Hands-on exercises 10: Mixed problems from stellar and solar physics

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Problem 1: Add gravity to the system that was used to demonstrate sound waves on the lectures and derive the equations governing internal gravity waves or g modes.

Problem 2: Estimate the number density of electrons in the corona assuming that the brigthness of the corona is 10^{-6} smaller than the solar disk and that the corona emits light by scattering photospheric photons via Thomson scattering, where effective cross-section is $6.65 \times 10^{-29}\mathrm{m}^2$.

Problem 3: Estimate the equipartition magnetic field in the solar photosphere, that is the field for which magnetic pressure is equal to the gas pressure. Typical gas pressure in the solar atmosphere is of the order of 0.01 bar. How do these pressures compare to radiation pressure?

Useful physical constants

- $R_\odot = 696 \times 10^6\,\mathrm{m}$
- $M_\odot = 1.989 \times 10^{30}\,\mathrm{kg}$
- $L_\odot = 3.83 \times 10^{26}\ \mathrm{W}$
- $T_\odot^{\mathrm{eff}} = 5777\,\mathrm{K}$
- $1\,\mathrm{AU} = 1.496 \times 10^8\,\mathrm{km}$
- $c = 2.997 \times 10^8\,\mathrm{m/s}$
- $G = 6.674 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$
- $k = 1.38 \cdot 10^{-23}\ \mathrm{J/K}$
- $m_\mathrm{e} = 9.11 \cdot 10^{-31}\ \mathrm{kg}$
- $m_\mathrm{H} = 1.67 \cdot 10^{-27}\ \mathrm{kg}$