

By Eq. (19) in the opening angle derivation,

$$E_q = \frac{E_W}{2}(1 \pm \beta \cos \theta_{\text{tilt}}). \quad (19)$$

Therefore,

$$\Delta E_q = \frac{E_W}{2}(1 + \beta \cos \theta_{\text{tilt}} - 1 + \beta \cos \theta_{\text{tilt}}) = E_W \beta \cos \theta_{\text{tilt}}. \quad (1)$$

But $\beta = p_W/E_W$, so

$$\boxed{\frac{\Delta E_q}{p_W} = \cos \theta_{\text{tilt}}} . \quad (2)$$