

Phys 343 Assignment (6)

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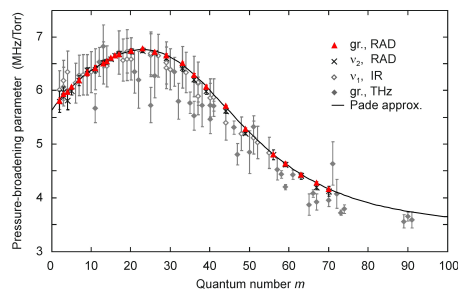
PROBLEM

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 $m \rightarrow m+1$. And the fitted curve is given by:

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

REQUESTS

1. What statistics this system seems to obey?
2. Normalise the distribution function given above.
3. Find the transition of maximal probability. Note that only m is needed to be 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 !