

# Narrow Resonances in Complex Potential Energy Surfaces

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Several studies of the vibrational resonances of diatomic molecular anions have shown evidence of very narrow resonances. Here we present an analytical model for the complex potential energy surface of diatomic anions where we study the appearance of very narrow resonances together with very broad resonances. We find two different mechanisms by which the eigenvalues of the model Hamiltonian begin to separate into narrow and broad resonances. In one of these mechanisms the eigenvalues go through a branch point where  $\left. \frac{\partial \text{Im}[E]}{\partial \Gamma} \right|_{\Gamma=\Gamma_{bp}} = \infty$  whereas in the other mechanism they go through a turning point in the complex energy plane where  $\left. \frac{\partial \text{Im}[E]}{\partial \Gamma} \right|_{\Gamma=\Gamma_{tp}} = 0$ . At these special points in the spectrum two different conditions on the wavefunctions can be formulated depending on the mechanism involved.