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Bound state energy of a Coulomb impurity in gapped bilayer graphene: "Hydrogen atom with a Mexican hat" BRIAN SKINNER, Argonne National Laboratory, BORIS SHKLOVSKII, MIKHAIL VOLOSHIN, University of Minnesota — Application of a perpendicular electric field induces a band gap in bilayer graphene, and it also creates a "Mexican hat" structure in the dispersion relation. This structure has unusual implications for the hydrogen-like bound state of an electron to a Coulomb impurity. We calculate the ground state energy of this hydrogen-like state as a function of the applied interlayer voltage and the effective fine structure constant. Unlike in the normal hydrogen atom, the resulting wavefunction has many nodes of density even in the ground state. Further, the electron state undergoes "atomic collapse" into the Dirac continuum both at small and large voltage. Our results have important implications for the pursuit of a robust, tunable band gap in bilayer graphene.

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