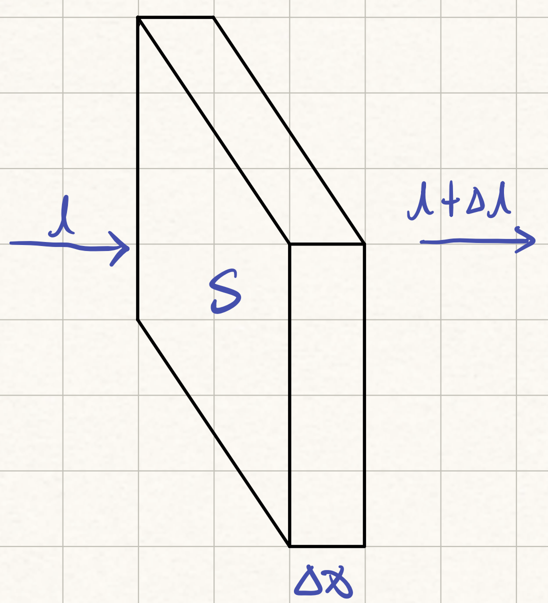
# Week 8 — PHAS0004 ASU — Note

ChengXu Liu — Leo.

# Reading Assignment.

Chap 16.1 — Chap 5.4 Radiative Transfer.




Assume P of throw the gas per area = $\sigma$
per particle.

$\Delta I / I = -\sigma / S$

Num of absorbing particle $N = n \cdot S \cdot \Delta x$

$\Delta I / I = -(n S \Delta x) \cdot \sigma / S = -n\sigma\Delta x$

☆ Same as $dI/I = -n\sigma \cdot dx$

$\Rightarrow \quad I = I_0 \exp(-n\sigma x) + C$

Set $-n\sigma x = \tau(x)$ for measure on howmuch intensity left after path throw $x$ gas

$I = I_0 \exp(-\tau(x)) \rightarrow$ Flux $F = F_0 \exp(-n\sigma r)$

Similar : $\langle x \rangle = \dfrac{\int_0^\infty x \cdot \exp(-\tau(x)) \cdot dx}{\int_0^\infty \exp(-\tau(x)) \cdot dx} = 1/n\sigma$

$m_{obs} = C - 2.5 \log F$ □. in week 7. notes Magnetitude.

$= C - 2.5 \log F_0 - 2.5 \log (e^{-\tau})$

$= m_0 + 2.5 \tau \log e = m_0 + 1.086 \tau$

> Insert $\lambda$ term in $m_{obs}(\lambda) = m_0(\lambda) + 1.086\,\tau(\lambda)$

Set as $A(\lambda) = 1.086\,\tau(\lambda)$

$$m_{obs} - M = 5\log r - 5 + A$$

Extinction Effect Term.

> Color Index : $(B-V)_0$ : Original dif. on two colors
$(B-V)$ : obs. dif. ~

$$(B-V) = (B_0 + A_B) - (V_0 + A_V)$$
$$= (B_0 - V_0) + (A_B - A_V)$$ Extinction Term
$$= (B-V)_0 + \underline{E(B-V)}$$ E define as color excess
$$= 1.086(\tau_B - \tau_V)$$ $E = (A_B - A_V)/(B-V)$
$$= 1.086\,\tau_V(\tau_B/\tau_V - 1)$$

define $R$ = Total E / Select E = $1/(\tau_B/\tau_V) - 1 \approx 4.2$

## Chap 17.1 Star Formation

> Size of Raw materials. $n_{mc} \sim 10^{12}$ mol/m$^3$
$$\rho_{mc} \approx 2 \cdot m_p \cdot n_{mc} \approx 5\times10^{-12} M_\odot AU^{-3}$$
For normall value $\rho \sim 1400\,kg/m^3$

$$R_\odot / R_{mc} = (\rho_{mc}/\rho_\odot)^{1/3} \approx 10^{-6}$$

> Free Collaps Time $a^3/T^2 = C \rightarrow T^2 = 4\pi^2 a^3/GM$
$$t_{ff} = \tfrac{1}{2}T \qquad a = r_0/2$$

$$4t_{ff}^2 = \frac{4\pi^2 (r_0/2)^3}{GM}$$

No relation on $r$ — $t_{ff} = (3\pi/32G\rho_0)^{1/2}$

## ★ pressure stop free fall collaps.

> $t_{press} = r_0 / $ Speed of sound $C_s$.

Normally $C_s = (\gamma k T / \mu m_p)^{1/2}$

if $t_{ff} < t_{press}$ no collaps.

$$\left(\frac{3\pi}{32 G \rho_0}\right)^{1/2} < r_0 \left(\frac{\mu m_p}{\gamma k T}\right)^{1/2}$$

for limit, $r_J = \left(\frac{3\pi \gamma k T}{32 G \rho_0 \mu m_p}\right)^{1/2}$ Jeans radius.

if $r_{solar} > r_J$ cloud collaps.

> Rotation Situation. $GM / r_J^2 = v_f^2 / r_f$

$\Rightarrow r_f \approx 200\,AU$

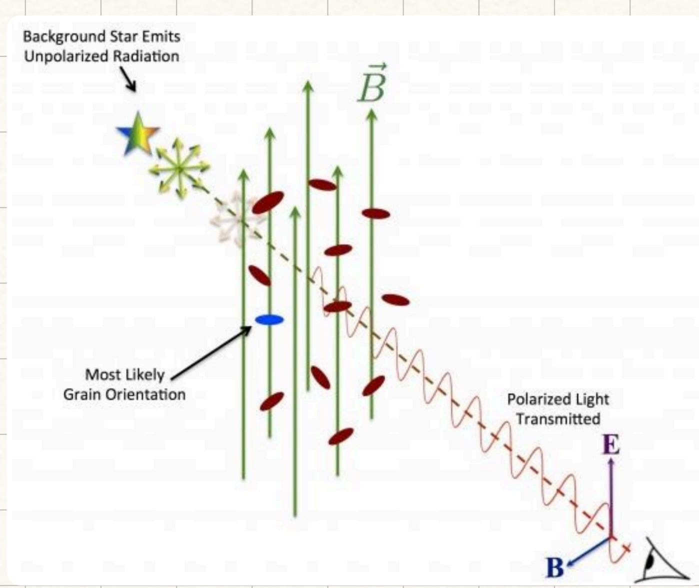
★ lots of materials infact didn't collaps to core star.

Slides Part.

> Interstellar dust grains.

i). $m_{obs}(\lambda) = m_0(\lambda) + A(\lambda)$ □

ii). Polarization — only left one-direction light.



> Main Sequence $H \to He$ react

In week 7. $L = 4\pi R^2 \sigma T_e^4$

> Hydrostatic $dP/dr = -G M\rho/r^2 \Rightarrow P \propto M^2/R^4$

> Equation State $P = \rho k_B T/\mu m_H \Rightarrow P \propto MT/R^3$

$\Rightarrow T \propto M/R$

For $= 4\pi\sigma R^2 T^4$ $L \propto M^3/k$

☆ k for different type star

i). Kumpton Scattering Star: $L \propto M^3$ $k$ = Sth. Constant

ii). Kramers Star: $k \propto \rho T^{-3.5} \Rightarrow L \propto M^5$ □

> Neutron Star. - linked to week 5. Pauli exclusion.

If $[\hat{A}, \hat{B}] = 0$ A, B observe at same time.

$$[\hat{x}, \hat{p}] \cdot \psi = \hat{x} \cdot i\hbar \cdot \partial\psi/\partial x - i\hbar \cdot \partial/\partial x (\hat{x} \cdot \psi)$$
$$= \hat{x} \cdot i\hbar \cdot \partial\psi/\partial x - i\hbar (\psi + \partial\psi/\partial x \cdot \hat{x})$$
$$= -i\hbar \psi$$

$$\sigma_A^2 \sigma_B^2 \geq (1/2 \langle [\hat{A}, \hat{B}] \rangle)^2 \Rightarrow \sigma_x \sigma_p \geq \hbar/2$$

week 7. >>

$\Delta x \sim V^{1/3} \sim n^{-1/3}$   $\Delta p \sim \hbar/\Delta x \sim \hbar n^{1/3}$

$\Delta v = \Delta p/m_e \sim \hbar n_e^{1/3}/m_e \Rightarrow P_{degen} \sim n_e m_e (\Delta v)^2$

$\sim \hbar^2 \cdot n_e^{5/3} \cdot m_e^{-1}$

> Mass - Radius Relation   $P_c = \frac{GM^2/R^2}{R^2} \sim GM^2/R^4$

For mass $M = n \times m \cdot \text{Volumn} \sim R^3 nm$

$P_c \approx P_{degen} \Rightarrow GM^2/R \sim \hbar^2 M^{5/3}/m_n m_p^{5/3} R^5$

$\Downarrow$

$R_{neutron} \sim \hbar^2/G m_n m_p^{3} (M/m_p)^{-1/3}$