

1 Radiation & Composition.

1.

$$N = N_{\max_0} \exp\left(1 - \frac{z}{H} - \frac{\exp(-\frac{z}{H})}{\cos \theta}\right)$$

Show $N_{\max} = N_{\max_0} \cos \theta$

height of max production $z_m = H \ln \frac{1}{\cos \theta}$

$$N_m = N_{m_0} \exp\left(1 - \frac{H \ln \frac{1}{\cos \theta}}{H} - \frac{\exp(-\frac{H \ln \frac{1}{\cos \theta}}{H})}{\cos \theta}\right)$$

$$N_m = N_{m_0} \exp\left(1 - \ln \frac{1}{\cos \theta} - \frac{\exp(-\ln \frac{1}{\cos \theta})}{\cos \theta}\right)$$

$$\ln\left(\frac{a}{b}\right) = \ln(a) - \ln(b)$$

$$\ln(ab) = \ln(a) + \ln(b)$$

$$N_m = N_{m_0} \exp\left(1 - \ln \frac{1}{\cos \theta} - \frac{1}{e^{\ln \frac{1}{\cos \theta} \cos \theta}}\right)$$

$$N_m = N_{m_0} \exp\left(1 - \ln \frac{1}{\cos \theta} - 1\right) = N_{m_0} \exp(-\ln \frac{1}{\cos \theta})$$

$$N_m = N_{m_0} \exp\left(\underbrace{-\ln(1)}_{=0} + \ln(\cos \theta)\right)$$

$$\Rightarrow N_m = N_{m_0} \cos \theta$$

