huge literature on this subject; we can only mention a recent textbook (Tarantola, 1987) but cannot help quoting the fundamental paper (Backus, 1970).

7.2 Zero-Potential Densities

Since N^{-1} is non-unique, it is fundamental to investigate the *kernel* (or *nullspace*) of the operator N: the set of all density distributions ρ_0 within S that produce zero external potential:

$$N\rho_0 = 0 \quad \text{outside}\, S \quad . \tag{7–7}$$

Such density distributions ρ_0 will be called zero-potential densities. We repeat: *the set of all possible zero-potential densities forms the kernel of the Newtonian operator* N, symbolized by $\ker(N) = N^{-1}(0)$.

Clearly, ρ_0 must be alternatively positive and negative, so that the total mass is zero; otherwise (7–7) would be impossible. Contrary to the usage of much of standard potential theory, we do not require ρ to be positive now. In fact, in practical applications, V will represent *potential anomalies* rather than potentials, and the corresponding ρ will be *density anomalies* which may be positive or negative.

It is extremely easy to find a rather general method of determining $\ker(N)$. Take any function V_0 that is zero outside S and continued in a continuous and differentiable manner to the inside of S in such a way that it is also twice piecewise differentiable within S. This is illustrated in Fig. 7.1 for one instead of three dimensions; then the

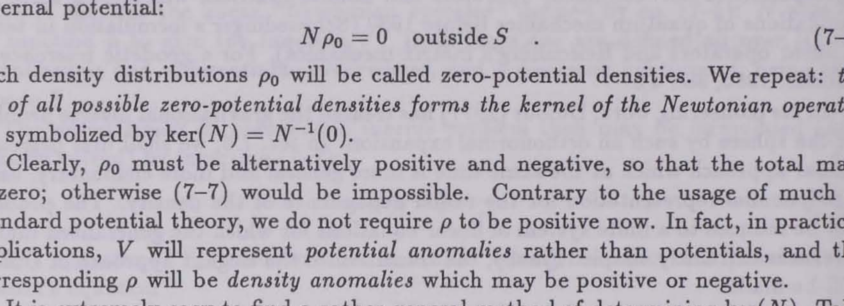

FIGURE 7.1: Two possible functions V_0 in one dimension

boundary S consists of two points S_1 and S_2.

Return to R^3. Since after continuation to the inside of S, V_0 is now defined throughout R^3, the corresponding density ρ_0 is given by (7–4):

$$\rho_0 = -\frac{1}{4\pi G}\,\Delta V_0 \quad . \tag{7–8}$$

Outside S this gives $\rho_0 = 0$ as it should, and inside, the zero potential density ρ_0 is piecewise continuous according to our differentiability assumptions concerning V_0.