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(November 29, 2002)*

We introduce a nonlocal functional to treat *finite* electric fields in first-principles electronic structure calculations with periodic boundary conditions. The present functional provides a practical way for investigating dielectric properties. Furthermore, we show that this functional is suitable for application in *ab initio* molecular dynamics schemes. The reliability of the method is demonstrated in the case of bulk MgO for the Born effective charges, and the high- and low-frequency dielectric constants. We show how the static dielectric constant can be obtained by performing a molecular dynamics relaxation, entirely avoiding the calculation of normal modes. We illustrate the potential of the method for treating systems of large size through examples and applications.

* P. Umari and A. Pasquarello, Phys. Rev. Lett. **89**, 157602 (2002).