Pseudo Scalar $I = \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z$

$I_{xyz} = \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z$

Geom Derivative of Electomagnetic Field Bi-Vector

set $e_E \cdot e_k = e_B \cdot e_k = 0$ and $e_E \cdot e_E = e_B \cdot e_B = e_k \cdot e_k = -e_t \cdot e_t = 1$

$$g = \begin{bmatrix} 1 & (e_E \cdot e_B) & 0 & 0 \\ (e_E \cdot e_B) & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix}$$

$K \cdot X = -\omega t + k x_k$

$F = -Be^{-i(\omega t - k x_k)} \boldsymbol{e}_E \wedge \boldsymbol{e}_k + Ee^{i(-\omega t + k x_k)} \boldsymbol{e}_E \wedge \boldsymbol{t} + (e_E \cdot e_B)\, Be^{i(-\omega t + k x_k)} \boldsymbol{e}_B \wedge \boldsymbol{e}_k$

Previous equation requires that: $e_E \cdot e_B = 0$ if $B \neq 0$ and $k \neq 0$

eq1: $B = -\frac{E\omega}{k}$

eq2: $B = -\frac{Ek}{\omega}$

eq3 = eq1-eq2: $0 = -\frac{E\omega}{k} + \frac{Ek}{\omega}$

eq3 = (eq1-eq2)/E: $0 = -\frac{\omega}{k} + \frac{k}{\omega}$

$$k = \begin{bmatrix} -\omega \\ \omega \end{bmatrix}$$

$$B = \begin{bmatrix} -E \\ E \end{bmatrix}$$