

Part III

Properties of Stellar Matter

In addition to the basic variables (m, r, P, T, l) in terms of which we have formulated the problem, the differential equations of stellar structure (Sect. 10.1) also contain quantities such as density, nuclear energy generation, or opacity. These describe properties of stellar matter for given values of P and T and for a given chemical composition as indicated in (10.7)–(10.14) and are quantities that certainly do not depend on m, r , or l at the given point in the star. They could just as well describe the properties of matter in a laboratory for the same values of P, T , and chemical composition. We can therefore deal with them without specifying the star or the position in it for which we want to use them. In this chapter we shall discuss these “material functions”, and we start by specifying the dependence of the density ρ on P, T , and the chemical composition. This is described by an *equation of state*, which is especially simple if we have a perfect gas. We already discussed this case in Sect. 4.2. But radiation and ionization also influence the pressure and the internal energy. We therefore have to include them.