Breit Wigner, relativistic and non-relativistic

The non-relativistic and relativistic Breit Wigner distributions are given by equations 1 and 2 respectively.

$$p(M)dM = \frac{1}{2\pi}\ \frac{\Gamma}{(M-M_0)^2 + \frac{\Gamma^2}{4}}\ dM \tag{1}$$

$$p(M)dM = \frac{k}{(M^2-M_0^2)^2 + M_0^2\Gamma^2}\ dM \tag{2}$$

with $k = 2\sqrt{2}M\Gamma\gamma/(\pi\sqrt{(M_0^2+\gamma})$ and $\gamma = M_0\sqrt{M_0^2+\Gamma^2}$.

If $\Gamma << M_0$, then $\gamma \approx M_0^2$ and $k \approx \frac{2}{\pi}M_0^2\Gamma$.
Also since $M + M_0\ \approx 2M_0$, $(M^2 - M_0^2)^2 = (M+M_0)(M-M_0)(M+M_0)(M-M_0) \approx 4M_0^2(M-M_0)^2$. Putting all of these ingredients into equation 2, the relativistic Breit Wigner approximates as

$$p(M)dM \approx \frac{2}{\pi}\frac{M_0\Gamma}{4M_0^2(M-M_0)^2 + M_0^2\Gamma^2}\ dM$$

$$p(M)dM \approx \frac{1}{2\pi}\frac{\Gamma}{(M-M_0)^2 + \frac{\Gamma^2}{4}}\ dM$$

which is the same as the expression for the non relativistic case (equation 1).