La expresión se puede simplificar definiendo (8)
la variable auxiliar:

$$\bar{x} \equiv \frac{p}{\hbar\beta^2}, \quad \text{donde entonces se tiene:}$$

$$\mathcal{P}_\Delta(p_0) = \frac{1}{3}\left[\int_{\frac{p_0-\Delta/2}{\hbar\beta^2}}^{\frac{p_0+\Delta/2}{\hbar\beta^2}} d\bar{x}\, \varphi_0^2(\bar{x}) + 2\int_{\frac{p_0-\Delta/2}{\hbar\beta^2}}^{\frac{p_0+\Delta/2}{\hbar\beta^2}} d\bar{x}\, \varphi_1^2(\bar{x}) - 2\int_{\frac{p_0-\Delta/2}{\hbar\beta^2}}^{\frac{p_0+\Delta/2}{\hbar\beta^2}} d\bar{x}\, \varphi_1(\bar{x})\,\varphi_0(\bar{x})\right]$$

y $\varphi_0(\bar{x})$, $\varphi_1(\bar{x})$ son las funciones propias del oscilador armónico usuales, en términos de los polinomios de Hermite:

$$\varphi_0(\bar{x}) = \left(\frac{\beta^2}{\pi}\right)^{1/4} e^{-\beta^2\bar{x}^2/2}\, H_0(\bar{x})$$

$$\varphi_1(\bar{x}) = \left(\frac{\beta^2}{\pi}\right)^{1/4} \frac{e^{-\beta^2\bar{x}^2/2}}{\sqrt{2}}\, H_1(\bar{x})$$