Appendix B

Phase-Noise-Limited Tiled-Aperture Fringe Visibility

We consider the case of tiled-aperture CBC with two emitters. We assume that the emitters have equal intensities and are phase-locked with a residual phase error $\delta\theta_{12}(t)$. The far-field intensity at location $\boldsymbol{r}$ is then given by:

$$I \propto \langle |1 + \exp\left[j\theta_{12}(\boldsymbol{r}) + j\delta\theta_{12}(t)\right]|^2 \rangle_t = 2 + 2e^{-\sigma_{12}^2/2}\cos\theta_{12}(\boldsymbol{r}), \tag{B.1}$$

where $\theta_{12}(\boldsymbol{r})$ is the mean phase difference between the beams at the point $\boldsymbol{r}$ and $\langle\rangle_t$ denotes an average over time. We assumed that $\delta\theta_{12}(t)$ is a zero-mean Gaussian random variable with variance σ_{12}^2, so that $\langle e^{j\delta\theta_{12}(t)}\rangle_t = e^{-\sigma_{12}^2/2}$. Intensity extrema are found at points of constructive and destructive interference, with $\cos\theta_{12}(\boldsymbol{r}) = \pm 1$. The fringe visibility is therefore given by:

$$V \equiv (I_{max} - I_{min})/(I_{max} + I_{min}) = e^{-\sigma_{12}^2/2} \tag{B.2}$$

Strictly speaking, this derivation applies only to single-frequency beams, since in the chirped case the propagation phase θ_{12} is a function of both $\boldsymbol{r}$ and t. However, equation (B.2) still applies to the chirped-seed CBC experiments of chapter 6, because the frequency ranges considered there are $\sim 0.25\%$ of the nominal lasing frequency. Chirp ranges that constitute a significant fraction of the lasing frequency require a more sophisticated analysis based, for example, on chirped Gaussian modes [109].