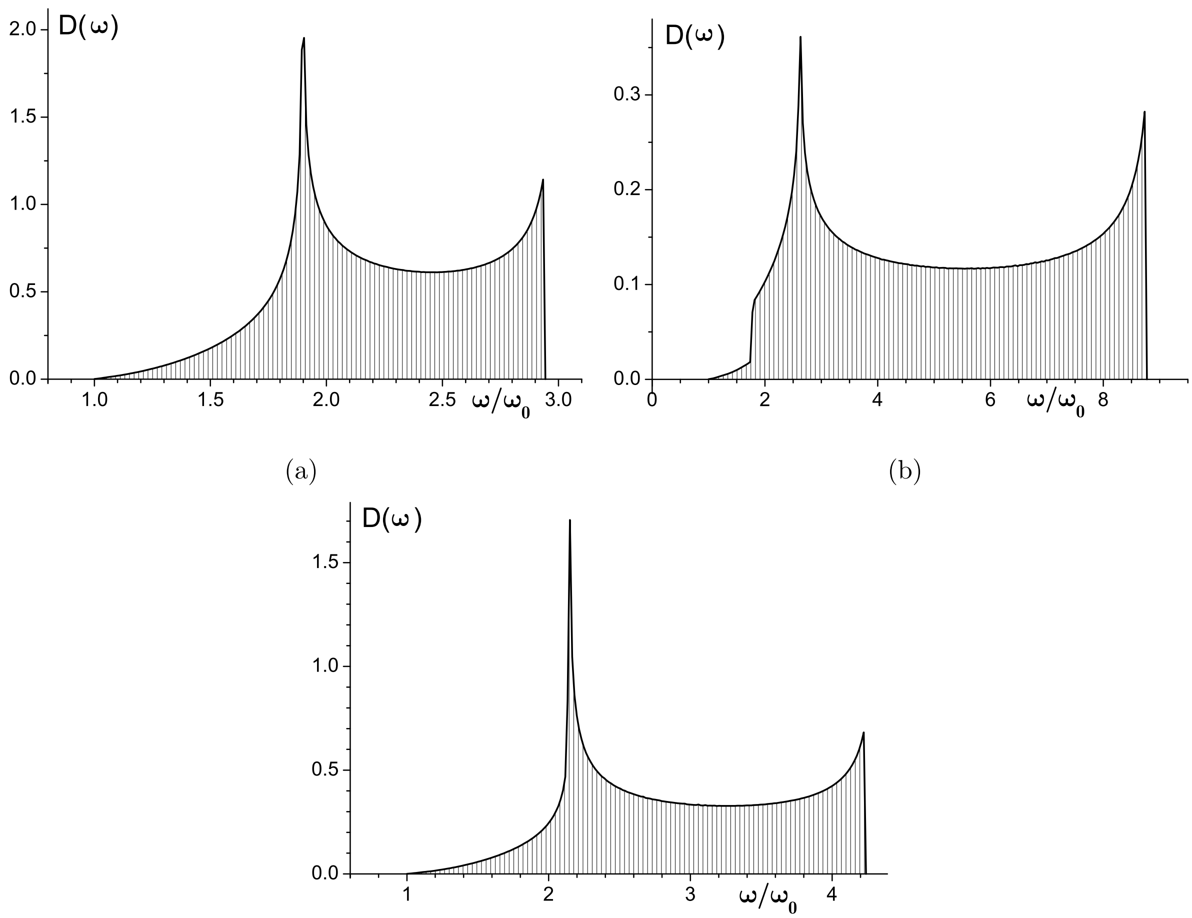

FIG. 3: The profile of the density of state function, normalized by the condition $\int D(\omega) d\omega/\omega_0 = 1$, for different values of the parameter $\lambda = \omega_0/\omega_{\rm int}$. a) weak interaction, $\lambda = 6 > \lambda_{\rm c}$; b) strong interaction, $\lambda = 1.5 < \lambda_{\rm c}$; c) special case $\lambda = \lambda_{\rm c}$, where more strong singularity appears.

($\vec{k} = (1,1)$). Therefore, near the upper and lower edges of the frequency band, the character of the singularities of the density of states $D(\omega)$ is universal, $D(\omega) \propto (\omega - \omega_0)$ near the ω_0 (see Eq. (13)), and $D(\omega)$ has a finite jump near the maximal frequency, $\omega_{\max}$. At all values of λ, the logarithmic singularity of the form of $\Delta D(\omega) = C \cdot \ln \left[\omega_{\rm c}/ \left|\omega - \omega_{\rm c}\right|\right]$ is also present (see Fig. 3).

For large λ, corresponding to a weak interaction of particles, the frequency grows with $|\vec{k}|$ for all directions of $\vec{k}$. In this case the situation is standard: saddle points are located at four symmetrical points of the type of X (1,0), and only the three aforementioned singularities are present in the density of state function, see Fig. 3a. However, for small λ, $\lambda < \lambda_{\rm c} = 3.6$ the dependence $\omega(\vec{k})$ for $\vec{k}||(0,1)$ is non-monotonous: a local minimum with a standard parabolic