

$$\hat{\mathcal{H}} \Phi_{i\nu}(\vec{r}, \vec{R}) = \left[-\frac{1}{M} \nabla_R^2 + \hat{h}^e(\vec{r}, \vec{R}) + \frac{1}{R} \right] \left[F_{i\nu}^N(\vec{R}) \psi_i^e(\vec{r}; \vec{R}) \right];$$

$$\begin{aligned} \text{ma } \hat{h}^e(\vec{r}, \vec{R}) \left[F_{i\nu}^N(\vec{R}) \psi_i^e(\vec{r}; \vec{R}) \right] &= F_{i\nu}^N(\vec{R}) \left[\hat{h}^e(\vec{r}, \vec{R}) \psi_i^e(\vec{r}; \vec{R}) \right] = \\ &= F_{i\nu}^N(\vec{R}) \left[\varepsilon_i^e(R) \psi_i^e(\vec{r}; \vec{R}) \right] = \varepsilon_i^e(R) \Phi_{i\nu}(\vec{r}, \vec{R}), \text{ e pertanto} \end{aligned}$$

$$\begin{aligned} \hat{\mathcal{H}} \Phi_{i\nu}(\vec{r}, \vec{R}) &= \left[-\frac{1}{M} \nabla_R^2 + \varepsilon_i^e(R) + \frac{1}{R} \right] \left[F_{i\nu}^N(\vec{R}) \psi_i^e(\vec{r}; \vec{R}) \right] = \\ &= \left[-\frac{1}{M} \nabla_R^2 F_{i\nu}^N(\vec{R}) \right] \psi_i^e(\vec{r}; \vec{R}) - \frac{2}{M} \vec{\nabla}_R F_{i\nu}^N(\vec{R}) \cdot \vec{\nabla}_R \psi_i^e(\vec{r}; \vec{R}) + \\ &= -\frac{1}{M} F_{i\nu}^N(\vec{R}) \nabla_R^2 \psi_i^e(\vec{r}; \vec{R}) + \left[\varepsilon_i^e(R) + \frac{1}{R} \right] F_{i\nu}^N(\vec{R}) \psi_i^e(\vec{r}; \vec{R}) = \end{aligned}$$

$$\left[\hat{\mathcal{H}}_i^{BO} F_{i\nu}^N(\vec{R}) \right] \psi_i^e(\vec{r}; \vec{R}) - \frac{1}{M} \left[F_{i\nu}^N(\vec{R}) \nabla_R^2 \psi_i^e(\vec{r}; \vec{R}) + 2 \vec{\nabla}_R F_{i\nu}^N(\vec{R}) \cdot \vec{\nabla}_R \psi_i^e(\vec{r}; \vec{R}) \right] =$$

$$\left[\mathcal{E}_{i\nu}^{BO} F_{i\nu}^N(\vec{R}) \right] \psi_i^e(\vec{r}; \vec{R}) - \frac{1}{M} [\dots] = \mathcal{E}_{i\nu}^{BO} \Phi_{i\nu}(\vec{r}, \vec{R}) - \frac{1}{M} [\dots] \text{ e quindi, alla fine,}$$

$$\hat{\mathcal{H}} \Phi_{i\nu}(\vec{r}, \vec{R}) = \mathcal{E}_{i\nu}^{BO} \Phi_{i\nu}(\vec{r}, \vec{R}) - \frac{1}{M} \left[F_{i\nu}^N(\vec{R}) \nabla_R^2 \psi_i^e(\vec{r}; \vec{R}) + 2 \vec{\nabla}_R F_{i\nu}^N(\vec{R}) \cdot \vec{\nabla}_R \psi_i^e(\vec{r}; \vec{R}) \right];$$

moltiplicando a sx per $\Phi_{i\nu}^*$ e integrando in d^3r e d^3R si ottengono le equazioni 2.9-2.12