Core-shift and group delays

Let $\vec{s}_0$ be a reference position.

Core-shift causes source displacement $\vec{s}_0 + \kappa/f^r$.

$\tau_{\mathrm{geom},0}$ is geometric path delay to $\vec{s}_0$. Then $\tau_f = \tau_{\mathrm{geom},0} + \frac{\partial\tau}{\partial d}\frac{\kappa}{f^r}$, where d is unit direction of the core-shift.

Fringe phase when there is no core-shift

$$\phi = \phi_0 + 2\pi\,\tau(f - f_0) + \dot{\tau}(t - t_0)$$

and when there is core-shift:

$$\phi = \phi_0 + 2\pi\,\tau_{\mathrm{geom},0}(f - f_0) + \dot{\tau}(t - t_0) + \frac{\partial\tau}{\partial d}\frac{\kappa}{f^{r-1}} - \frac{\partial\tau}{\partial d}\,f_0\,\frac{\kappa}{f^r}$$

When r = 1

$$\phi = \phi_0 + 2\pi\,\tau_{\mathrm{geom},0}(\mathbf{f} - \mathbf{f_0}) + \dot{\tau}(\mathbf{t} - \mathbf{t_0}) + \frac{\partial\tau}{\partial \mathbf{d}}\,\kappa - \frac{\partial\tau}{\partial \mathbf{d}}\,\mathbf{f_0}\,\kappa\,\frac{\mathbf{1}}{\mathbf{f}}$$

Porcas R. W., 2009, A&A, 505, L1