Elastic scattering of low-energy electrons by Ne, Ar, Kr, and Xe

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We treat low-energy electron scattering by atoms within a Kohn-Sham-type one-particle theory. In applying this theory, all many-body effects involved in the projectile-target interaction are absorbed into a one-particle potential. Hence, one merely has to solve an elementary potential-scattering problem. However, there are two crucial points to be observed in the construction of the scattering potential. (1) The Kohn-Sham-type exchange-correlation potential must be formed by using correlation factors which are required to have certain asymptotic and integral properties. (2) Since the scattering process is viewed as being quasistationary, the unbound projectile state must be modified by a bell-jar-type envelope function to account for the effect of a finite residence time in the target where the projectile causes a finite perturbation. During this time the entire system has to be treated as consisting of $N+1$ indistinguishable electrons which in a Kohn-Sham-type theory are described by only $N+1$ self-consistent one-particle states. Once the analytical forms of the correlation factors and the envelope function have been chosen, the calculational procedure is completely parameter-free. Although it is considerably simpler than well-established methods in this field, it provides comparably good results on differential cross sections and scattering-induced polarizations in a wide range of impact energies (5–100 eV).

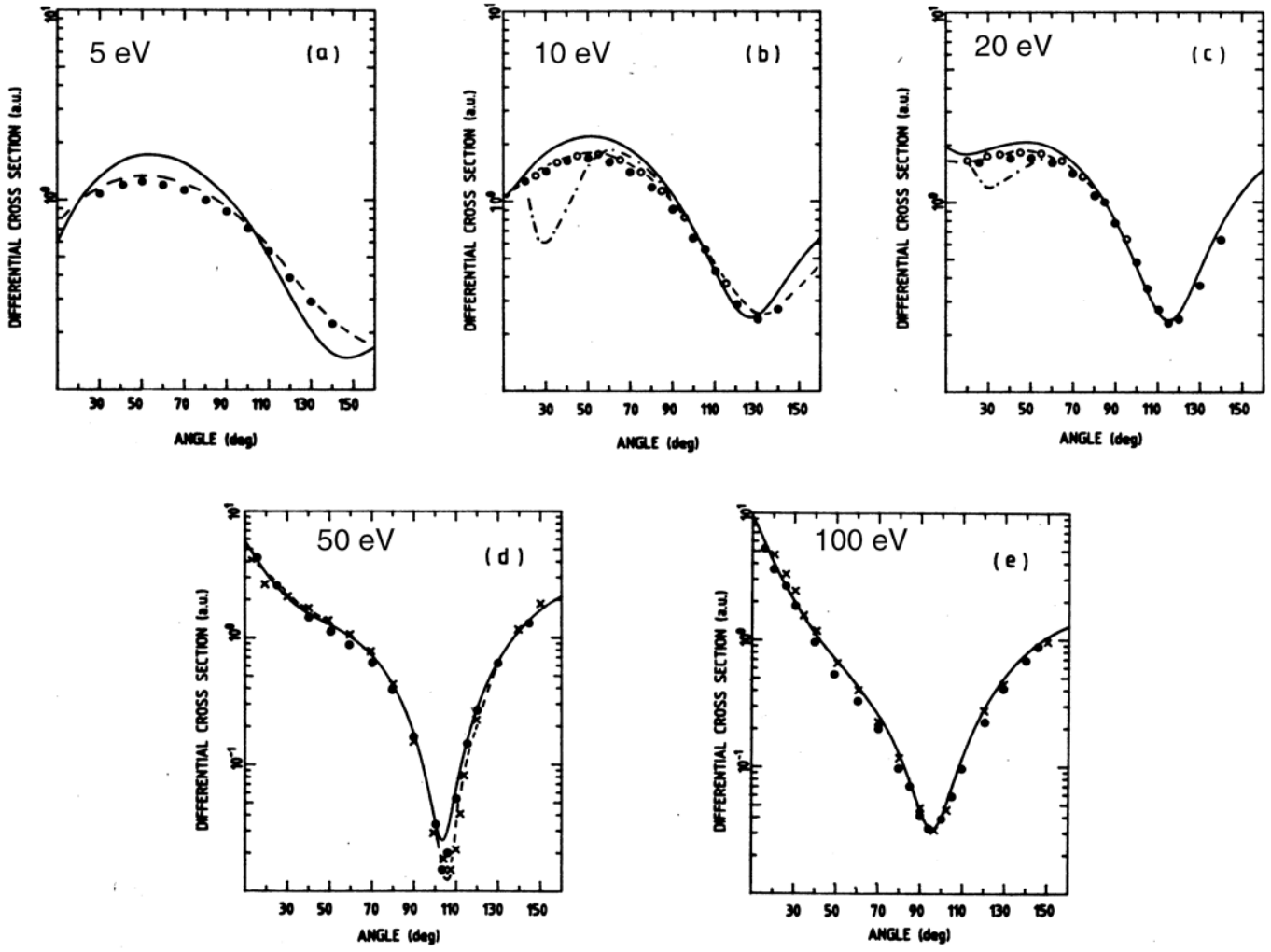

FIG. 2. Differential cross sections for elastic scattering of electrons by Ne atoms (in atomic units): (a) 5 eV, (b) 10 eV, (c) 20 eV, (d) 50 eV, (e) 100 eV. Experiment: ●, Ref. 14; ○, Ref. 15; ×, Ref. 16. Theory: ——, present work; – – –, McEachran and Stauffer (Ref. 13); —·—·—·, Fritsche *et al.* (Ref. 1).