Estimating Planck's Constant
Physics 102 001
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Aim a red laser with a wavelength of $\lambda = 632.8$ nm through a narrow 0.02 mm slit at a screen that is about 2.5 m from the slit. Each photon has a momentum $p = 1.05 \times 10^{-27}$ m kg/s.

We set $\Delta x = 10^{-5}$ m or half the width of the slit. The central maximum of the diffraction pattern is about 0.05 m wide. We use a quarter of the width of the central maximum and estimate Δp as

$$\Delta p = 0.05\, p/(4 \times 2.5) = 5 \times 10^{-30}\,\text{kg m/s}.$$

Then we use Heisenberg's uncertainty principle

$$\Delta x\, \Delta p \gtrsim \frac{h}{4\,\pi}$$

to get

$$\begin{aligned} h &\sim 4\pi\, \Delta x\, \Delta p = 4\pi\, (10^{-5}\,\text{m})(5 \times 10^{-30}\,\text{kg m/s}) \\ &= \; = 20\,\pi \times 10^{-35}\,\text{kg}\,\text{m}^2/\text{s} \approx 6.3 \times 10^{-34}\ \text{kg}\,\text{m}^2/\text{s} \end{aligned}$$

which differs from the known value of

$$h = 6.626 \times 10^{-34}\,\text{kg}\,\text{m}^2/\text{s}$$

by less than 5 percent.

In this demo, I assumed that the momentum of a single photon coming out of the laser has been measured by other means. (I used $p = h/\lambda$, but one *could* have measured p.)