[tex63] **Doppler broadening of atomic spectral lines**

Consider a furnace containing a dilute gas at high temperature. Through a small window of the furnace, we observe a particular spectral line of the gas atoms by means of a spectrometer. The width of the observed spectral line is broadened due to the spread of velocities of the gas atoms. This effect is called *Doppler broadening*. Show that the intensity profile is given by the expression

$$I(\lambda) \;\propto\; \exp\left(\frac{mc^2(\lambda-\lambda_0)^2}{2\lambda_0^2 k_B T}\right),$$

where T is the temperature of the furnace, c is the speed of light, m is the mass of the gas atoms, and λ_0 is the wavelength of the radiation emitted by an atom at rest.