

First-principles linewidths of quantum-well states in Pb(111) thin films.

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First-principles calculations of the linewidth of quantum-well states (QWS) in Pb(111) thin films are presented. Damping rates are obtained as the sum of electron-phonon and inelastic electron-electron scattering contributions, $\Gamma = \Gamma_{e-ph} + \Gamma_{e-e}$. Layer-dependent *ab initio* calculations of Γ_{e-ph} were performed for 4-10 monolayers thick free-standing Pb(111) films, whereas the electron-electron scattering contribution was estimated from first-principles calculations of Γ_{e-e} for the parent bulk band dispersing along $\Gamma - L$. As expected, scaling of the linewidth with the square of the quasiparticle energy is found. The effect of spin-orbit coupling on the band energies and on Γ_{e-e} is analyzed and found to be small in the studied energy range.