RESONANCE STATES OF ATOMIC ANIONS

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We investigate the existence of resonance states for doubly charged atomic negative ions using two methods. The ground state energy level is traced as the nuclear charge decreases. When the charge drops below the critical value, which is the minimum charge necessary to bind N electrons, the level goes into a complex plane and becomes a resonance.

The first method is a reformulated variational approach to treat resonance and bound states on equal footing. The Hylleraas-basis variation technique is used for accurate determination of position and width of the resonance of two-electron atoms below the critical charge $Z_c \approx 0.911$. These results are used to check the less accurate second method, which is an extrapolating scheme based on a one-particle model.

Destabilization of the ground state of a multi-electron atom is studied with decrease of its nuclear charge. The results agree with earlier estimates of closed-shell resonances of O^{--} and S^{--}. The model predicts series of similar resonances of di-anions that are isoelectronic to some bound singly charged anion. The proposed analytic continuation method reproduces threshold behavior of the energy at the critical charge.