Phys 506 Assignment (1)

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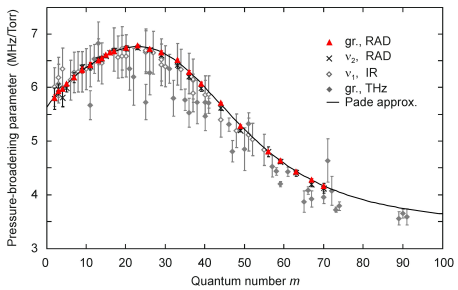
PROBLEM

DESCRIPTION

A diatomic gas is placed in contact with a reservoir at temperature T. Each molecule rotates around its centre of mass at some axis. The energy of rotation is quantised and proportional to the rotation angular momentum quantum number m.It is given explicitly by:

$$E_m = B\,h\,c\;m(m+1),$$

where B is a constant. The graph below represents a spectroscopic experiment made in order to plot the probability for transition from the state m to $m+1$,VS the quantum number m. If



you know that the only allowed transitions are $m \longrightarrow m+1$. And the fitted curve is given by:

$$P = (m+1)e^{-\beta E_m}$$

REQUESTS

1. Calculate the partition function, then derive the distribution above from it
2. Normalise the distribution function given above.
3. Find the transition of maximal probability Note that only m is needed to be know known.
4. What are the microstates and macrostates of this system?
5. Write the entropy function, then maximise it What do you observe ?

Data reference :

M.A. Koshelev, M.Yu. Tretyakov, *Collisional broadening and shifting of OCS rotational spectrum lines*, J. Quant. Spectrosc. Radiative Transfer, 110(v. 1-2) (2009) 118-128.

End of assignment... Best of Luck !