Part II
Application to Low-Energy Fission

In the second part of the book we apply the microscopic method presented in part I to the fission problem. The starting point for microscopic calculation of fission is a set of constrained HFB states calculated with respect to a few collective parameters relevant to fission in the Hartree-Fock-Bogoliubov (HFB) approximation. These collective parameters serve as constraints in the HFB calculation. Once the HFB solutions have been calculated, the Time-Dependent Generator Coordinate Method (TDGCM) is invoked to construct a wave packet from the HFB solutions that describe the fissioning nucleus in a fully quantum-mechanical way. In practice, we do not solve the full Hill-Wheeler equations, but, as explained in Sect. 3.2, an approximation that yields a collective, time-dependent Schrödinger equation (TDSE). The potential- and kinetic-energy terms of this Schrödinger equation are calculated from the microscopic HFB solutions, and produce a collective Hamiltonian for the system constructed from the underlying microscopic degrees of freedom. The time-independent form of this equation is used first to generate a spectrum of initial collective states expressed as linear superpositions of static HFB solutions. These collective solutions are then evolved in time toward a set of scission configurations by solving the TDSE. The set of scission configurations form a line in calculations with two collective constraints (or a hypersurface of $D-1$ dimensions in D dimensions) that defines a boundary between a pre-scission and a post-scission region. Within the pre-scission region the collective Hamiltonian describes a single (parent) nucleus, and in the post-scission region it describes two fragments moving apart and interacting eventually through their mutual Coulomb repulsion. We will describe this approach in greater detail in this chapter with the goal of computing fission-fragment mass, kinetic-energy and excitation-energy distributions that can be compared with experimental data, and illustrate the results in the case of neutron induced fission on a ^{239}Pu target (i.e., fission from an excited state of ^{240}Pu).