

Stimulated Absorption

In his book "The Internal Constitution of the Stars", Sir Arthur Eddington deduced the Planck distribution formula, but from a direction opposite to that used by Einstein. Eddington presumed the principles that:

- (1.) Thermodynamic equilibrium requires reversible exchanges, and
- (2.) Electromagnetic energy exchanges occur in a "quantized" fashion.

He then deduced Boltzmann's formula and Planck's formula from "pure quantum theory" (Einstein presumed Boltzmann's formula to deduce the quantization concept.).

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Eddington's argument was based upon the absorption and emission coefficients, a_{12} and between quantum states 1 and 2, and the spontaneous coefficient (of decay from 2 to 1) given by the coefficient, b_{21} . Balancing the transitions between states 1 and 2 (the equilibrium assumption) he formulates the Einstein equation,

$$a_{12}n_1I(\nu_{12}, T) = +b_{12}n_2 + a_{21}n_2I(\nu_{21}, T),$$

where $I(\nu, T)$ represents the distribution law of radiation at temperature T .

Eddington then considers the detailed balance between 3 states, and ultimately deduces the relation

$$(1 + C/f(\alpha))(1 + C/f(\beta)) = (1 + C/f(\alpha + \beta)),$$

which he states has the only solution

$$(1 + C/f(\alpha)) = e^{k\alpha}.$$

The result leads to the Bose-Einstein formula,

$$f(\nu, T) = C/(e^{k\nu/T} - 1).$$

Eddington then demonstrates that at a temperature $T > 0$, for the atom in the higher energy state, the "emission is stimulated by the presence of radiation in the field. This stimulated emission is called by Einstein negative absorption".

With further characteristic insight, Eddington examined equilibrium between four states, and obtained a modified distribution law of the form,

$$f(\nu, T) = C/(ae^{k\nu/T} - 1),$$

for which dissociation and combination of atoms (the coefficient a in front of the exponential) takes place in a radiation field. All of this was done before 1926! and before the Fermi-Dirac distribution was known.

While reading Eddington's book, I noticed (about 25 years ago) that if equation (1) was modified to read,

$$a_{12}n_1I(\nu_{12}, T) = \pm b_{12}n_2 + a_{21}n_2I(\nu_{21}, T),$$

then all of Eddington's arguments are still valid, and the result for the minus sign becomes

$$f(\nu, T) = C/(ae^{k\nu/T} \mp 1).$$

In other words, the distribution function is the Fermi-Dirac law with the minus sign and Bose-Einstein with the positive sign.

By comparison, the negative coefficient, $-b_{21}$, could be interpreted as *stimulated absorption* (in the same sense as when the positive coefficient is interpreted as stimulated emission).

In the same sense of the coherent effects in a laser (Boson system) the argument could be made that there should exist the dual effect in a chemical (Fermion) system. Stimulated absorption instead of stimulated emission. Absorption of what? Absorption of molecules and atoms to form specific precipitate chiral compounds.

For the past few years I have been interested in (Topological) Torsion and Spin in electromagnetic fields (not the usual stuff).

see <http://www22.pair.com/csdc/car/carhomep.htm>

While messing around with these ideas just recently, the old thought above re-surfaced. I think I have some patentable (wild) proprietary ideas that might be worth big bucks. Know anybody interested? We might yet have some fun in our old age?

I believe that this effect can be used to produce biological enantiomers in an efficient manner.

References

Sir Arthur Eddington, "The Internal Constitution of the Stars", Dover (1959)

(In this same book (1926) Eddington notes that the background radiation of the night sky is about 3 degrees Kelvin. No one in Big Bang theory ever makes mention of this.?!)

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