

$$\Xi[H, \beta, \tilde{J}_-, \eta] = \frac{\tilde{J}_-}{2H^2(1-H\eta)} + \frac{\beta \tilde{J}_-}{4H^3} \Psi(x) \Big|_{x=-\frac{\beta}{H}(1-H\eta)}^{x=\frac{\beta}{H}(1-H\eta)}$$

$$\text{with} \qquad \Psi(x) = e^x \int_{\infty}^x \frac{e^{-t} dt}{t} \, .$$