1. Equation for Analysing GW Data (question 4)

Q.) Using the results from previous exercises, write an algorithm to determine the chirp mass from the gravitational wave data.

- Integrating the above expression to get rid of the term $\dot{f_{GW}}$

$$M_c^5 = \frac{c^{15}}{G^5}\left(\left(\frac{5}{96}\right)^3 \pi^{-8} \cdot f_{GW}^{-11} \cdot \left(\dot{f_{GW}}\right)^3\right)$$

$$\dot{f}_{GW} = \frac{(GM_c)^{\frac{5}{3}}}{c^5}\left(\frac{96}{5}\right)\pi^{\frac{8}{3}} \cdot (f_{GW})^{\frac{11}{3}}$$

$$\frac{\mathrm{d}f_{GW}}{\mathrm{d}t} = \frac{(GM_c)^{\frac{5}{3}}}{c^5}\left(\frac{96}{5}\right)\pi^{\frac{8}{3}} \cdot (f_{GW})^{\frac{11}{3}}$$

$$\int \frac{\mathrm{d}f_{GW}}{f_{GW}^{11/3}} = \int \frac{(GM_c)^{\frac{5}{3}}}{c^5}\left(\frac{96}{5}\right)\pi^{\frac{8}{3}} \cdot \mathrm{d}t$$

$$-\frac{3}{8} f_{GW}^{-8/3} = \frac{(GM_c)^{\frac{5}{3}}}{C^5}\left(\frac{96}{5}\right)\pi^{\frac{8}{3}} \cdot (t - t_c)$$

where t_c denotes coalescence time.

$$f_{GW}^{-8/3}(t) = \frac{(GM_c)^{\frac{5}{3}}}{c^5}\frac{2^8 \cdot \pi^{\frac{8}{3}}}{5} \cdot (t_c - t)$$

$$f_{GW}^{-8/3}(t) = \frac{(GM_c)^{\frac{5}{3}}}{c^5}\frac{(8\pi)^{\frac{8}{3}}}{5} \cdot (t_c - t)$$

Note: This term will later help us to find chirp mass using curve fitting