

29. If the beam carries energy U away from the spaceship, then it also carries momentum $p = U/c$ away. Since the total momentum of the spaceship and light is conserved, this is the magnitude of the momentum acquired by the spaceship. If P is the power of the laser, then the energy carried away in time t is $U = Pt$. We note that there are 86400 seconds in a day. Thus, $p = Pt/c$ and, if m is mass of the spaceship, its speed is

$$v = \frac{p}{m} = \frac{Pt}{mc} = \frac{(10 \times 10^3 \text{ W})(86400 \text{ s})}{(1.5 \times 10^3 \text{ kg})(2.998 \times 10^8 \text{ m/s})} = 1.9 \times 10^{-3} \text{ m/s} .$$