

Notes on Phase Determination for Pulsar Signals

1 General

The phase of a pulsar timing signal as a function of time is given by

$$\phi(t) = \phi_0 + \int_{t_0}^t f(t') dt', \quad (1)$$

where ϕ_0 is the phase at time $t = t_0$ and $f(t)$ is the pulsar frequency as a function of time. To zeroth order, $f(t) = f_0 = 1/T = \text{constant}$, where T is the period of the pulsar as seen in the barycenter of the solar system. There are, however, small $\mathcal{O}(10^{-5})$ corrections stemming from the Doppler shift associated with the Earth's orbital and rotational motion. Thus

$$f(t) = f_0 \left(1 + \frac{v_D(t)}{c} \right), \quad (2)$$

where c is the speed of light and v_D is the motion of the telescope projected onto the line of sight to the star under observation.