Chapter 1

光的量子化

1.1 黑體輻射 Blackbody Radiation

In 1859 Gustav Kirchhoff

Definition 1.1. *BlackBody*
an object that absorbs all the electricmagnets radtion on it.

Law 1.2. *Kirchhoff's law of thermal radiation*

$$e_f = J(f,T)A_f \tag{1.1}$$

where.

- e_f *is the power emitted per unit area per unit frequency*
- $J(f,T)$ *is a universal function that depends only* f*, the light frequency and* T*, the body temperature*
- A_f *is the absorption power (fraction of the incident power)*

but why emitted power connect with absorption power?

$$e_{total,1} \cdot A_1 \cdot \Delta t = a_1 \cdot A_1 \Delta t \ \cdot I$$

$e_{total,1}$ is the power emitted per unit area,so LHS is the energy which emitted from backbody,and let RHS is the energy of absorption.
where a_1 is a material constant and I is Intensity.

RHS means Right hand side and LHS means Left Hand side

$$e_{total,1} = a_1 I \qquad e_{total,2} = a_2 I$$
$$\frac{e_{total,1}}{a_1} = \frac{e_{total,2}}{a_2} = I \text{ (a material independent constant)}$$

According to Definition 1.1, A_f of Blackbody Radiation is 1 in Eq. 1.1. ($A_f = 1$ at blackbody)

1.1.1 Spectral Energy Density of a blackbody

The more convenient of Law. 1.2 to consider the apectral energy density, $u(f,T)$, the energy per unit volume per unit frequenct og the radiation.

Law 1.3. *Rayleight-Jeans Law*

$$E = \frac{\int E \cdot e^{-E/k_B T} dE}{\int e^{-E/k_B T} dE} \tag{1.2}$$