

Abstract Submitted
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Relative stability of excitonic complexes in quasi-one-dimensional semiconductors¹ IGOR BONDAREV, North Carolina Central University — A configuration space approach first implemented in Ref.[1] to evaluate biexciton binding energies in carbon nanotubes (CNs), is developed to obtain the universal asymptotic relations for the lowest energy trion and biexciton binding energies in quasi-1D semiconductors. Trions are shown to be generally more stable (have greater binding energy) than biexcitons in strongly confined quasi-1D structures with small reduced electron-hole masses, while biexcitons are more stable than trions in less confined quasi-1D structures with large reduced electron-hole masses. As such, there is a crossover behavior whereby trions get less stable than biexcitons as the nanostructure transverse size increases – an interesting, quite a general effect which could likely be observed through comparative measurements on semiconducting CNs of increasing diameter. For a specific case of CNs with diameters ≤ 1 nm, the model predicts the trion binding energy greater than that of the biexciton by a factor ≈ 1.4 , decreasing with the CN diameter, thus revealing the general physical principles that underlie recent experimental observations [2,3].

[1] I.V.Bondarev, PRB 83, 153409;

[2] B.Yuma et al., PRB 87, 205412;

[3] L.Colombier et al., PRL 109, 197402.

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