

Fig. 12.1. Scattering of a plane wave incident from the left, that is, along the z direction, by a repulsive potential. The potential is confined to the region $r < d$, indicated by the small half-circle marked off by a short-dash line. The energy E of the plane wave is two-thirds the height of the potential in this region. Shown are the real part, the imaginary part, and the absolute square of the wave function $\varphi_k^{(+)}$.

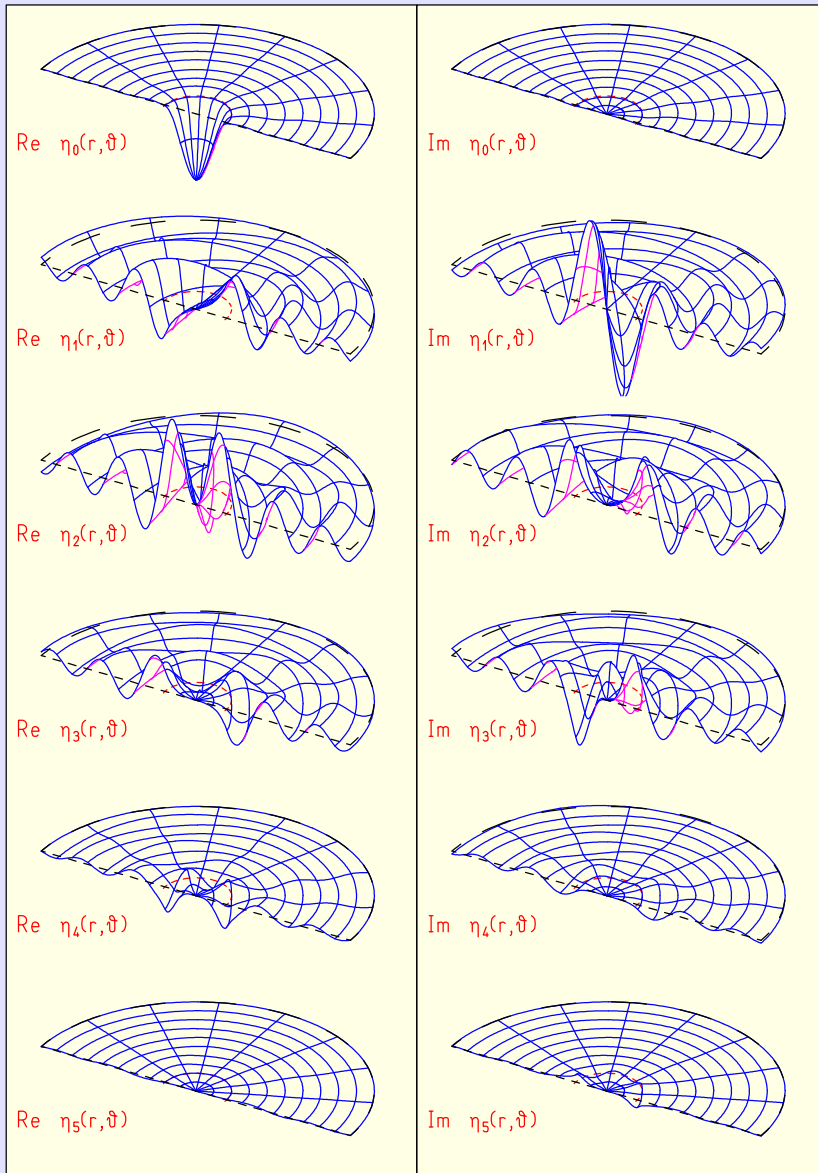


Fig. 12.2. Real and imaginary parts of the scattered partial waves η_ℓ , resulting from the scattering of a plane wave by a repulsive potential, as shown in Figure 12.1.

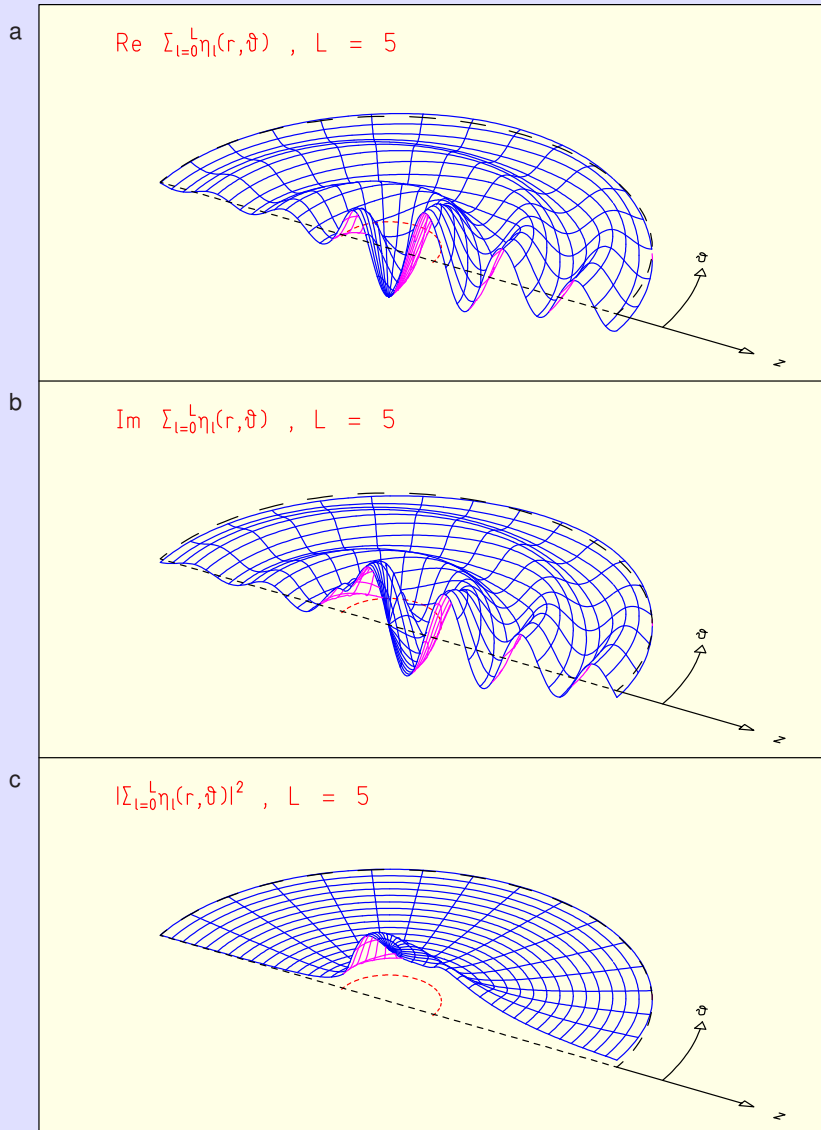


Fig. 12.3. Real part, imaginary part, and absolute square of the scattered spherical wave η_k resulting from the scattering of a plane wave by a repulsive potential, as shown in Figure 12.1.

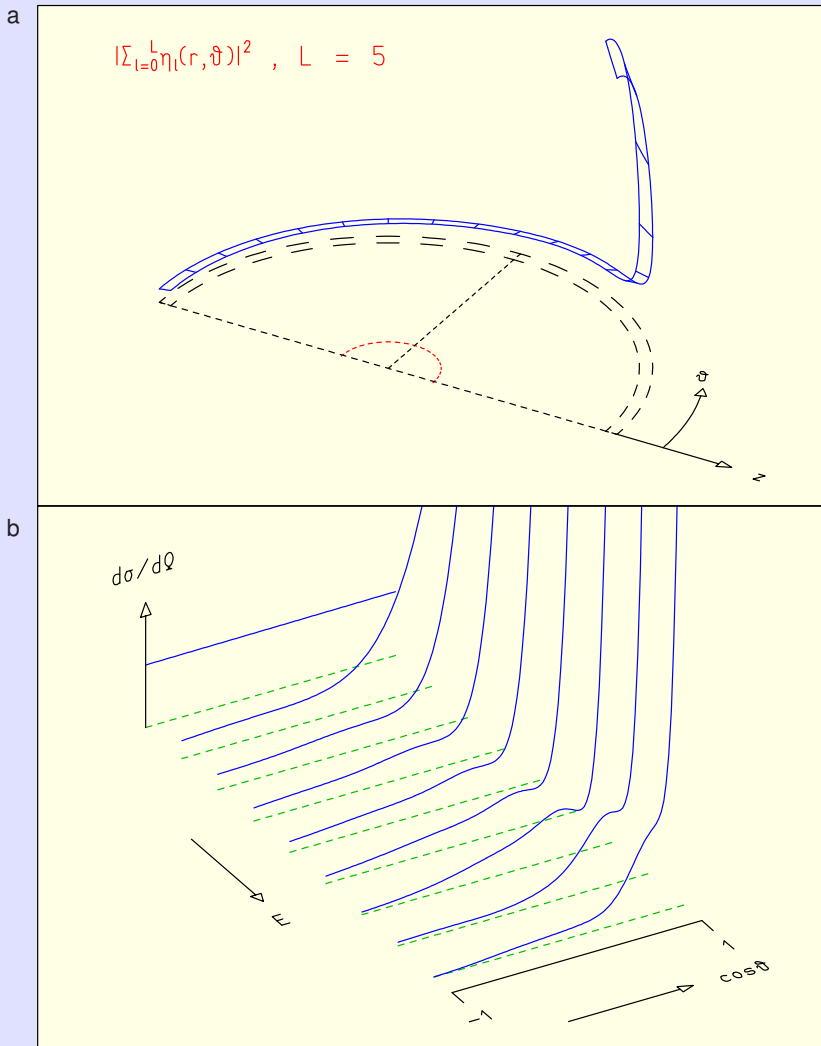


Fig. 12.4. (a) Intensity of the scattered spherical wave resulting from the scattering of a plane wave by a repulsive potential, as shown in Figure 12.1. The intensity at a fixed radius far outside the scattering region and for a given scattering angle ϑ is indicated by the height of the band. The band corresponds to the outer rim of Figure 12.3c, blown up by a scale factor. (b) Energy dependence of the differential scattering cross section $d\sigma(\vartheta)/d\Omega$ for the scattering of a plane wave by a repulsive potential. The differential cross section is proportional to the intensity of the scattered wave, as we can see by comparing the curve in the middle of part b with the band in part a. Both correspond to the same energy.

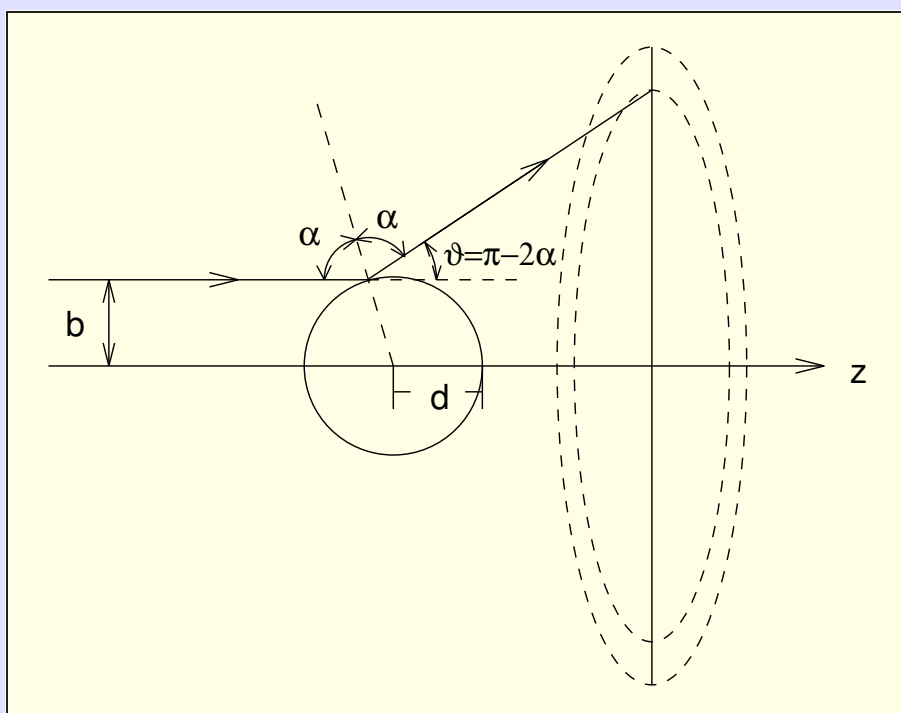


Fig. 12.5. The classical elastic scattering of a point particle by a rigid sphere.

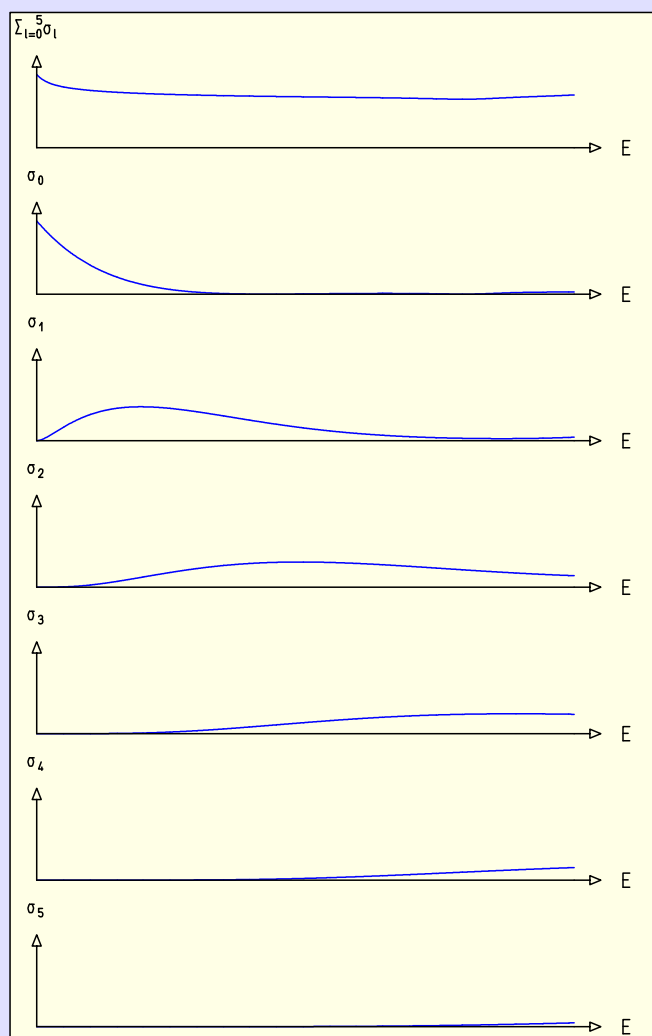


Fig. 12.6. The partial cross sections $\sigma_\ell(E)$ for $\ell = 0, 1, \dots, 5$, and the total cross section $\sigma_{\text{tot}}(E)$, which is approximated by the sum over the first five partial cross sections for the scattering of a plane wave by a repulsive potential.

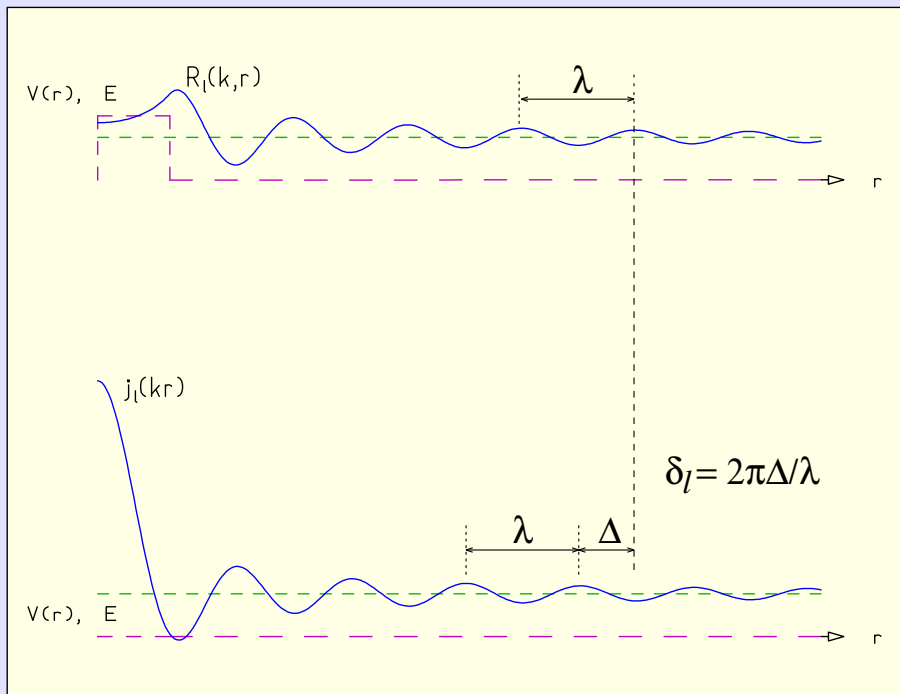


Fig. 12.7. Definition of the scattering phase shift δ_ℓ . The solution R_ℓ of the radial Schrödinger equation for a given ℓ , here $\ell = 0$, is shown for the scattering of a wave of energy E by a repulsive potential (top) and for vanishing potential (bottom). Asymptotically, that is, far outside the potential region, both solutions differ only by a phase shift δ_ℓ .

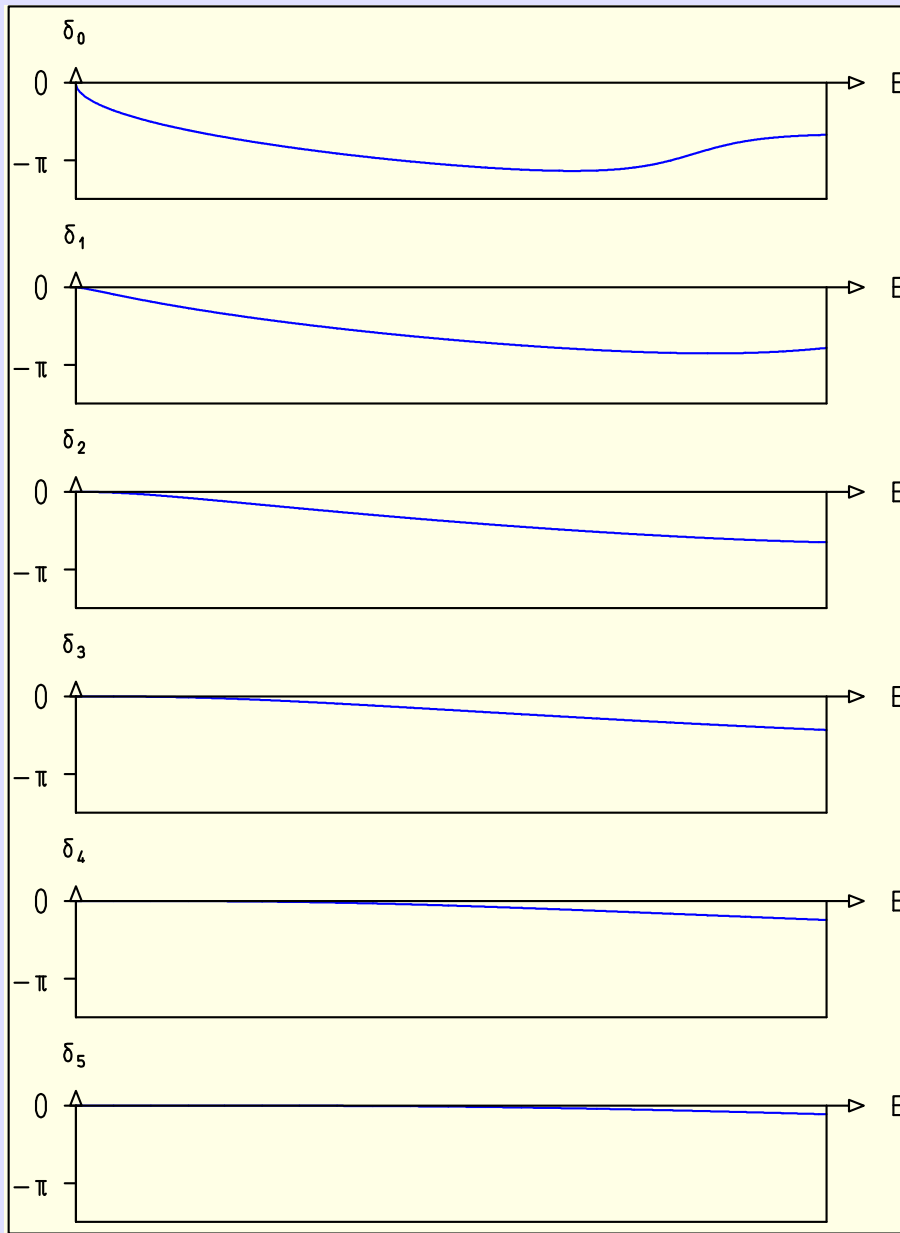


Fig. 12.8. Energy dependence of the phase shifts $\delta_0(E)$, $\delta_1(E)$..., $\delta_5(E)$ for scattering by a repulsive potential. There is an ambiguity in the definition of δ_ℓ , which is resolved by choosing $\delta_\ell(0) = 0$. All phase shifts vary slowly with energy for scattering by a repulsive potential.

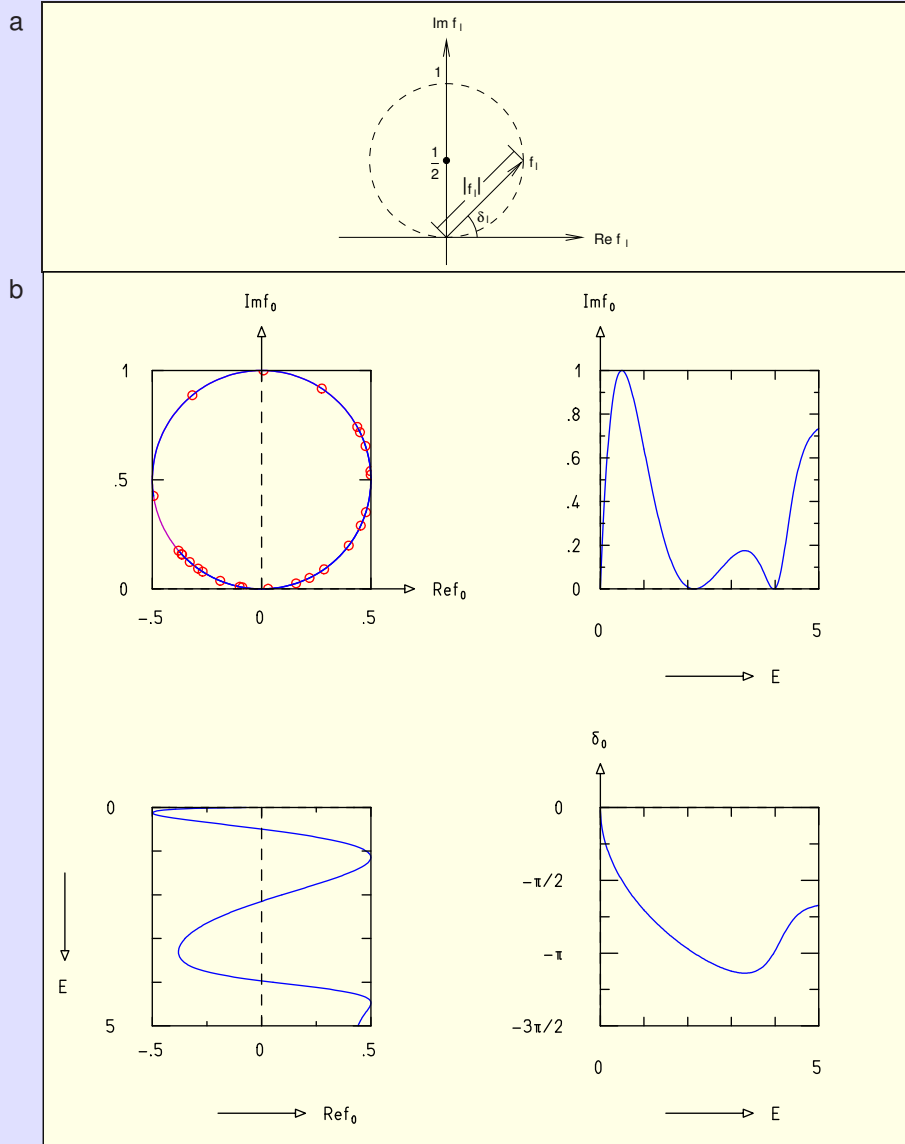


Fig. 12.9. (a) Unitarity circle. (b) Through the unitarity relation $\text{Im } f_l = |f_l|^2$ the elastic partial-wave amplitude is confined to a circle in an Argand diagram. The angle between the vector f_l in the complex plane and the real axis is the phase shift δ_l . As the energy E increases the point $f_l(E)$ moves on the circle starting at $f_l(0) = 0$. Points equidistant in energy are marked off by small circles (top left). Projections onto a vertical and horizontal axis yield graphs of $\text{Im } f_l(E)$ (top right) and $\text{Re } f_l(E)$ (bottom left), respectively. The function $\delta_l(E)$ is also shown (bottom right).