Correction to "Optical coherence techniques for plasma spectroscopy",

Rev. Sci. Instrum. Vol. 72, 888-897 (2001)

Equation (2) of this paper expresses the optical coherence $\gamma(\phi)$ at some fixed optical delay ϕ in terms of the Fourier transform of the quasi-monochromatic emission line spectrum $e(\xi)$ where $\xi = (\nu - \nu_0)/\nu_0$ is the normalized optical frequency

$$\gamma(\phi) = \frac{1}{\mu_0} \int_{-\infty}^{\infty} e(\xi) \exp(\mathrm{i}\phi\xi)\, \mathrm{d}\xi. \tag{1}$$

and μ_0 is the line-of-sight integrated emission intensity. The interferometer phase delay at fixed frequency $\nu = \nu_0$ is given by $\phi_0 = 2\pi L B(\nu_0)\nu_0/c$ where $B(\nu)$ is lithium niobate crystal birefringence and L is the crystal thickness. In evaluating Eq. (1), we neglected to take account of the optical frequency dispersion of the birefringence, effectively setting $\phi = \phi_0$ in the exponent in Eq. (1).

The correct expression for the birefringent phase delay at frequency $\nu = \nu_0 + \delta\nu$, where $\delta\nu$ is a small optical frequency shift, is given by

$$\begin{aligned} \varphi(\nu) &= \frac{2\pi L}{c}\left(B(\nu_0) + \frac{\partial B}{\partial \nu}\,|_{\nu_0}\right)(\nu_0 + \delta\nu) \\ &= \phi_0 + \phi_0 \xi \left(1 + \frac{\nu_0}{B_0}\frac{\partial B}{\partial \nu}\,|_{\nu_0}\right) \end{aligned} \tag{2}$$

where $B_0 \equiv B(\nu_0)$. The second term in brackets, representing the birefringence dispersion, is not negligible. The Sellmeier equations for the refractive indices of lithium niobate [1] give

$$\kappa = \frac{\nu_0}{B_0}\frac{\partial B}{\partial \nu}\,|_{\nu_0} = 0.60 \tag{3}$$

at the Ar II wavelength 488nm. This result has been confirmed by comparing measurements of the σ components of a Zeeman split triplet using the MOSS spectrometer and a calibrated monochromator [2]. The result of this oversight is that the flow velocities reported in the paper must be revised downwards by a factor $(1 + \kappa) = 1.6$ and all temperatures reduced by the square of this factor.

References

[1] R. S. WEISS and T. K. GAYLORD, Appl. Phys. **A37**, 191 (1985).

[2] J. HOWARD, Appl. Opt. (2001 (submitted)).