564.

Problem 41.35 (RHK)

High-power lasers are used to compress gas plasmas by radiation pressure. The reflectivity of a plasma is unity if the electron density is high enough. A laser generating pulses of radiation of peak power 1.5 GW *is focussed onto* $1.3\ \text{mm}^2$ *of high-electron-density plasma. We have to find the pressure exerted on the plasma.*

Solution:

It is given that the reflectivity of the plasma is unity. If the power of the laser is *P* the momentum transferred per second by the laser beam to the plasma will be

$$\Delta p = \frac{2P}{c},$$

where c is the speed of electromagnetic waves. As a laser beam of peak power $P = 1.5 \times 10^9$ W is focussed onto $1.3\ \text{mm}^2$ of high-electron-density plasma the pressure exerted on the plasma will be

$$\text{pressure} = \frac{\Delta p}{A} = \frac{2 \times 1.5 \times 10^{9}}{3 \times 10^{8} \times 1.3 \times 10^{-6}} \text{ Pa} = 7.69 \times 10^{6} \text{ Pa.}$$