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Bound electron states in skew-symmetric quantum wire intersections[1] SUBASH NEPAL, LIUBOV ZHEMCHUZHNA, AREG MELIKSETYAN, IGOR BONDAREV, North Carolina Central University — We analyze the angular dependence of the lowest energy bound state for an electron trapped at the intersection of two identical narrow channels (quantum wires) crossed at an arbitrary angle. When the channels are perpendicular, such a classically unbound system is known to possess a quantum bound state [1]. We use the variational approach to study how the binding energy of the lowest bound state varies as a function of the wire intersection angle. Using two different trial wave functions, we simulate two intersection types, X-type and S-type, different in their respective channel intersection areas (diamond for the former and square for the latter). For both geometries, the binding energy generally decreases as the intersection angle deviates from the right angle. The S-type wire intersection preserves the bound state even at angles close to zero degree, as opposed to the X-type intersection. Our data supplement a theory of quantum bound states in classically unbound systems (Ref.[1]) and may be useful to interpret electron transport peculiarities in realistic systems such as semiconductor nanowire films and carbon nanotube bundles.

[1] R.L.Schult, et al, PRB 39, 5476 (1989).

[1]DOE-DE-SC0007117 (S.N.,L.Z.,I.B.), ARO-W911NF-11-1-0189 (A.M.)

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