i^{th} and j^{th} particle are excited. Hence

$$\frac{1}{e} g_{ij} \Phi = \eta(\vec{r}_{ij}) \tag{4.10}$$

Here we have used the limit of zero momenta for all hole states, so that $\Phi = 1$. This approximation, reasonable inasmuch as the average hole momentum in $\sqrt{0.3}\, k_f \approx 1/3c$, will be used in all subsequent discussion. Thus, Eq. (4.4) becomes

$$\Phi - \psi^{(3)} = \frac{1}{e} g_{23}\Phi + \frac{1}{e} g_{13}\Phi - \frac{1}{e} g_{23} (\Phi - \psi^{(1)}) - \frac{1}{e} g_{13} (\Phi - \psi^{(2)})$$

or,

$$Z^{(3)} = \eta(\vec{r}_{23}) + \eta(\vec{r}_{13}) - \frac{1}{e} g_{23} Z^{(1)} - \frac{1}{e} g_{13} Z^{(2)} \tag{4.11}$$

where $Z^{(i)} = \Phi - \psi^{(i)}$.

We thus have to solve the three coupled differential equations implied in (4.11), for the $Z^{(i)}$. Since each $Z^{(i)} = \Phi - \psi^{(i)}$ represents an excited wave function with no initial state in it, the operation of $\frac{1}{e} g_{ij}$ on it will involve only the function $\zeta(\vec{r}_{ij})$, and not $\eta(\vec{r}_{ij})$.

However, the $Z^{(i)}$ are functions of all three coordinates. Therefore, to find the result of operating $\frac{1}{e} g_{12}$ on $Z^{(3)}(\vec{r}_1, \vec{r}_2, \vec{r}_3)$, one must first Fourier analyse $Z^{(3)}$, replace $e^{i\vec{k}\cdot\vec{r}_{12}}$ by $\zeta_{\vec{k},\vec{P}}(\vec{r}_{12})$ in each Fourier component and then perform the inverse Fourier transformation. The resulting function is of course not related in any simple way to $Z^{(3)}(\vec{r}_1, \vec{r}_2, \vec{r}_3)$ and the coupled equations (4.11) are not easy to solve. Consequently, two approximtions