4.1 Internal Potential

The gravitational potential at a point P in the interior of the body bounded by the surface S is

$$V(P) = \iiint G\frac{\rho}{l}\,dv = \underset{I_P}{\iiint} + \underset{E_P}{\iiint} = V_i(P) + V_e(P) \quad , \tag{4–6}$$

where I_P denotes the interior of the surface S_P of constant density labeled, as usual, by a parameter q, and E_P denotes its exterior, that is, the layer between S_P and S (Fig. 4.2).

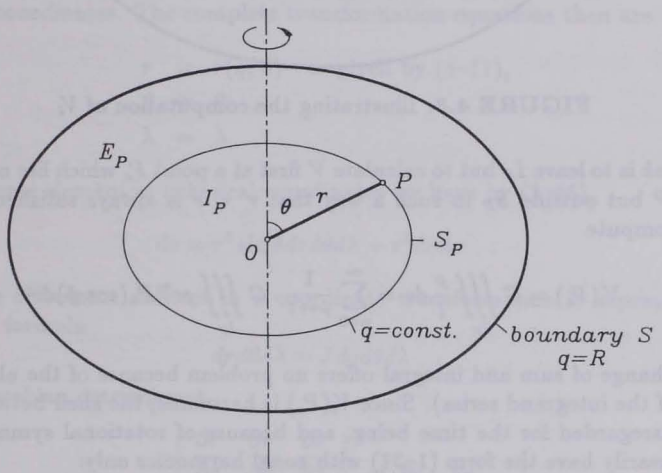

FIGURE 4.2: Illustrating the computation of $V(P)$

4.1.1 Potential of Interior I_P

Consider first only

$$V_i = G \underset{I_P}{\iiint} \frac{\rho}{l}\,dv \quad . \tag{4–7}$$

For $1/l$ we have the usual series

$$\frac{1}{l} = \sum_{n=0}^{\infty} \frac{r'^n}{r^{n+1}} P_n(\cos\psi) \quad , \tag{4–8}$$

which converges if $r' < r$. *The problem* is that for $r = r_P = OP$ (Fig. 4.3), this convergence condition may be violated: r' may be greater than r.