

Group Meeting 12.13

Reading Rev.Mod.Phys. 29 (1957) 547-650

Synthesis of the Elements in Star

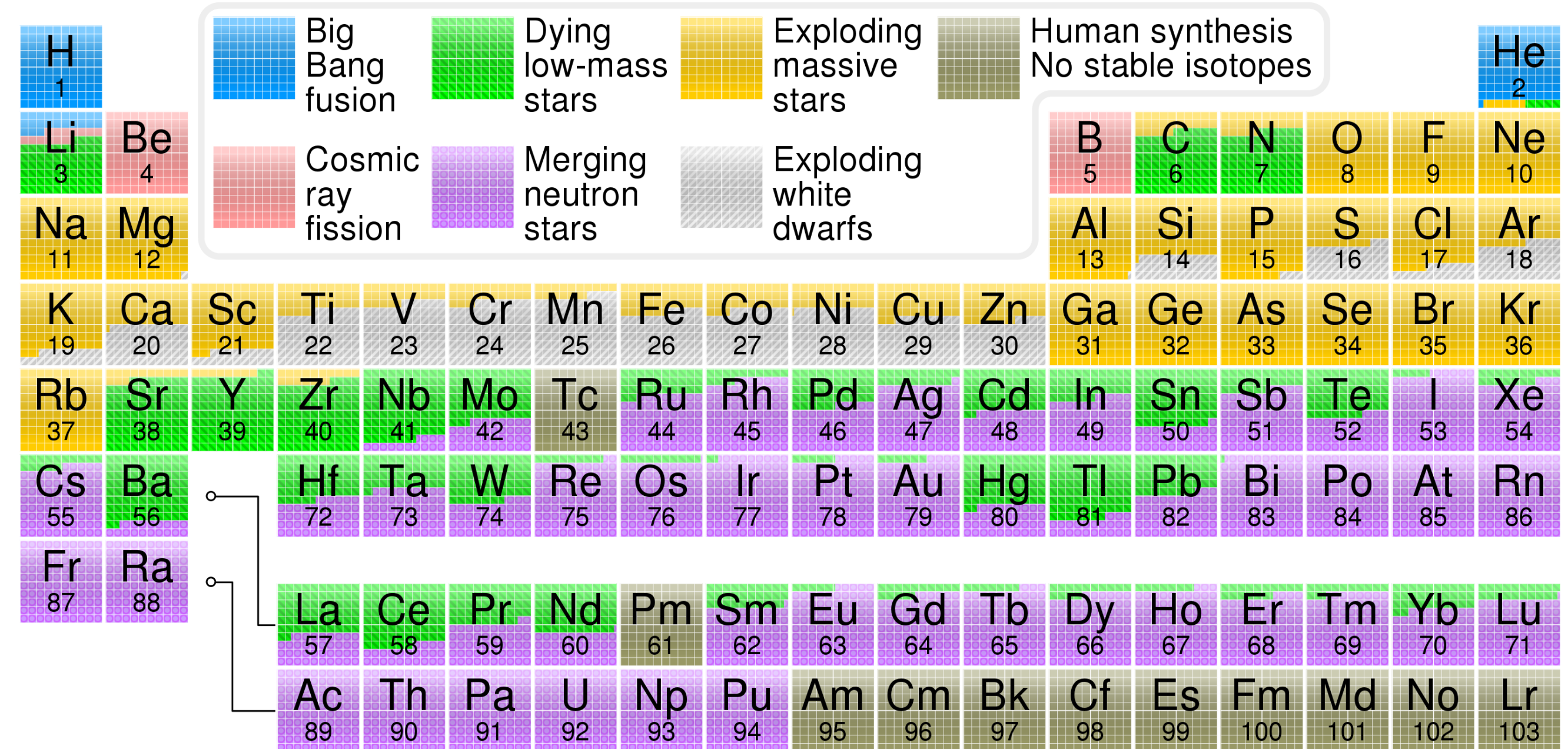
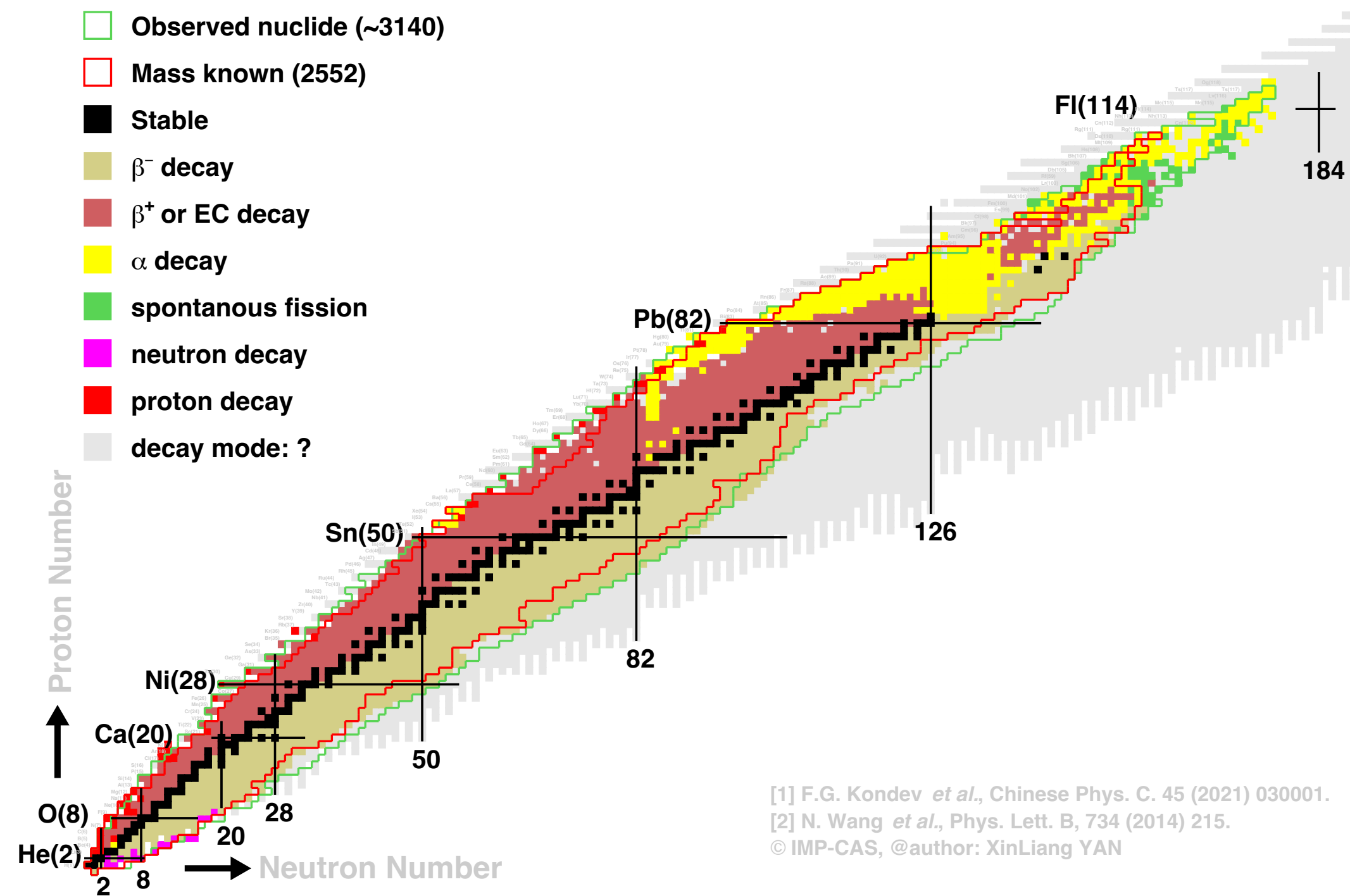
Hao Liu
Zetian Ma

Overview

There are so many different processes in the stellar.

How to assign them to different isotopes?

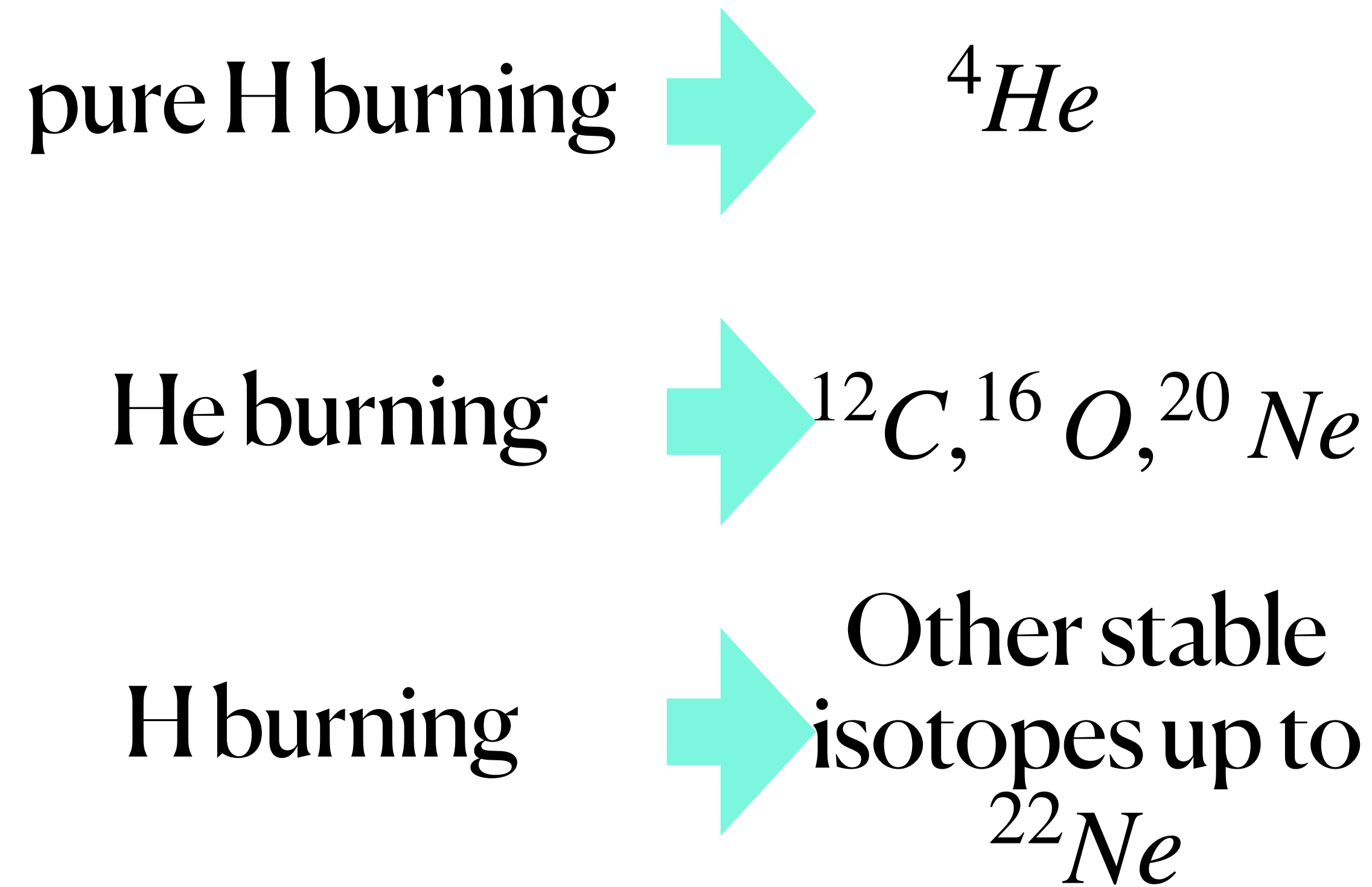
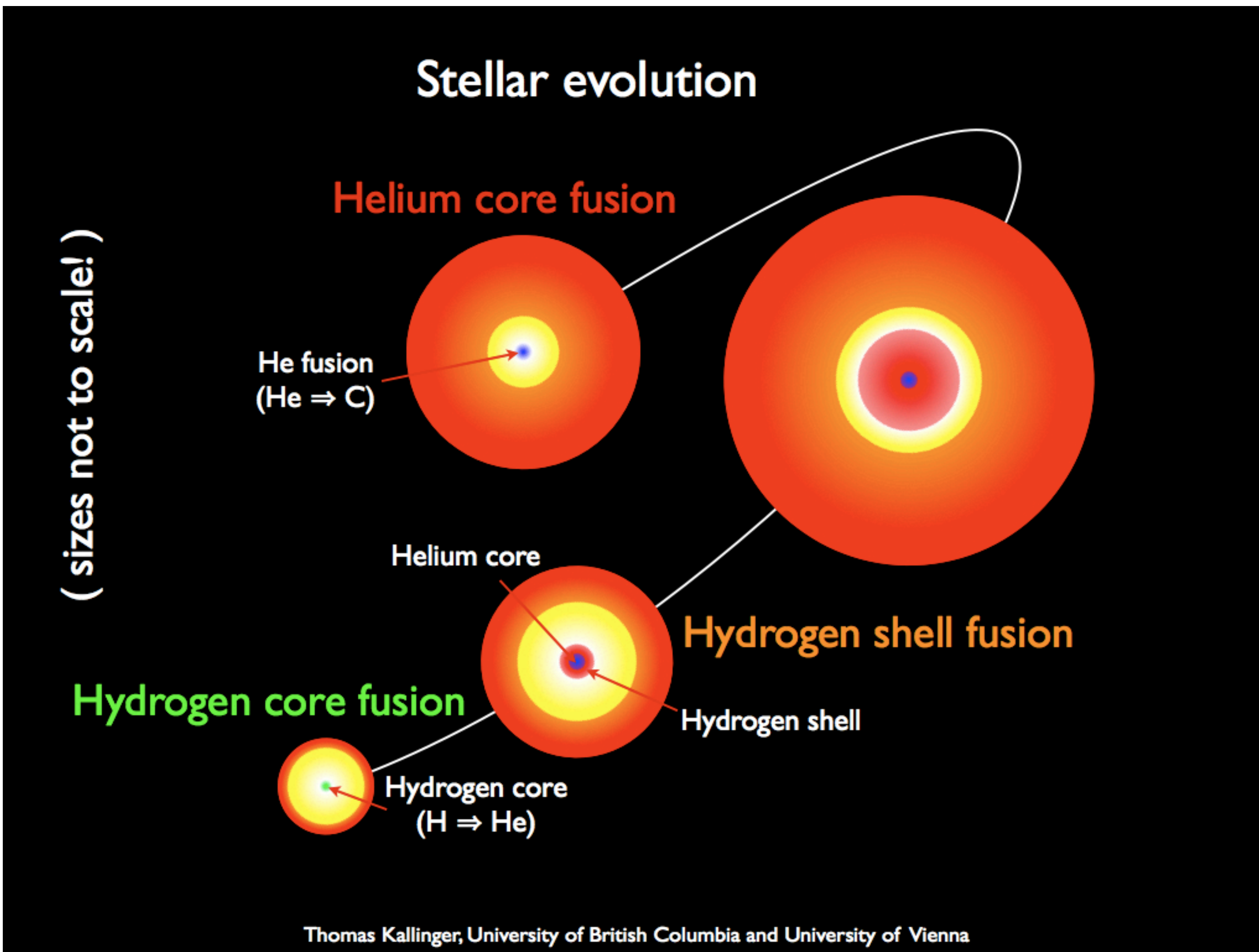
Nuclear Chart: decay mode of the ground state nuclide(NUBASE2020)



[1] F.G. Kondev *et al.*, Chinese Phys. C. 45 (2021) 030001.
 [2] N. Wang *et al.*, Phys. Lett. B, 734 (2014) 215.
 © IMP-CAS, @author: XinLiang YAN

Overview

Let's begin with the pure H burning.

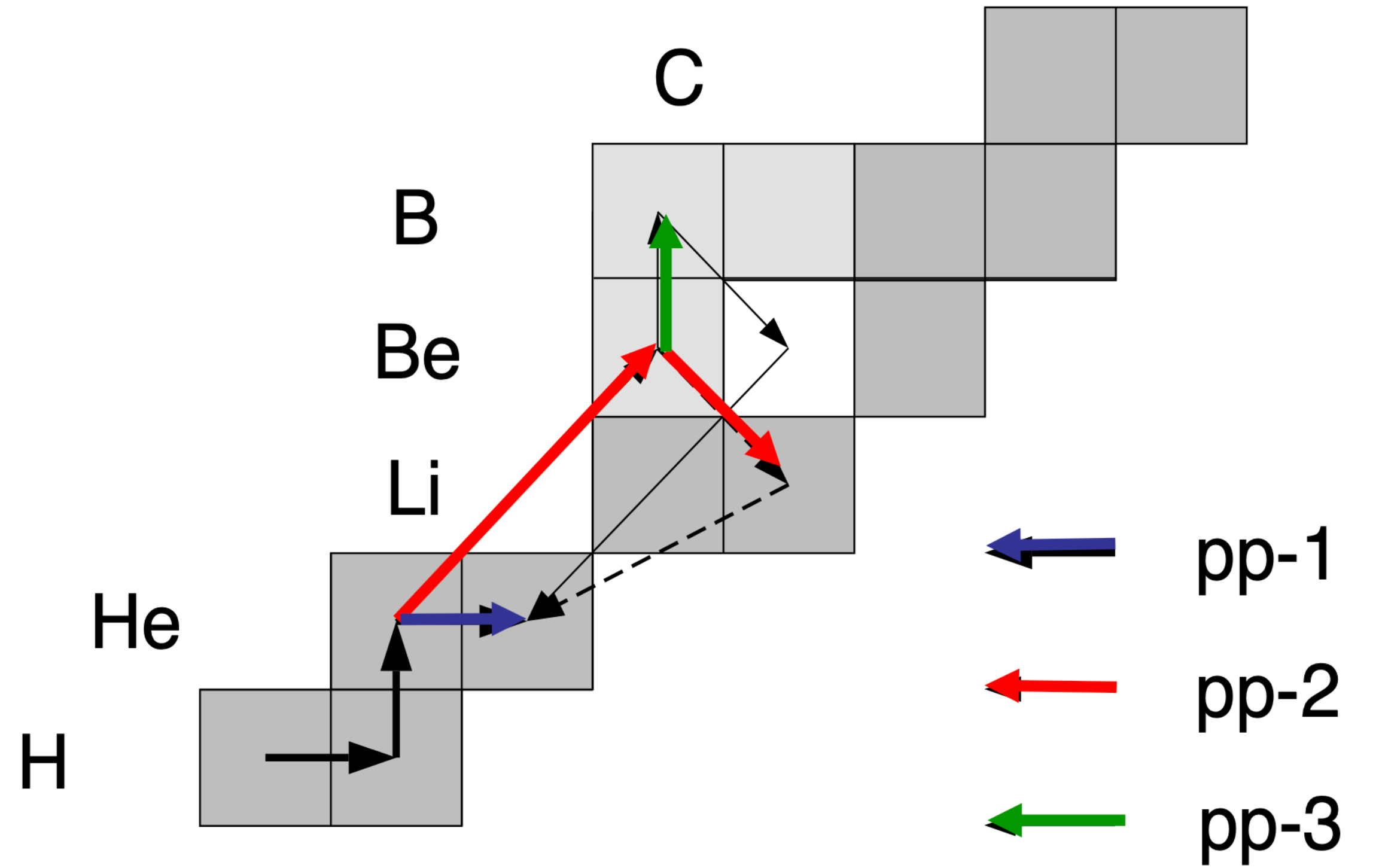


Except for deuteron, *Li*, *Be*, *B*

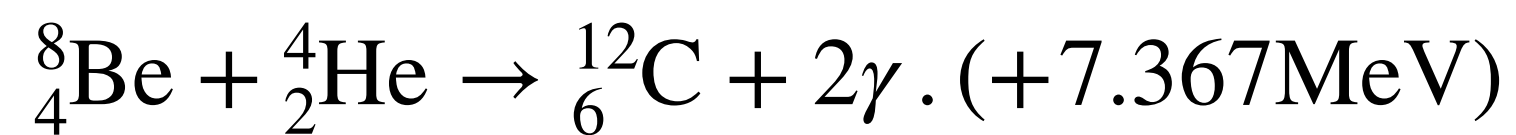
Some difference

Now we say the x process is part of the p-p chain.

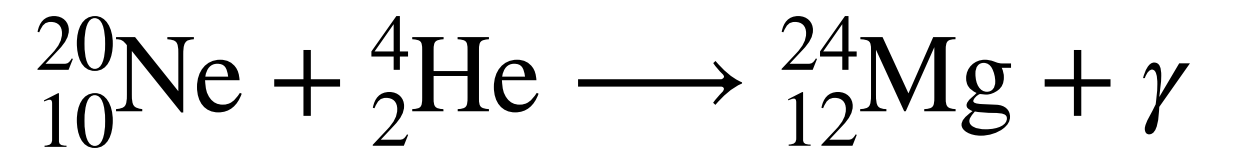
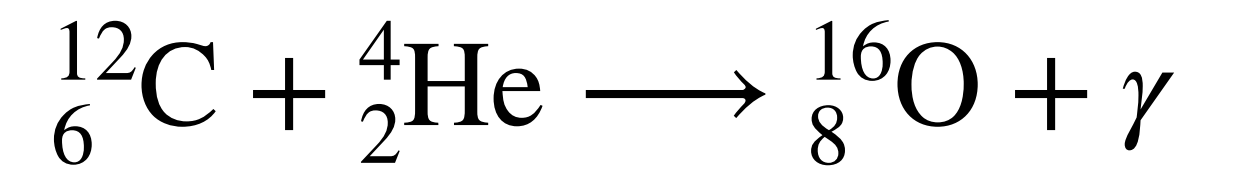
And the He burning, we usually divide it into triple- α process and α -process.



triple- α process



α -process



.....

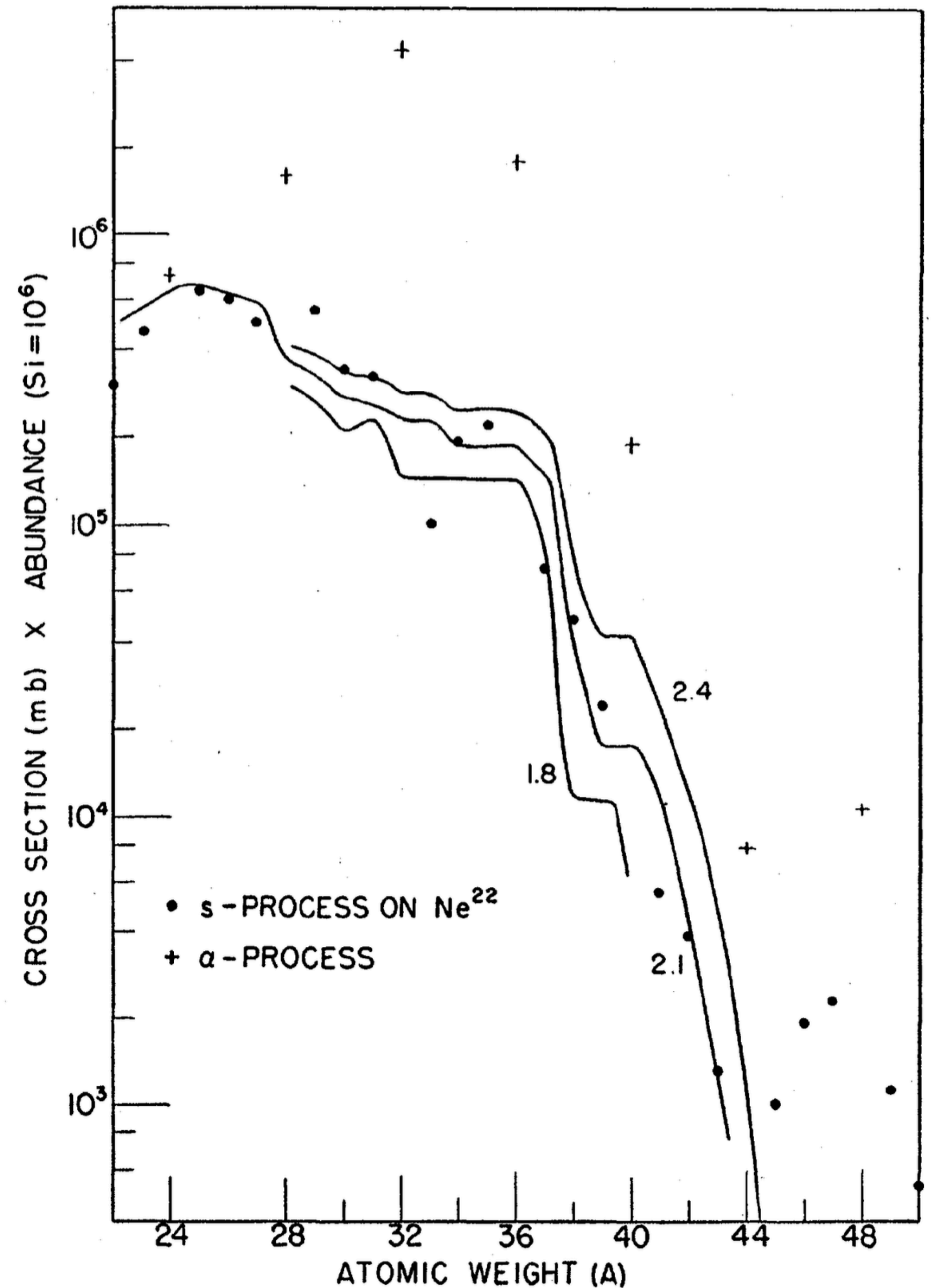
Assignment

In the s-process, abundance N multiplied by neutron capture cross-section should be smooth.

Four-structure nuclei: like

${}_{8}^{16}\text{O}$, ${}_{10}^{20}\text{Ne}$, ${}_{12}^{24}\text{Mg}$, ${}_{14}^{28}\text{Si}$, ${}_{16}^{32}\text{S}$,

${}_{18}^{36}\text{Ar}$, ${}_{20}^{40}\text{Ca}$, ${}_{22}^{44}\text{Ti}$, ${}_{24}^{48}\text{Cr}$



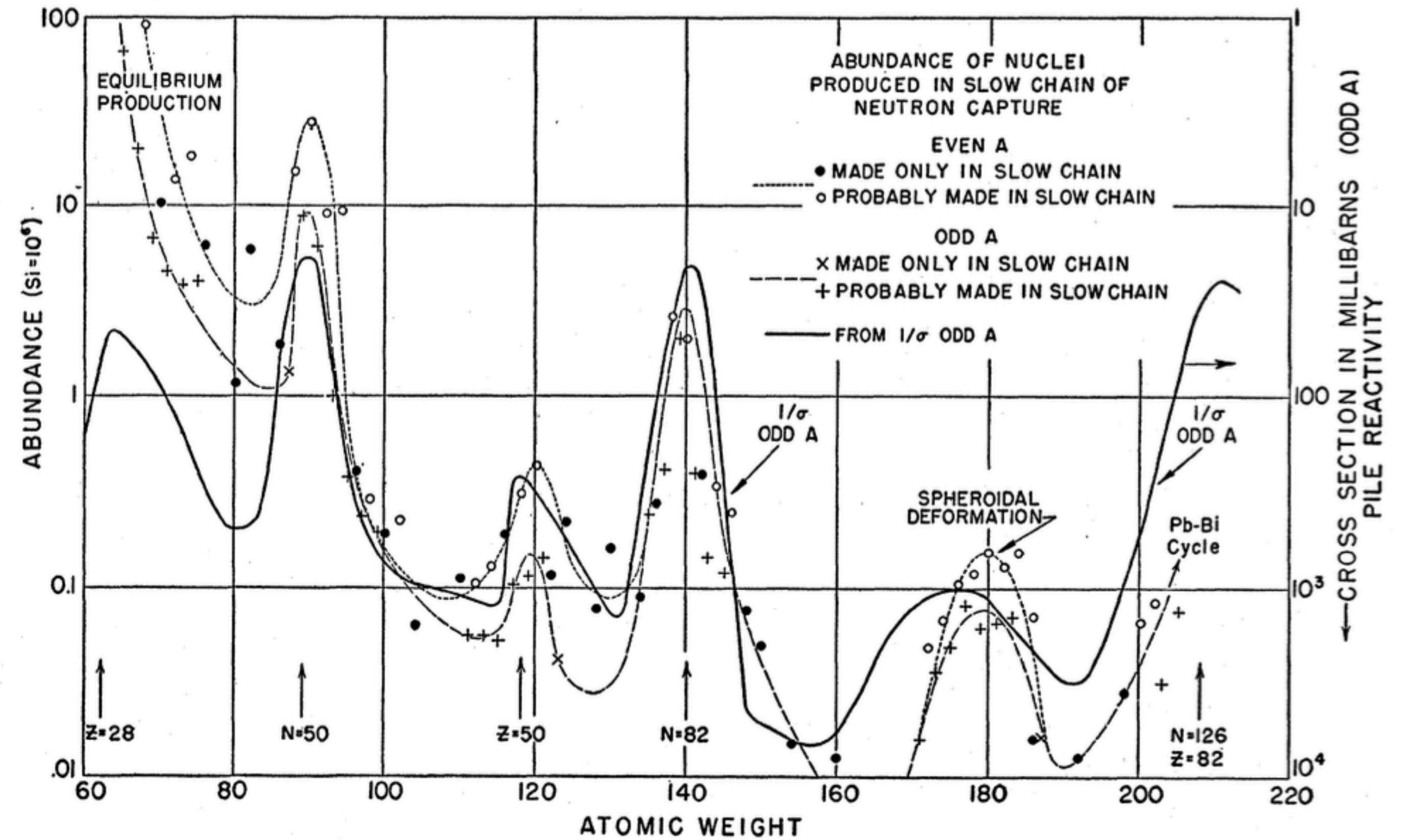
Assignment

Assignment of the nuclei in the iron peak to the e-process.

For the r-, s-, p-process.

At $A=90$, $N=50$; $A=138$,
 $N=82$; $A=208$, $N=126$...

It mainly depends on
the s-process.



Result

The abundance peak contributed by r-process are mainly shifted by 8-14.

All the heavy elements are built by r- or s- process.

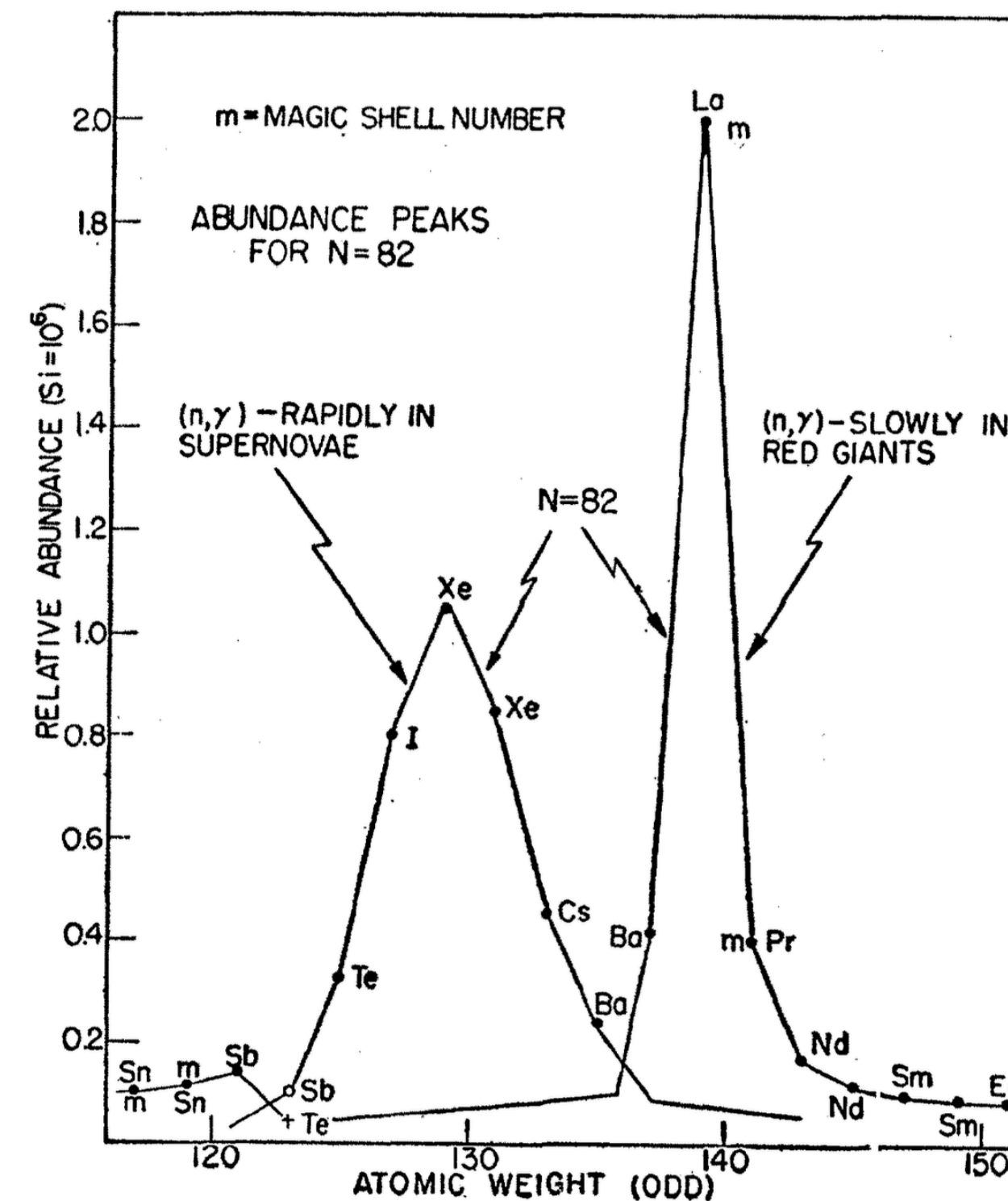


FIG. II,2. The odd A abundance peaks near $A = 129$ and 139 shown on a linear scale. See Fig. II,1 for comments.

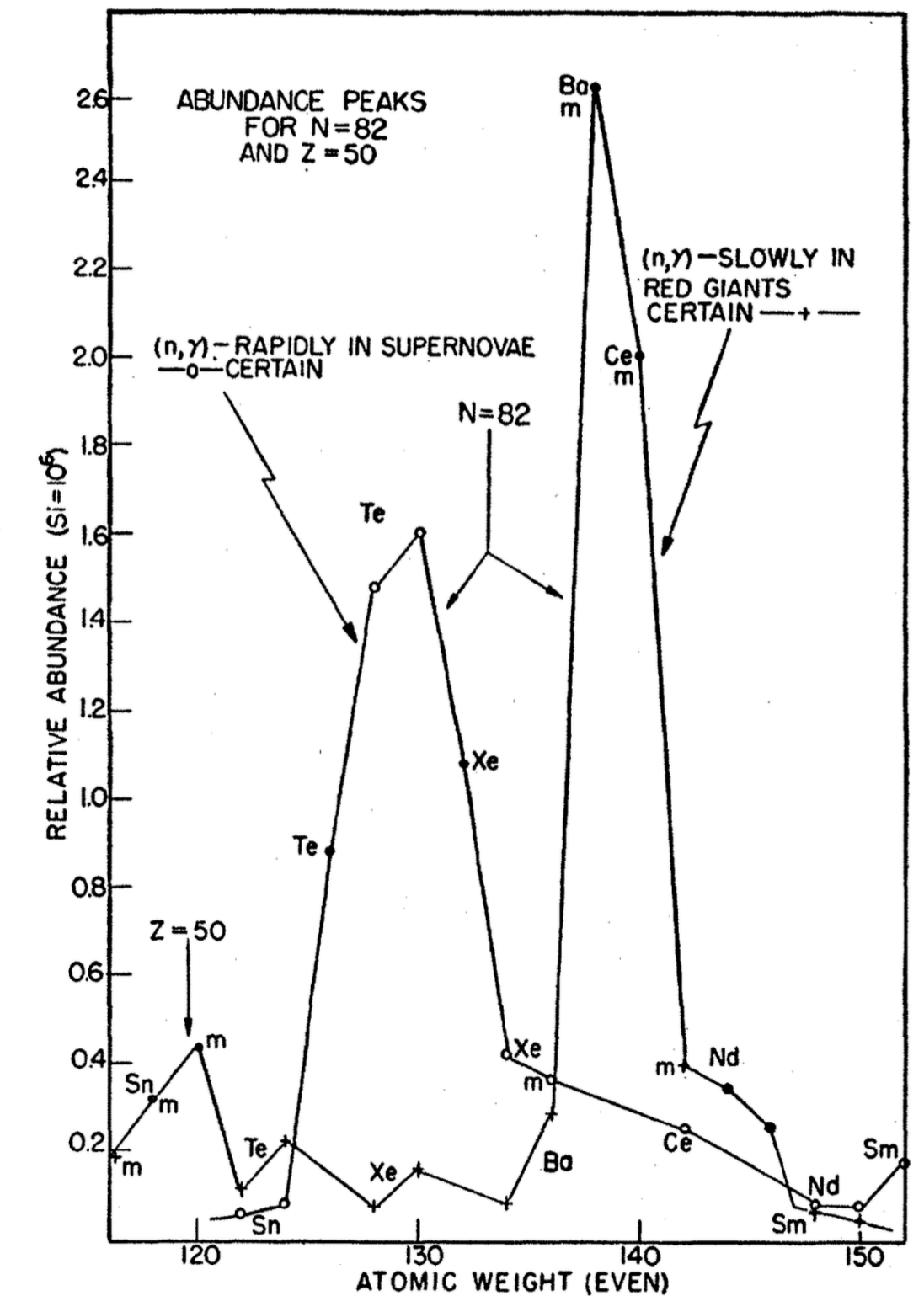


FIG. II,3. The even- A abundance peaks near $A = 130$ and 138 shown on a linear scale. See Fig. II,1 for comments.

Time scale

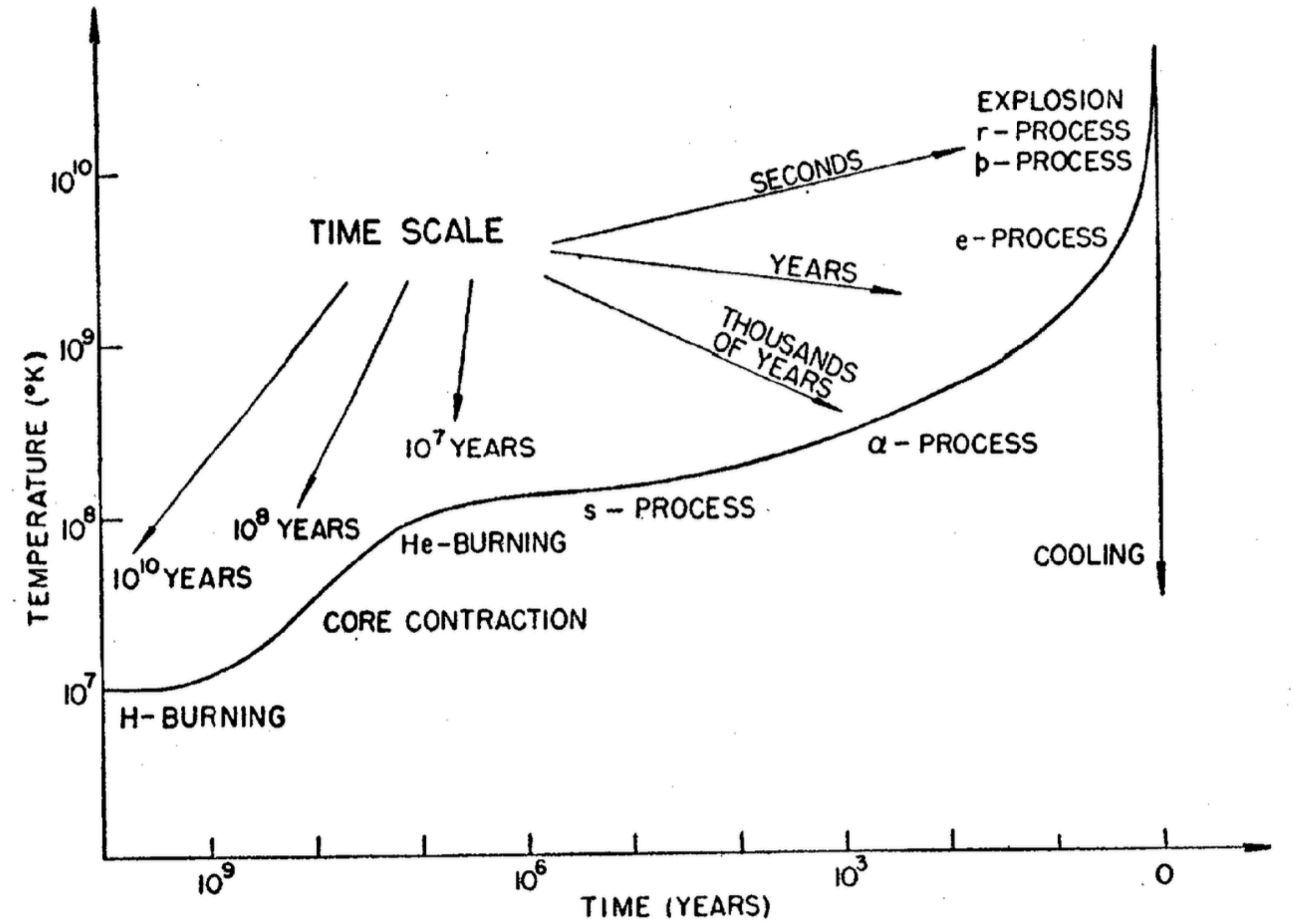
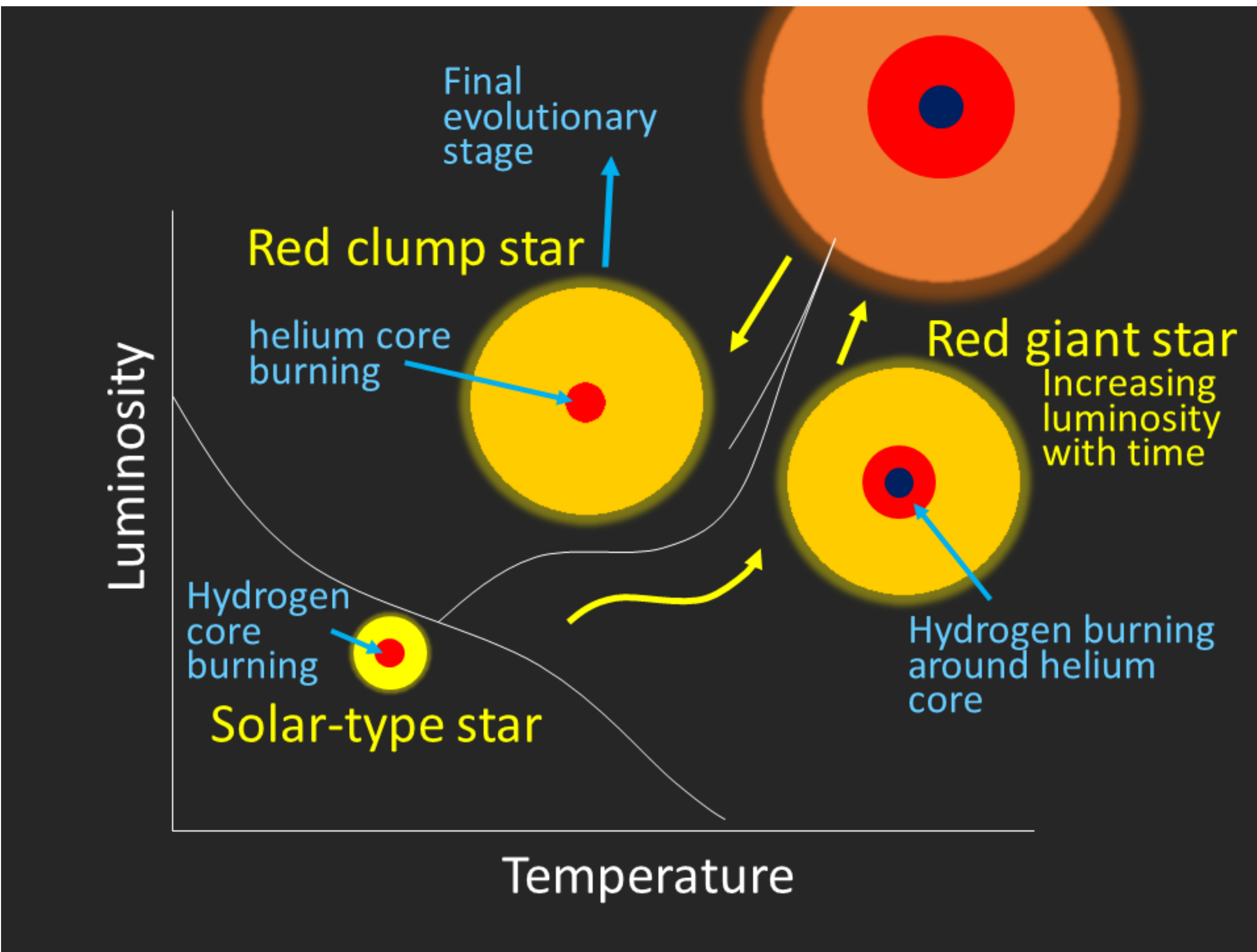
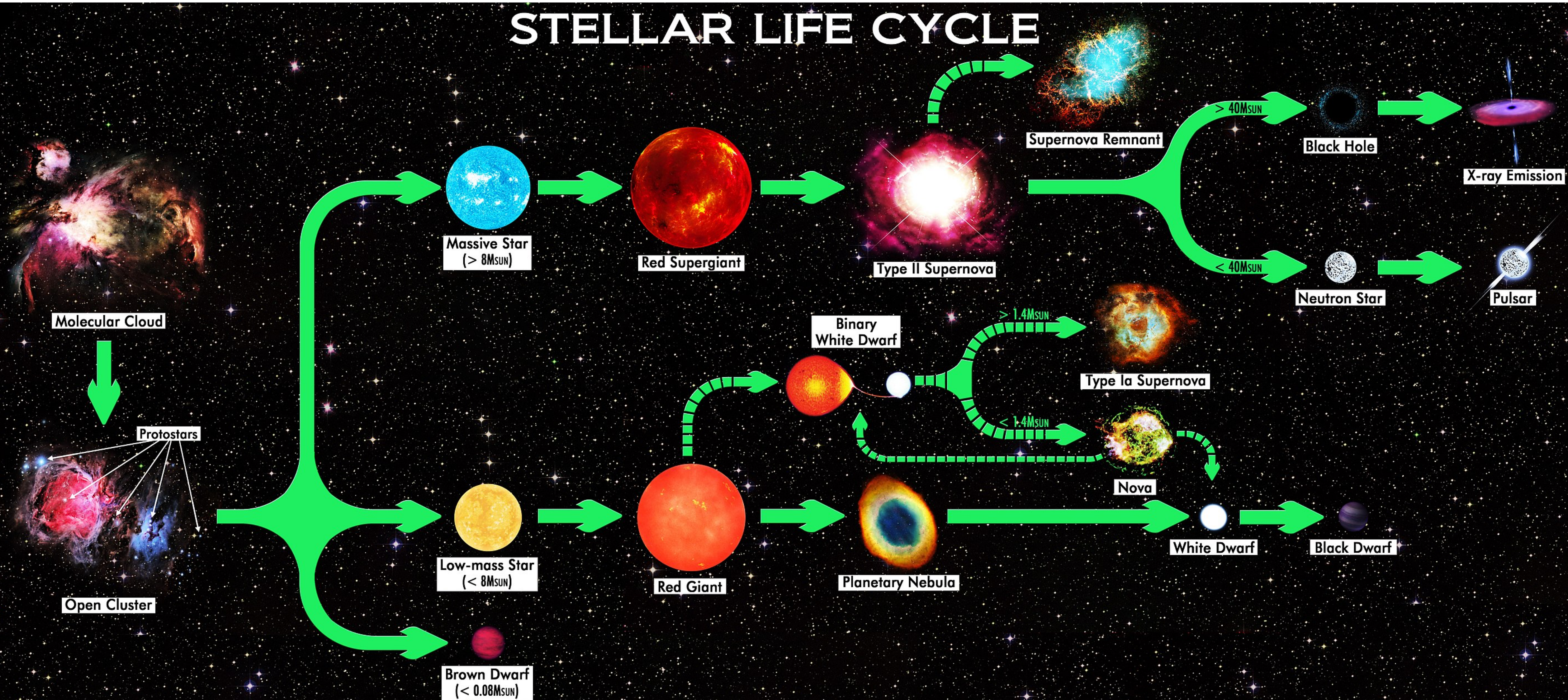


FIG. II,4. The time-scales of the various processes of element synthesis in stars. The curve gives the central temperature as a function of time for a star of about one solar mass. The curve is schematic.

Time scale

STELLAR LIFE CYCLE



Birth

Main Sequence

Old Age

Death

Remnant