$H = H_{c.p.p.} + H_{EM}$

$$= \sum_{\text{particles } i} \left\{ -(1+A_i)\, E^i_k \quad - \frac{1}{2} \left[\frac{1}{2} \left(\bar{\varphi}^{\alpha\beta}_i - \bar{\bar{\varphi}}^{\alpha\beta}_i \right) \frac{k^i_\alpha k^i_\beta}{(E^i_k)} + \frac{1}{2} \left(\bar{\varphi}^{\alpha\beta}_i + \bar{\bar{\varphi}}^{\alpha\beta}_i \right) \gamma_{\alpha\beta} \frac{(k_i)^2}{(E^i_k)} \right] \right\}$$

$$+ \int d^3x \left\{ - N^\alpha(x) \left[A_\alpha \partial_\mu \Pi^\mu + \sum_i p^i_\alpha \, \delta_{x_i}(x) \right] \right\}$$

$$+ \int d^3x \left\{ -(1+A) \left[2\pi\, \gamma_{\alpha\beta} \Pi^\alpha \Pi^\beta + \frac{1}{8\pi} \gamma_{\alpha\beta} H^\alpha H^\beta \right] \quad - N^\alpha \, \varepsilon_{\alpha\mu\nu} H^\mu \Pi^\nu \right.$$

$$- \frac{1}{2} \left(\bar{\bar{\varphi}}^{\alpha\beta} - \bar{\varphi}^{\alpha\beta} \right) \left[2\pi \left(\delta^\alpha_\sigma \delta^\beta_\tau - \frac{1}{2} \gamma^{\alpha\beta} \gamma_{\sigma\tau} \right) \Pi_\alpha \Pi_\beta + \frac{1}{8\pi} \left(\delta^\alpha_\sigma \delta^\beta_\tau - \frac{1}{2} \gamma^{\alpha\beta} \gamma_{\sigma\tau} \right) H_\alpha H_\beta \right]$$

$$+ \frac{1}{2} \left(\bar{\bar{\varphi}}^{\alpha\beta} + \bar{\varphi}^{\alpha\beta} \right) \left[2\pi \left(\delta^\alpha_\sigma \delta^\beta_\tau - \frac{1}{2} \gamma^{\alpha\beta} \gamma_{\sigma\tau} \right) \Pi_\alpha \Pi_\beta + \frac{1}{8\pi} \left(-\delta^\alpha_\sigma \delta^\beta_\tau - \frac{1}{2} \gamma^{\alpha\beta} \gamma_{\sigma\tau} \right) H_\alpha H_\beta \right]$$

$$\left. + \bar{\bar{\bar{\varphi}}}^{\beta}_{\mu} \left(\delta^\mu_\nu \delta^\alpha_\beta - \delta^\mu_\beta \delta^\alpha_\nu \right) \left[H^\nu \Pi_\alpha \right] \right\} + \int d^3x \left\{ -(1+A(x))\, \phi(x) \left(\partial_\alpha \Pi^\alpha + \sum_i e_i \, \delta_{x_i}(x) \right) \right\}$$

$E^i_k = \sqrt{m_i^2 + k_i^2}$ $\qquad k^\alpha_i = p^\alpha_i - e A^\alpha_i$ $\qquad H^\alpha = \frac{1}{2} \varepsilon^{\alpha\mu\nu} F_{\mu\nu}$

Fields with index i are evaluated @ λ_i, eg $\phi_i(t) := \phi(\lambda_i(t), t)$

Canonical momenta are $\{ p^i_\alpha \}$ and Π^α, indices pulled with $\gamma^{\cdot\cdot}$

Substitute $p^\alpha_i - e A^\alpha_i$ using the eom to see that all above stuff is gauge invariant!