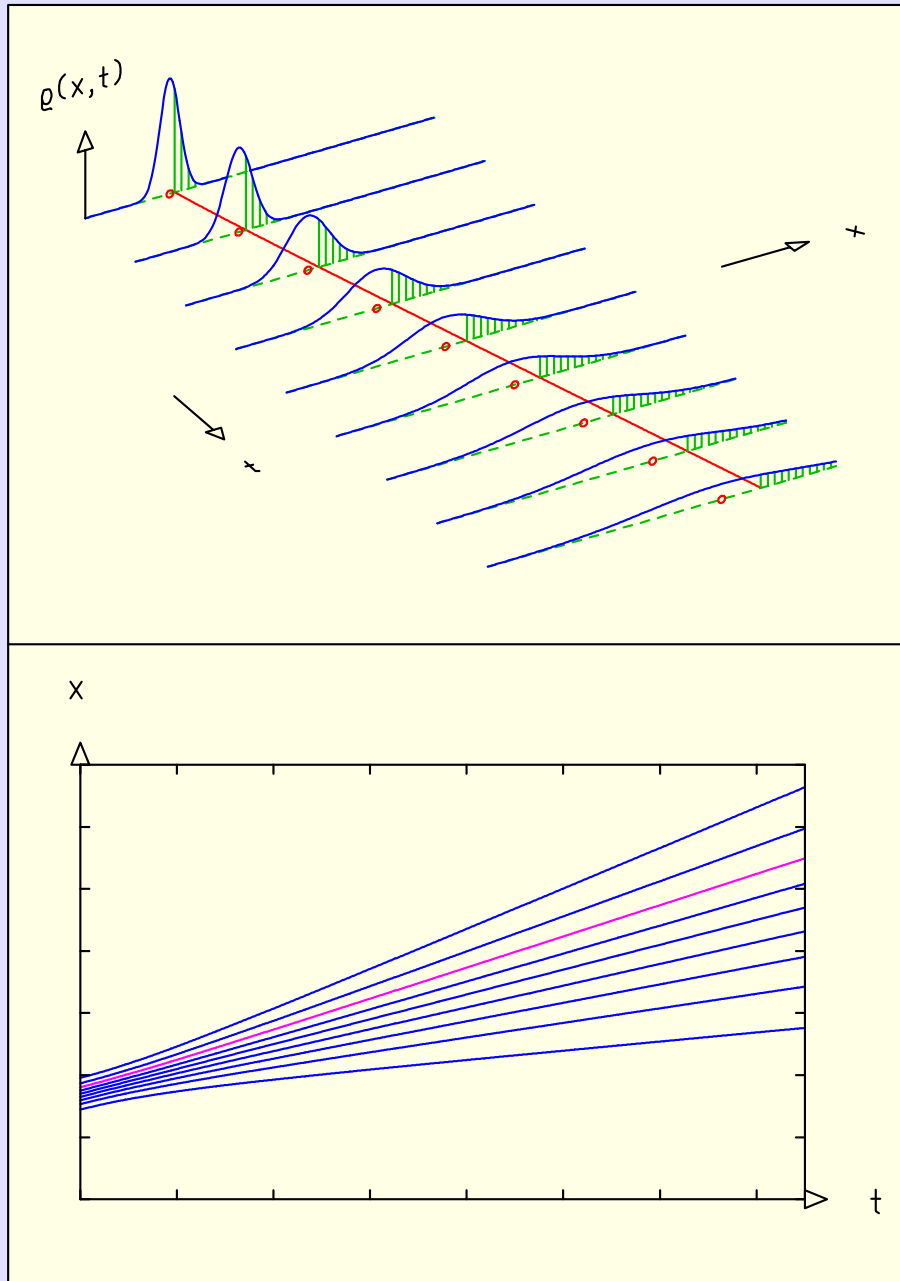


Fig. 7.6. Quantile trajectories of a force-free Gaussian wave packet. The upper plot presents the time development of the probability density. The small circles on the x axis indicate the position expectation values. The hatched areas correspond to the region $x > x_P(t)$ for $P = 0.3$. The thick line is the corresponding quantile trajectory. The lower plot exhibits the quantile trajectories for this wave packet for different values of P . The trajectories correspond to $P = 0.1$ (top line) and $P = 0.9$ (bottom line) in steps of $\Delta P = 0.1$. The thick line is the trajectory shown in the upper plot.

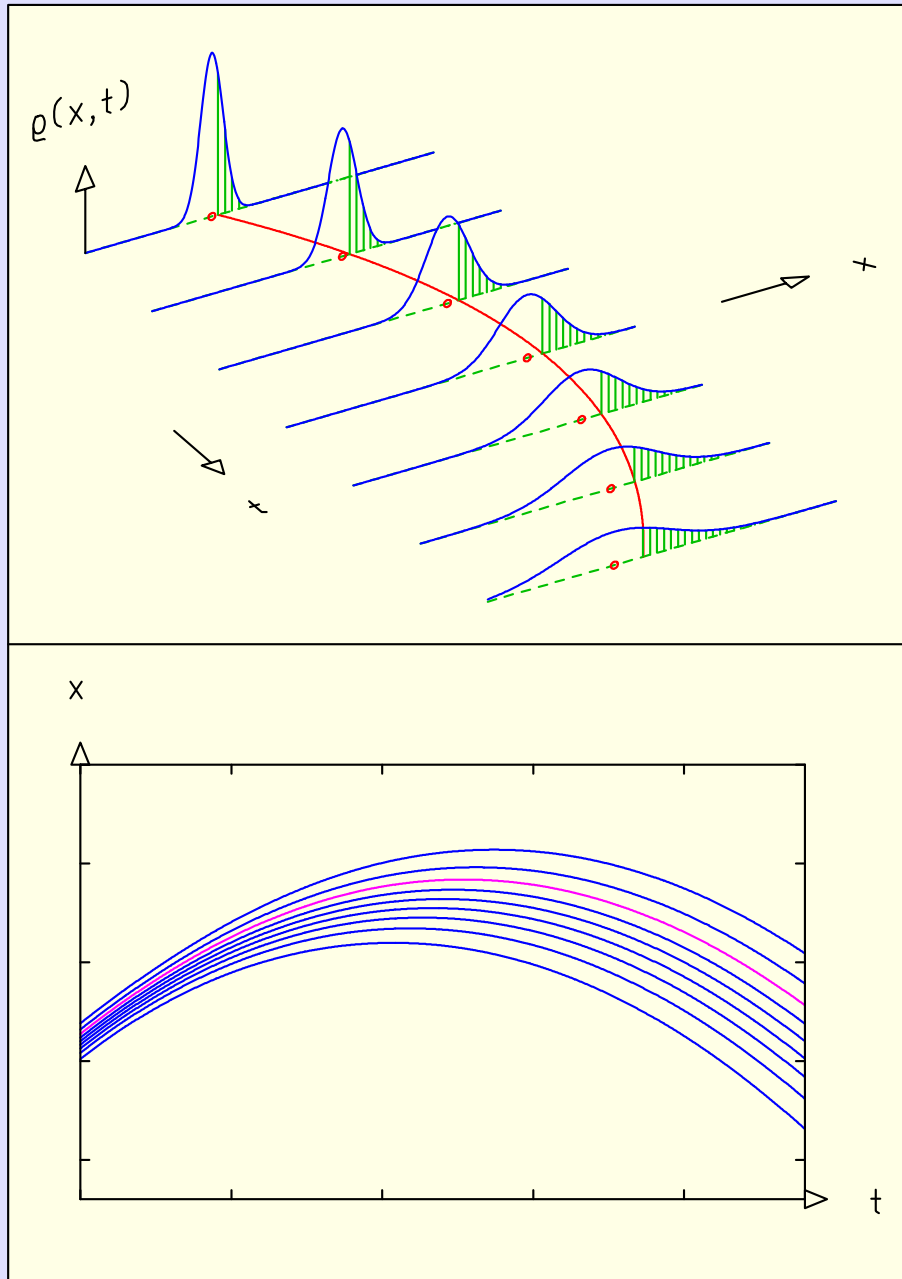


Fig. 7.7. As Figure 7.6 but for the motion under the influence of a constant force.

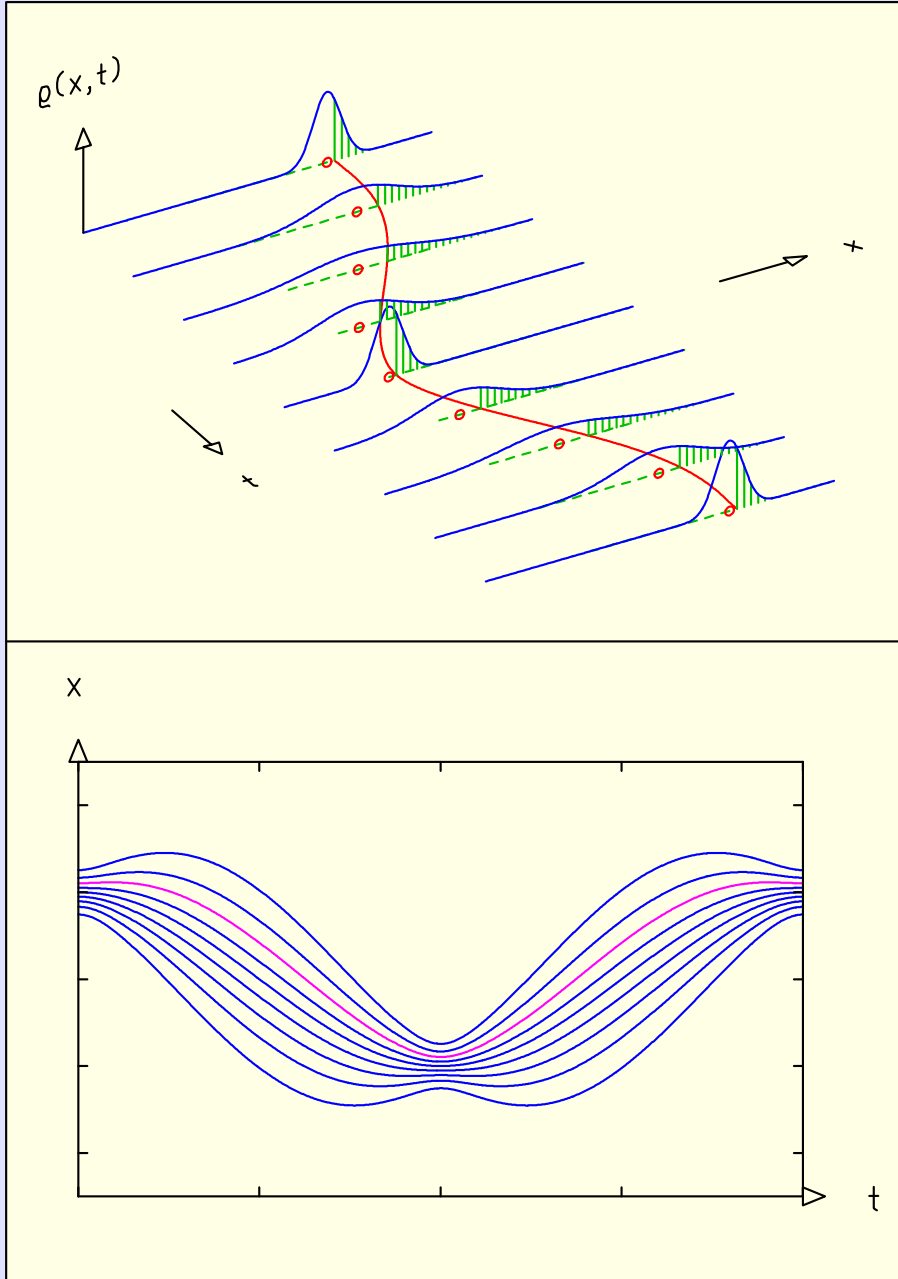


Fig. 7.8. As Figure 7.6 but for motion in a harmonic-oscillator potential. The line $x_P(t)$ for $P = 0.5$ is identical to the trajectory $\langle x(t) \rangle$ of the position expectation value. Only this curve is a cosine function. For all other values $P \neq 0.5$ the quantile trajectories deviate from the trigonometric functions. This deviation is due to the time dependence of the width $\sigma_x(t)$, i.e., due to the time-dependent broadening and shrinking of the squeezed state.

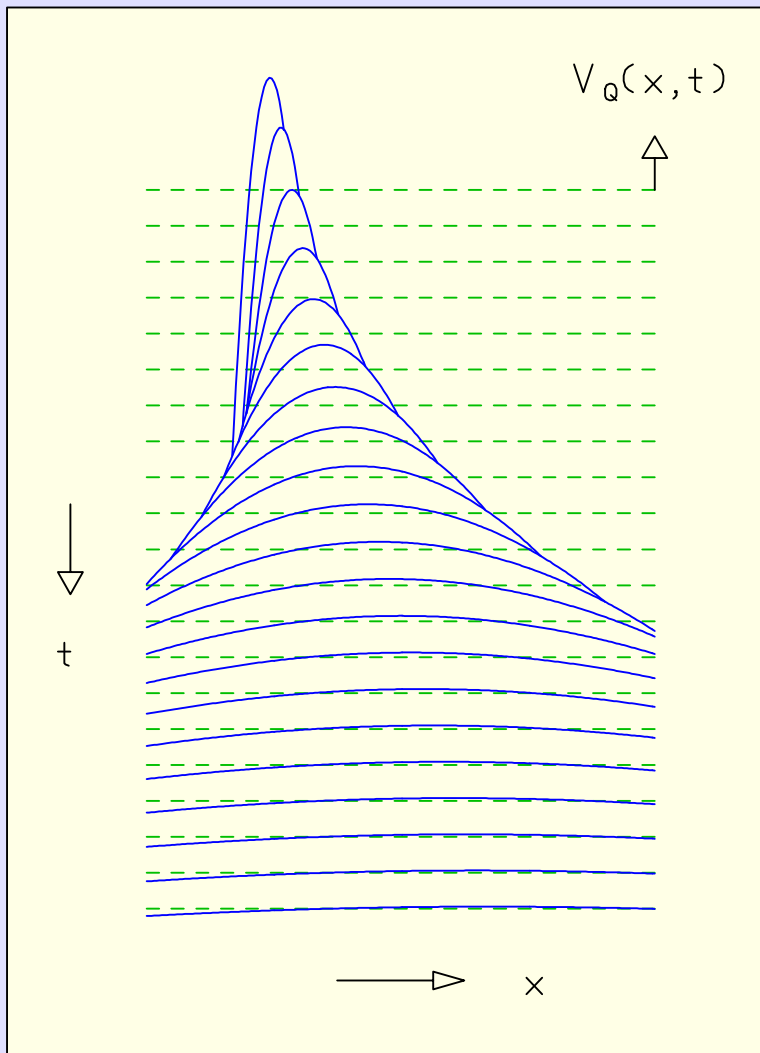


Fig. 7.9. Time development of the quantum potential $V_Q(x, t)$ of a force-free Gaussian wave packet. At any time it is a repulsive, parabolic potential. The force $F_Q = -\partial V_Q / \partial x$ produces the dispersion of the Gaussian wave packet in Bohm's description of quantum mechanics. At $t = 0$ the maximum at $x = \langle x(0) \rangle$ of the potential $V_Q(x, t)$ as well as its curvature are largest; both values decrease with increasing time. The decrease of the quantum potential reflects the fact that the quantile trajectories of the force-free Gaussian wave packets are hyperbolas as functions of time approaching straight lines as asymptotes for large times.