(1) Black-body radiation

To prove the Wien's Law :

$$\lambda_{\max} T = \text{constant}$$

$$\because \quad \left.\frac{d\rho(\lambda)}{d\lambda}\right|_{\lambda=\lambda_{\max}} = -5\lambda^{-6}(e^{hc/\lambda kT}-1)^{-1} + \lambda^{-5}(e^{hc/\lambda kT}-1)^{-2} \bullet e^{hc/\lambda kT} \bullet \left.\frac{hc\lambda^{-2}}{kT}\right|_{\lambda=\lambda_{\max}} = 0$$

$$let \quad x = \frac{\lambda_{\max} kT}{hc} \qquad we\ have:$$

$$-5x(e^{\frac{1}{x}}-1) + e^{\frac{1}{x}} = 0$$

$$by\ using\ Newton's\ method,\ we\ obtain:$$

$$x \approx 0.2014052 \quad \lambda_{\max} T = 0.00289779 mK$$

(2) The Uncertainty principle (melons in quantum land)

(a) Why do we have to be careful when cutting open melons grown in quantum land ?

$$\because \quad \Delta x \bullet \Delta P_x \geq \frac{h}{4\pi}$$

$$\therefore \quad \Delta V_x \geq \frac{h}{4\pi\, m\Delta x}, \quad m = 0.0001kg, \Delta x = 0.2m,$$

$$\Delta V_x \geq 25\, m/s \quad \Rightarrow Very\ fast\ !$$

The seeds leave the melon with this velocity when it is cut open. So you should be careful.

(b) Are such melons visible?

No, Let's consider the recoil of a melon at reflection of a "visual" photon. Because the peel of the melons is very hard, the collision can be treated as elastic collision, then the momentum of the melon after the collision is approximately :

$$P_M = 2P_{photon} = \frac{h}{\lambda} = 10^4\, kg\, m/s$$

$$\therefore \quad v \approx 5\, km/s \quad \Rightarrow very\ fast$$

By the time this photon is seen, the melon is already situated elsewhere