

2017 / 2 / 23 (목)

지금은 필요 없지만 expectation value 구할 때 유용한 공식.

$$\begin{pmatrix} \psi_1^{\text{Re}} - i \psi_1^{\text{Im}} & \psi_2^{\text{Re}} - i \psi_2^{\text{Im}} \end{pmatrix} \begin{pmatrix} H_{11} & H_{21}^{\text{Re}} - i H_{21}^{\text{Im}} \\ H_{21}^{\text{Re}} + i H_{21}^{\text{Im}} & H_{22} \end{pmatrix} \begin{pmatrix} \psi_1^{\text{Re}} + i \psi_1^{\text{Im}} \\ \psi_2^{\text{Re}} + i \psi_2^{\text{Im}} \end{pmatrix}$$

$$\begin{aligned} &= H_{11} \left((\psi_1^{\text{Re}})^2 + (\psi_1^{\text{Im}})^2 \right) + H_{22} \left((\psi_2^{\text{Re}})^2 + (\psi_2^{\text{Im}})^2 \right) \\ &\quad + H_{33} \left((\psi_3^{\text{Re}})^2 + (\psi_3^{\text{Im}})^2 \right) \\ &\quad + 2 H_{21}^{\text{Re}} \left(\psi_2^{\text{Re}} \psi_1^{\text{Re}} + \psi_2^{\text{Im}} \psi_1^{\text{Im}} \right) + 2 H_{21}^{\text{Im}} \left(\psi_2^{\text{Im}} \psi_1^{\text{Re}} - \psi_2^{\text{Re}} \psi_1^{\text{Im}} \right) \\ &\quad + 2 H_{31}^{\text{Re}} \left(\psi_3^{\text{Re}} \psi_1^{\text{Re}} + \psi_3^{\text{Im}} \psi_1^{\text{Im}} \right) + 2 H_{31}^{\text{Im}} \left(\psi_3^{\text{Im}} \psi_1^{\text{Re}} - \psi_3^{\text{Re}} \psi_1^{\text{Im}} \right) \\ &\quad + 2 H_{32}^{\text{Re}} \left(\psi_3^{\text{Re}} \psi_2^{\text{Re}} + \psi_3^{\text{Im}} \psi_2^{\text{Im}} \right) + 2 H_{32}^{\text{Im}} \left(\psi_3^{\text{Im}} \psi_2^{\text{Re}} - \psi_3^{\text{Re}} \psi_2^{\text{Im}} \right). \end{aligned}$$