

Exercise sheet 9**1. Binary system on circular orbits**

Consider a binary system of two stars on circular orbits..

- a.) Calculate the quadrupole moments I_{ab} .
- b.) Find the amplitude of the gravitational wave $\bar{h}_{\alpha\beta}(t, \boldsymbol{x})$.
- c.) Find the emitted luminosity of gravitational waves.
- d.) Estimate the strength for a Galactic neutron star neutron star binary with a separation of $r = 0.1 \text{ AU}$.

2. Energy flux of a GW

The energy flux \mathcal{F} of a GW is

$$\mathcal{F} = \frac{c^3}{32\pi G} \omega^2 (a^2 + b^2).$$

where a and b are the amplitudes of the two polarisation states.

- a.) Estimate the energy flux for the binary system in 1.
- b.) Estimate (using simple dimensional analysis) how much energy is dissipated if a GW crosses a medium (e.g., the ISM, Earth, Sun, ...) of your choice.