Appendix B: Relation between PMD vectors $\vec{\tau}$ and $\vec{\Omega}$

In the main body of this text we have defined the PMD vector $\vec{\tau}$ to characterize the fiber and derive the major PMD laws. To conform with most of the optics literature (9) and the available measurement instrumentation we are using "right-circular" Stokes space, where the Stokes parameter

$$s_3 = \langle s | \sigma_3 | s \rangle \qquad \textbf{[B.1]}$$

is unity and positive for right-handed circular polarization.

The PMD vector $\vec{\Omega}$ defined and introduced by Poole *et al*. (2, 3) is widely used in the PMD literature, and this appendix serves to connect $\vec{\tau}$ and $\vec{\Omega}$.

The vectors $\vec{\tau}$ and $\vec{\Omega}$ are different in two respects. The first is that $\vec{\Omega}$ is defined in "left-circular" Stokes space, where the s_3 Stokes parameter is unity and positive for left-handed circular polarization (and –1 for right-circular light).

The second distinction is that $\vec{\tau}$ is defined to point into the direction of the <u>slow</u> PSP with group delay

$$\tau_g = \tau_0 + \Delta\tau/2, \qquad \textbf{[B.2]}$$

while $\vec{\Omega}$ is defined to point into the direction of the <u>fast</u> PSP with group delay

$$\tau_g = \tau_0 - \Delta\tau/2 \ . \qquad \textbf{[B.3]}$$

These two differences combine to ensure that the basic law of infinitesimal rotation **(6.11)** has the same form and sign for both $\vec{\tau}$ and $\vec{\Omega}$. However, the Stokes vectors of the two spaces are not the same, and the relation between the PMD vectors is given by

$$\vec{\tau} = \begin{pmatrix} \tau_1 \\ \tau_2 \\ \tau_3 \end{pmatrix}; \quad \vec{\Omega} = \begin{pmatrix} -\tau_1 \\ -\tau_2 \\ \tau_3 \end{pmatrix}, \qquad \textbf{[B.4]}$$

where $\vec{\tau}$ is in right-circular Stokes space, and $\vec{\Omega}$ is in left-circular Stokes space. Our birefringence vector $\vec{\beta}$, defined in Eq. **6.2**, and the birefringence vector $\vec{W}$ often used in the literature (19) are related in a similar way as $\vec{\tau}$ and $\vec{\Omega}$. We have

$$\vec{\beta} = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix}; \quad \vec{W} = \begin{pmatrix} -\beta_1 \\ -\beta_2 \\ \beta_3 \end{pmatrix}, \qquad \textbf{[B.5]}$$

with $\vec{\beta}$ in right-circular and $\vec{W}$ in left-circular Stokes space.