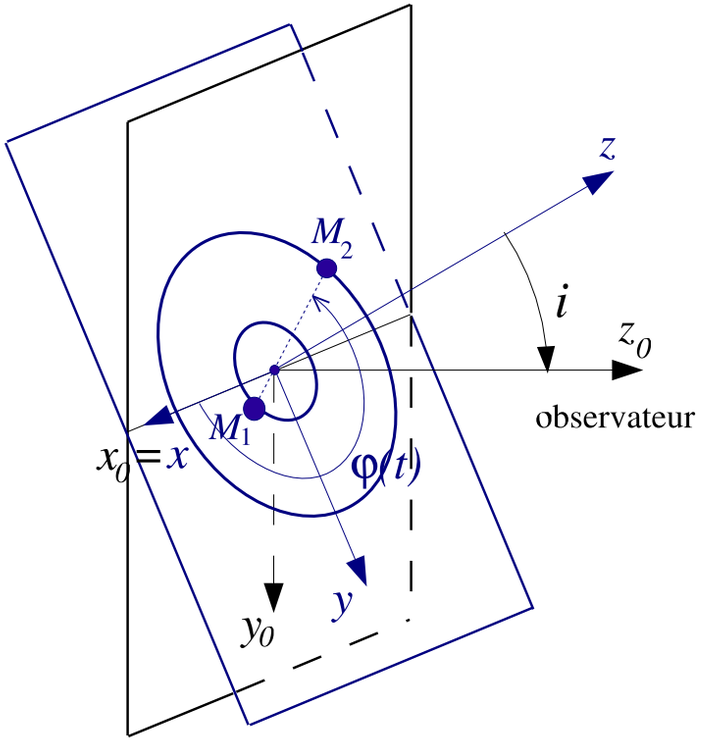
# Gravitational radiation from a binary system




Distance to the binary: $d$
Masses: $M_1$ and $M_2$
Chirp mass: $\mathcal{M} = \left[\frac{(M_1 M_2)^3}{M_1 + M_2}\right]^{1/5}$
Orbital period: $P$
Inclination angle: $i$

**GW for a circular orbit at the 0-PN level** (quadrupole formula):

$$h_+ = \frac{2}{c^4 d}(G\mathcal{M})^{5/3}\left(\frac{2\pi}{P}\right)^{2/3}(1+\cos^2 i)\ \cos\left(4\pi\frac{t}{P}+\varphi_0\right)$$

$$h_\times = \frac{4}{c^4 d}(G\mathcal{M})^{5/3}\left(\frac{2\pi}{P}\right)^{2/3}\cos i\ \sin\left(4\pi\frac{t}{P}+\varphi_0\right)$$

# Estimation of the gravitational wave amplitude

$$h_0 = \frac{2}{c^4 d}(G\mathcal{M})^{5/3}\left(\frac{2\pi}{P}\right)^{2/3}$$

$$\Longrightarrow \boxed{h_0 = 1.06 \times 10^{-21}\left(\frac{1\ \mathrm{kpc}}{d}\right)\left(\frac{\mathcal{M}}{0.87\ M_\odot}\right)^{5/3}\left(\frac{10\ \mathrm{min}}{P}\right)^{2/3}}$$

**Example:**

| System | $M_1\ [M_\odot]$ | $M_2\ [M_\odot]$ | $P$ [min] | $d$ [kpc] | $h_0$ | $f_{\mathrm{GW}}$ [Hz] |
|---|---|---|---|---|---|---|
| double pulsar PSR J0737-3039 | **1.34** | **1.25** | **147** | **0.6** | $\mathbf{4.5\ 10^{-22}}$ | $\mathbf{2.3\ 10^{-4}}$ |

$$\frac{S}{N} \sim \frac{h_0\sqrt{T_{\mathrm{obs}}}}{S(f)^{1/2}}$$

# Further refinements

- Post-Newtonian corrections to the wave form :
  [L. Blanchet, Living Rev. Relativity **5**, 3 (2002)]
  [K.G. Arun, L. Blanchet, B.R. Iyer & M.S.S. Qusailah, Class. Quantum Grav. **21**, 3771 (2004)]

- Elliptical orbits :
  [T. Damour, A. Gopakumar & B.R. Iyer, Phys. Rev. D **70**, 064028 (2004)]