component of the field can have a specific temporal correlation and, thus, *coherence time,* $\tau_c(\mathbf{k}_\perp) = 1/\Delta\omega(\mathbf{k}_\perp)$. Conversely, each monochromatic component can have a particular spatial correlation and, thus, *coherence area,* $A_c(\omega) = 1/\Delta k^2(\omega)$.

The two variances can be further *averaged* with respect to these variables, such that they become constant,

$$\left\langle \Delta\omega^2 \right\rangle_{k_\perp} = \frac{\int\limits_{A_{\mathbf{k}_\perp}} \int\limits_{-\infty}^{\infty} \left(\omega - \langle\omega\rangle\right)^2 S(\mathbf{k}_\perp, \omega)\, d\omega d^2\mathbf{k}_\perp}{\int\limits_{A_{\mathbf{k}_\perp}} \int\limits_{-\infty}^{\infty} S(\mathbf{k}_\perp, \omega)\, d\omega d^2\mathbf{k}_\perp}, \tag{39a}$$

$$\left\langle \Delta k_x^2 \right\rangle_{\omega} = \frac{\int\limits_{-\infty}^{\infty} \int\limits_{A_{\mathbf{k}_\perp}} \left(k_x - \langle k_x\rangle\right)^2 S(\mathbf{k}_\perp, \omega)\, d^2\mathbf{k}_\perp d\omega}{\int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} S(\mathbf{k}_\perp, \omega)\, d^2\mathbf{k}_\perp d\omega}. \tag{39b}$$

Equation (39a) yields a coherence time, $\tau_c = 1/\sqrt{\left\langle \Delta\omega^2 \right\rangle}$, that is averaged over all spatial frequencies, while Eq. (39b) provides a coherence area, $A_c = 1/\left\langle \Delta k_\perp^2 \right\rangle$, which is averaged over all temporal frequencies. In practice, we always deal with fields that fluctuate in both time and space, but rarely do we specify τ_c as a function of **k** or vice-versa; we implicitly assume averaging of the form in Eq. (39a) and (39b).

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