Radiative Feedback of Massive Stars

Chen, Yen-Hua 陳彥樺

Supervisor : Ken Chen

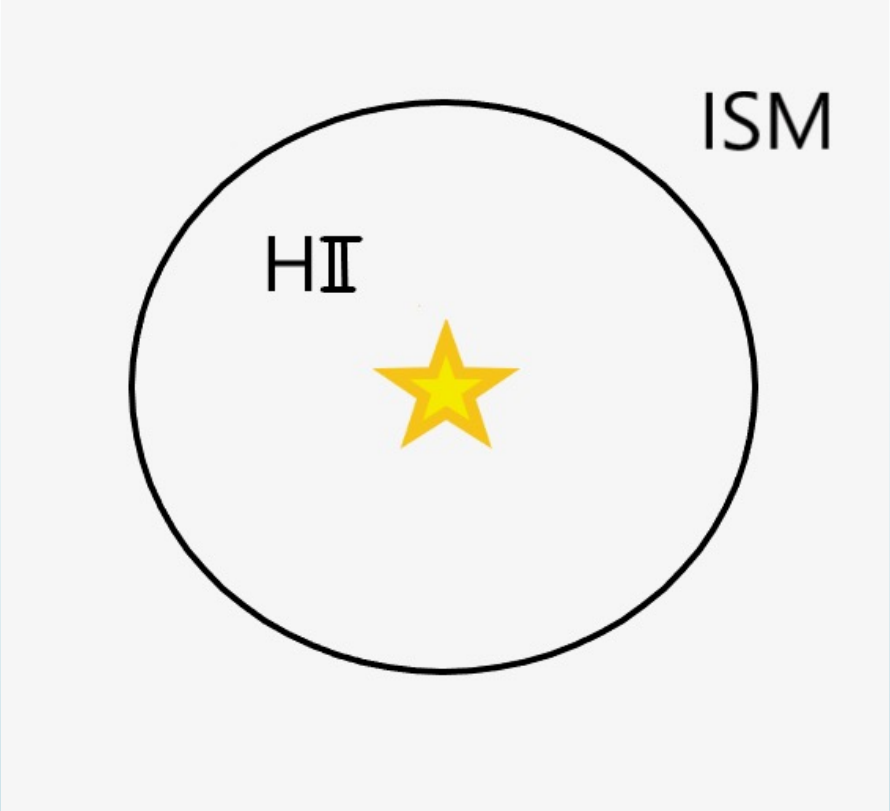
NTU Mechanical Engineering

2021/8/30

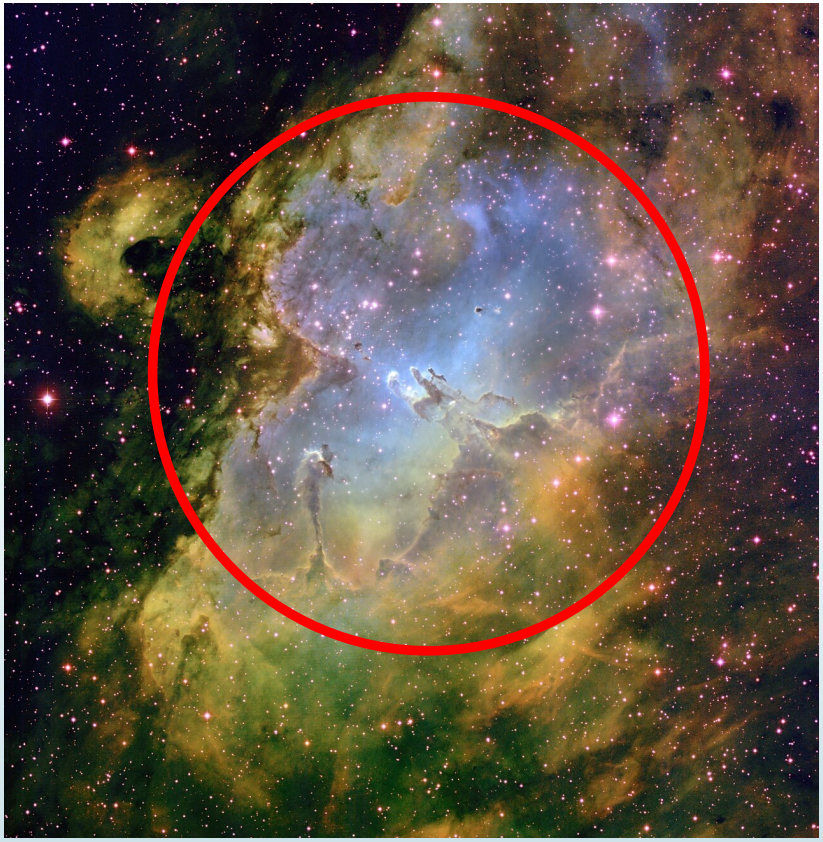
Outline

- Introduction
- Method and result
- Conclusion and Future work

Introduction



Eagle Nebula

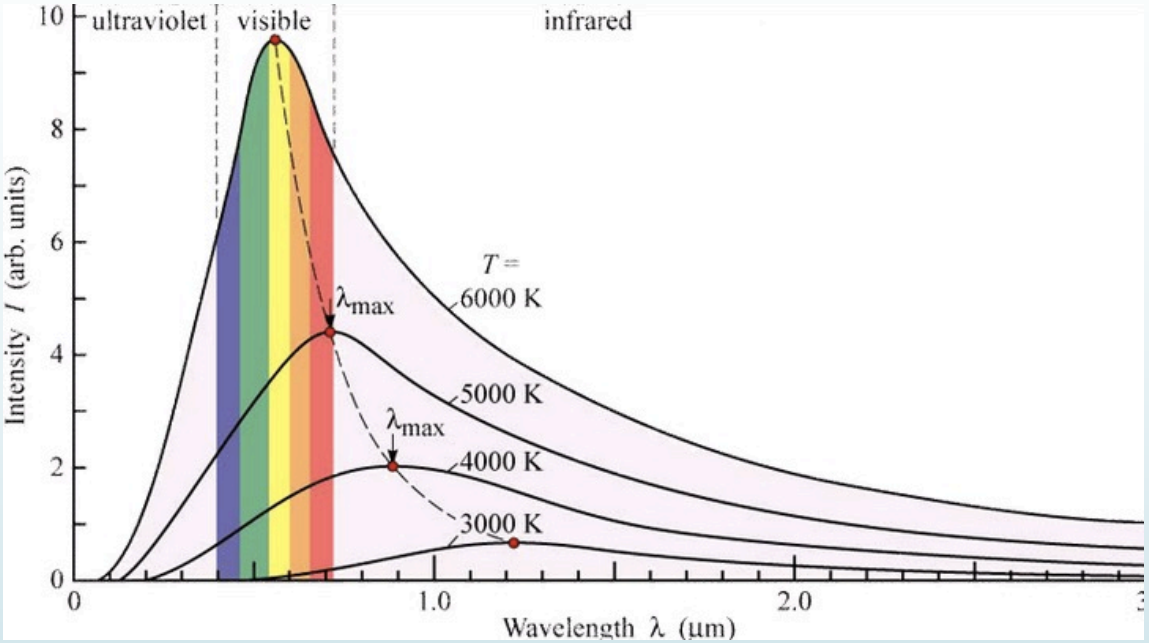


https://noirlab.edu/public/images/noao-04086/?fbclid=IwAR1Hasp9g4SanKfaJjwSqAvwCNaEEGyVb59d1OYM-hD0qOIt1KqQKp7eqyE

Why?

- The ionization energy is 13.6ev
- Equal to 136,000k

Black Body Radiation



https://esfsciencenew.wordpress.com/2013/10/29/black-body-radiation/?fbclid=IwAR1QlGtmX5ehhoMDE-mjhopOD3F5xlZZA3frgNPw_HI57-JJsOXIV-BXZ14

Photoionization Rate

$$n\xi \int \frac{L_\nu}{4\pi r^2} \frac{a_\nu}{h\nu} d\nu$$

(Number of neutral H) X (number of photons from source)

Recombination Rate

$$n_e \cdot n_p \cdot \alpha$$

Equilibrium State

$n_H \xi \int \frac{L_\nu}{4\pi r^2} \frac{a_\nu}{h\nu} d\nu$= Photoionization Rate

$n_e \cdot n_p \cdot \alpha$= Recombination Rate

$$n_H \xi \int \frac{L_\nu}{4\pi r^2} \frac{a_\nu}{h\nu} d\nu = n_e \cdot n_p \cdot \alpha$$

Simulation Tool

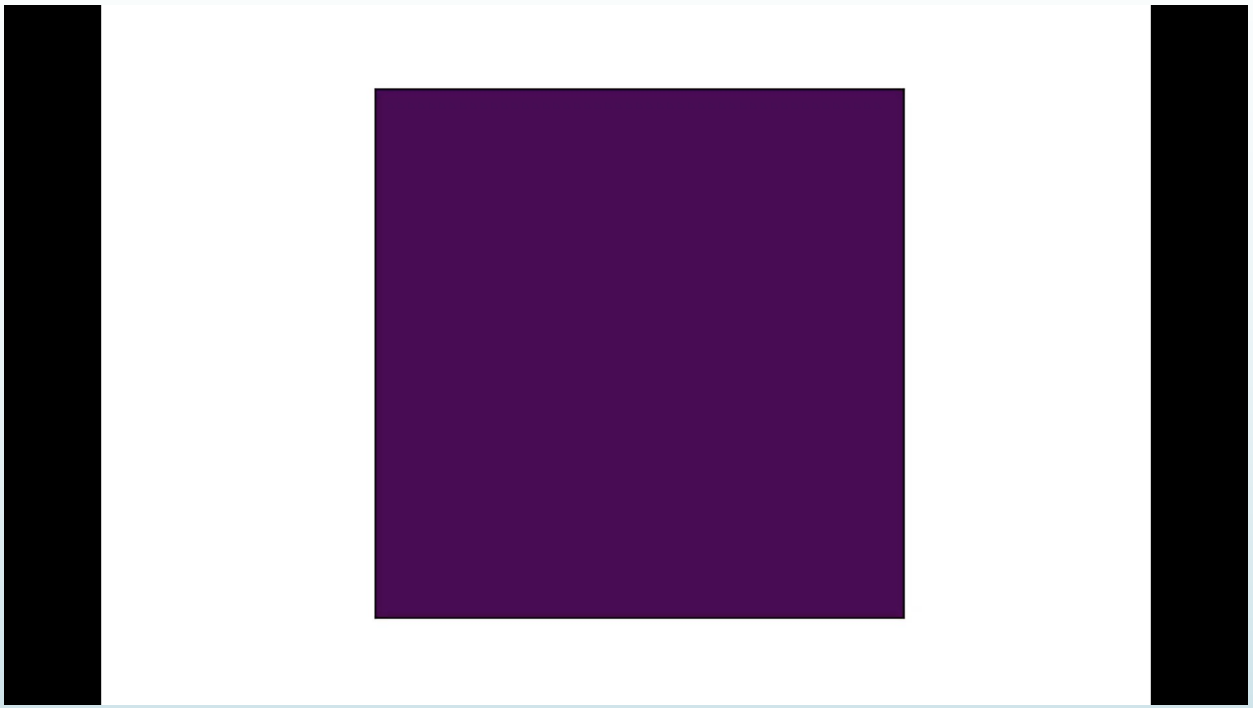
RAMSES

- The AMR sevice routines
- the particle mesh routines
- the poisson solver
- the hydrodynamical routines

Pymses

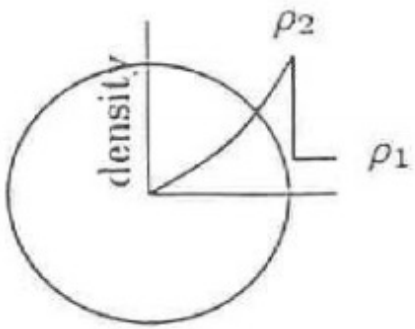
an analysis library written in Python for RAMSES outputs: http://irfu.cea.fr/Projets/PYMSES/

Test Problem: Sedov2d



Sedov Blastwave

blast wave
(energy conserving)



Dimensional Analysis

- Amount all relevant parameters we pick 3 of them as scaling parameters

  Parameters: E , t , ρ

  Dimensions: $\{\frac{ML^2}{T^2}\}$, $\{T\}$, $\{\frac{M}{L^3}\}$

  Fundamental dimension: $\{L\}$, $\{T\}$ $\{M\}$

- nondimensionalize the radius to form dimensionless groups

  $\xi = r\,\rho^{k} t^{h} E^{n}$

  Length dimension: L = k-3h+2n = 0

  Mass dimension: M = h+n = 0

  Time dimension: T = k-2n = 0

Dimensional Analysis

$$\xi = \mathrm{r}\left(\frac{\rho}{Et^2}\right)^{1/5}$$

$$\mathrm{r} = \xi\left(\frac{Et^2}{\rho}\right)^{1/5}$$

$$\frac{\mathrm{d}r}{\mathrm{d}t} = v = \frac{2}{5}\xi\left(\frac{E}{\rho t^3}\right)^{\frac{1}{5}}$$

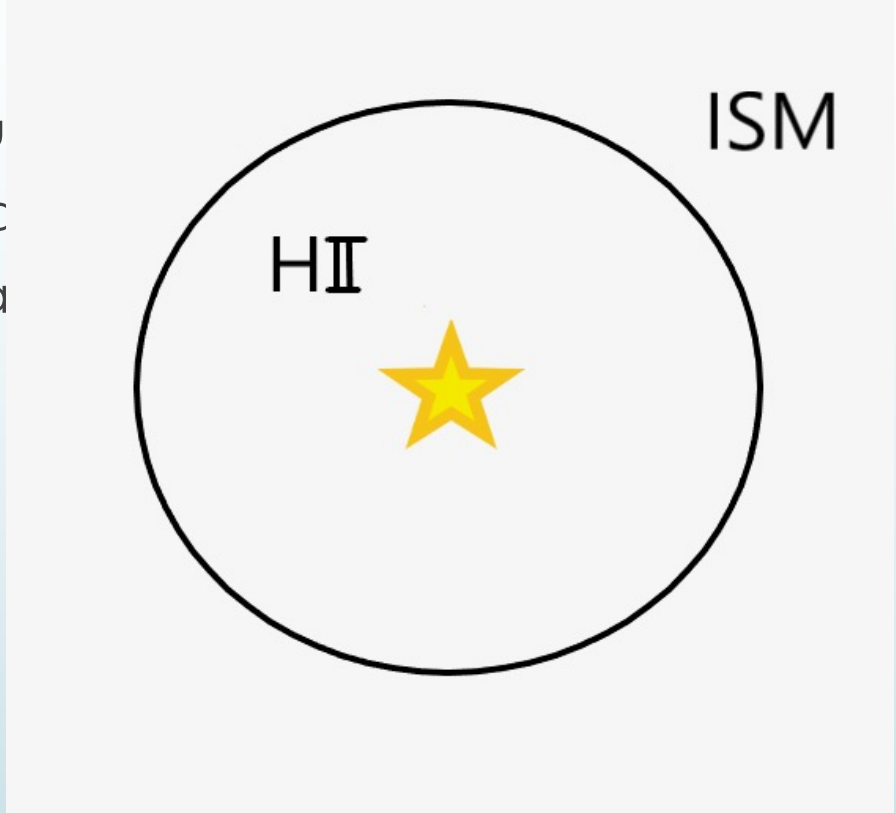
Preliminary

- Physics of HII region
- Ramses code
- Self-similar solution of Sedov blastwave

This is just a beginning !

Future Work

- Pu
- Ac
- Pa




Thank you for your listening ~