The Fermi Hole

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Title

Begin with the equations.

$$|\phi_\sigma(\mathbf{x})\rangle = \hat{\psi}_\sigma(\mathbf{x})\,|g\rangle$$
$$\hat{\psi}_\sigma(\mathbf{x}) = \sum_k \hat{c}_{k,\sigma}\psi_{k,\sigma}(\mathbf{x})$$
$$\psi_k(\vec{x}) = \frac{1}{\sqrt{\mathcal{V}}}e^{-i\vec{k}\cdot\vec{x}}$$

$$\langle\phi_\sigma(\mathbf{x})|\,\hat{\psi}^\dagger_{\sigma'}(\mathbf{x}')\hat{\psi}_{\sigma'}(\mathbf{x}')\,|\psi_\sigma(\mathbf{x})\rangle$$
$$\langle g|\,\hat{\psi}^\dagger_\sigma(\mathbf{x})\hat{\psi}^\dagger_{\sigma'}(\mathbf{x}')\hat{\psi}_{\sigma'}(\mathbf{x}')\hat{\psi}_\sigma(\mathbf{x})\,|g\rangle$$
$$\langle g|\sum_k c^\dagger_{k,\sigma}\psi^*_{k,\sigma}(\mathbf{x})\sum_l c^\dagger_{l,\sigma'}\psi^*_{l,\sigma'}(\mathbf{x}')\sum_m c_{m,\sigma'}\psi_{m,\sigma'}(\mathbf{x}')\sum_n c_{n,\sigma}\psi_{n,\sigma}(\mathbf{x})\,|g\rangle$$

Now we see two creation and two annihilation operators, but N should be conserved, so there are two cases:

$$k,\sigma = m,\sigma' \qquad l,\sigma' = n,\sigma \tag{1}$$

$$k,\sigma = n,\sigma \tag{2}$$

Example frame 1

This is the first frame

Example frame 2

Example block

- item 1
- item 2