$\Delta E\ \Delta t$ Uncertainty Principle Example*

A particular optical fiber transmits light over the range 1300-1600 nm (corresponding to a frequency range of 2.3×10^{14} Hz to 1.9×10^{14} Hz). How long (approximately) is the shortest pulse that can propagate down this fiber?

$$\Delta\omega\,\Delta t \geq 1 \quad \Rightarrow \quad 2\pi\,\Delta f\,\Delta t \geq 1$$

$$\Delta t \geq 1/2\pi\,\Delta f$$

$$\geq 1/(2\pi\ 0.4 \times 10^{14}\,\text{Hz})$$

$$= 4 \times 10^{-15}\,\text{s} = \boxed{4\ \text{fs}}$$

Note: This means the upper limit to data transmission is ~1/(4fs) = 2.5×10^{14} bits/second = 250 Tb/s

*This problem obviously does not require "quantum mechanics" *per se*. However, due to the Correspondence Principle, QM had better give a consistent result.