36.4 Equation 36.9 gives us $\frac{d^2P}{d\omega d\Omega} = \frac{\omega^2 e^2}{4\pi^2 c}\left(\frac{v^2}{c^2} - 1\right) 2\pi\, \delta(\omega(1-\frac{v}{c}\cos\theta))$

+2/2

In this case $\mu > 1$, and $\varepsilon = 1$, so $n = \sqrt{\varepsilon\mu} = \sqrt{\mu}$

$c \to \frac{c}{\sqrt{\varepsilon\mu}} = \frac{c}{n}$, $e \to \frac{1}{\sqrt{\varepsilon}} e = e$

$$\therefore \frac{d^2P}{d\omega d\Omega} = \frac{\omega^2 e^2 n}{4\pi^2 c}\left(\frac{v^2 n^2}{c^2} - 1\right) 2\pi\, \delta(\omega(1 - \frac{vn}{c}\cos\theta))$$

Integrate to get $dP/d\omega$

$$\frac{dP}{d\omega} = \frac{e^2 n}{2\pi c}\left(\frac{v^2 n^2}{c^2} - 1\right)\int d\Omega\, \omega^2\, \delta(\omega(1 - \frac{vn}{c}\cos\theta))$$ ✓

$d\Omega = \sin\theta\, d\theta\, d\phi$ The ϕ-integration is trivial.

$$\frac{dP}{d\omega} = \frac{\omega^2 e^2 n}{c}\left(\frac{v^2 n^2}{c^2} - 1\right)\int \sin\theta\, d\theta\, \delta(\omega(1 - \frac{vn}{c}\cos\theta))$$

$$= \frac{\omega^2 e^2 n}{c}\left(\frac{v^2 n^2}{c^2} - 1\right)\int d(\cos\theta)\, \delta(\omega(1 - \frac{vn}{c}\cos\theta))$$ ✓

The dirac delta's argument is zero when $\cos\theta = \frac{c}{vn\omega}$

$$= \frac{\omega^2 e^2 n(\omega)}{c}\left(\frac{v^2 n(\omega)^2}{c^2} - 1\right)\left[\frac{c}{\omega v n(\omega)}\right]$$ ✓ when $n(\omega) = \sqrt{\mu} > \frac{c}{v}$

$$\therefore \frac{dP}{d\omega} = \frac{e^2\omega}{v}\left(\frac{v^2 n(\omega)^2}{c^2} - 1\right) = \omega\frac{e^2 v}{c^2}\left(n(\omega)^2 - \frac{c^2}{v^2}\right)$$

Now, $\frac{-dE}{dz} = \frac{-dE}{dt}\frac{dt}{dz} = \frac{-dE}{dt}\frac{1}{v} = \frac{P}{v} = \frac{1}{v}\int_0^\infty d\omega \frac{dP}{d\omega}$ ✓

$$\Rightarrow \boxed{\frac{-dE}{dz} = \int d\omega\, \omega \frac{e^2}{c^2}\left[n^2(\omega) - \frac{c^2}{v^2}\right]}$$ ✓