5.1 Filter coherence length

Filter fractional bandpass $\beta = \delta\lambda/\lambda$, where $\delta\lambda = \lambda_L - \lambda_S$. After propagation over a distance $n\lambda_c$, waves at short and long ends of bandpass differ by $2\pi n\beta$ in phase. Thus after about $n = 1/\beta$ wavelengths of travel past the filter, the two 'ends' (in wavelength or frequency space) are out of phase with each other. The 'wave packet' passing through the filter begins to unravel. The coherence length is $\Lambda = \lambda_c/\beta$ (or $\lambda_c^2/\delta\lambda$). The coherence time is just Λ/c.

If two arms of an interferometer differ by about the coherence length or more, you won't get any fringes. The coherence length is the 'length of a photon', and remember that photons, being bosons, only interfere with themselves. A cheap HeNe laser coherence length is a few inches. Stabilized lasers with very narrow bandwidths and many meters of coherence length are hundreds of times more expensive.