

Thomas-Fermi type models of external charge screening in graphene

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Abstract. Graphene is a recently discovered material which consists of exactly one atomic layer of carbon. We discuss density functional theories of Thomas–Fermi and Thomas–Fermi–von Weizsäcker type which describe the response of a single layer of graphene to an external electric charge. Mathematically, this amounts to the analysis of two nonlocal variational problems which involve Coulombic terms and a Hardy type potential. We formulate variational setting in which the proposed energy functionals admit minimizers. The associated Euler–Lagrange equations are also obtained, and uniqueness and regularity of the minimizers are proved under some conditions. In addition, we discuss the decay rate (screening) of the minimizers and describe several open problems.