



$$(I) \Omega h^2 \sim \left[\sum_q \frac{4g_\chi^2 g_q^2 y_q^2 (s - 4m_q^2)^{3/2} \sqrt{s - 4m_\chi^2}}{32\pi s (s - m_Y^2)^2} \right]^{-1} \quad (II) \Omega h^2 \sim \left[\frac{m_\chi \sqrt{m_\chi^2 - m_Y^2} (9m_\chi^4 + 8m_\chi^2 m_Y^2 + 2m_Y^4)}{3\pi (m_Y^2 - 2m_\chi^2)^4} \right]$$