

Group Meeting 12.13

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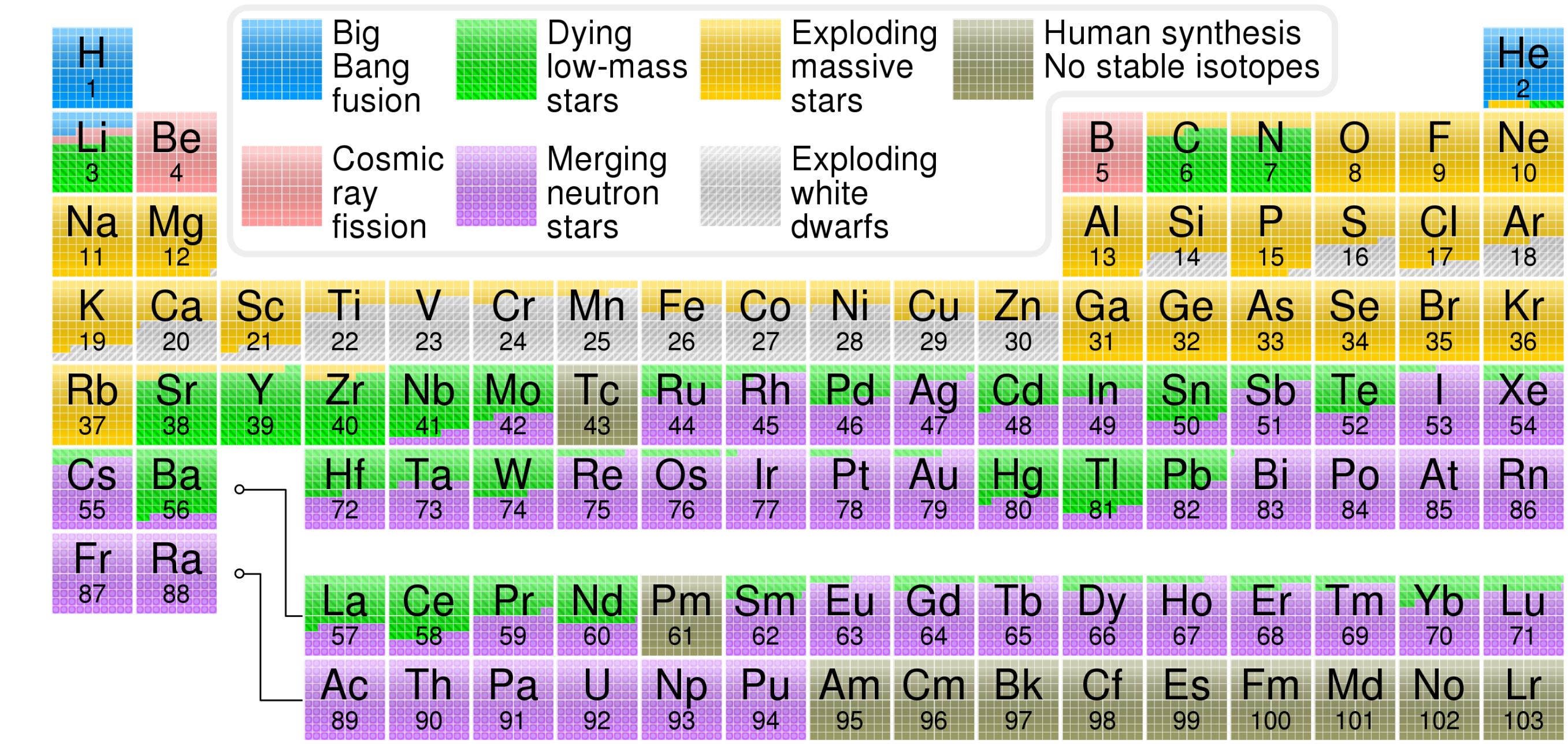
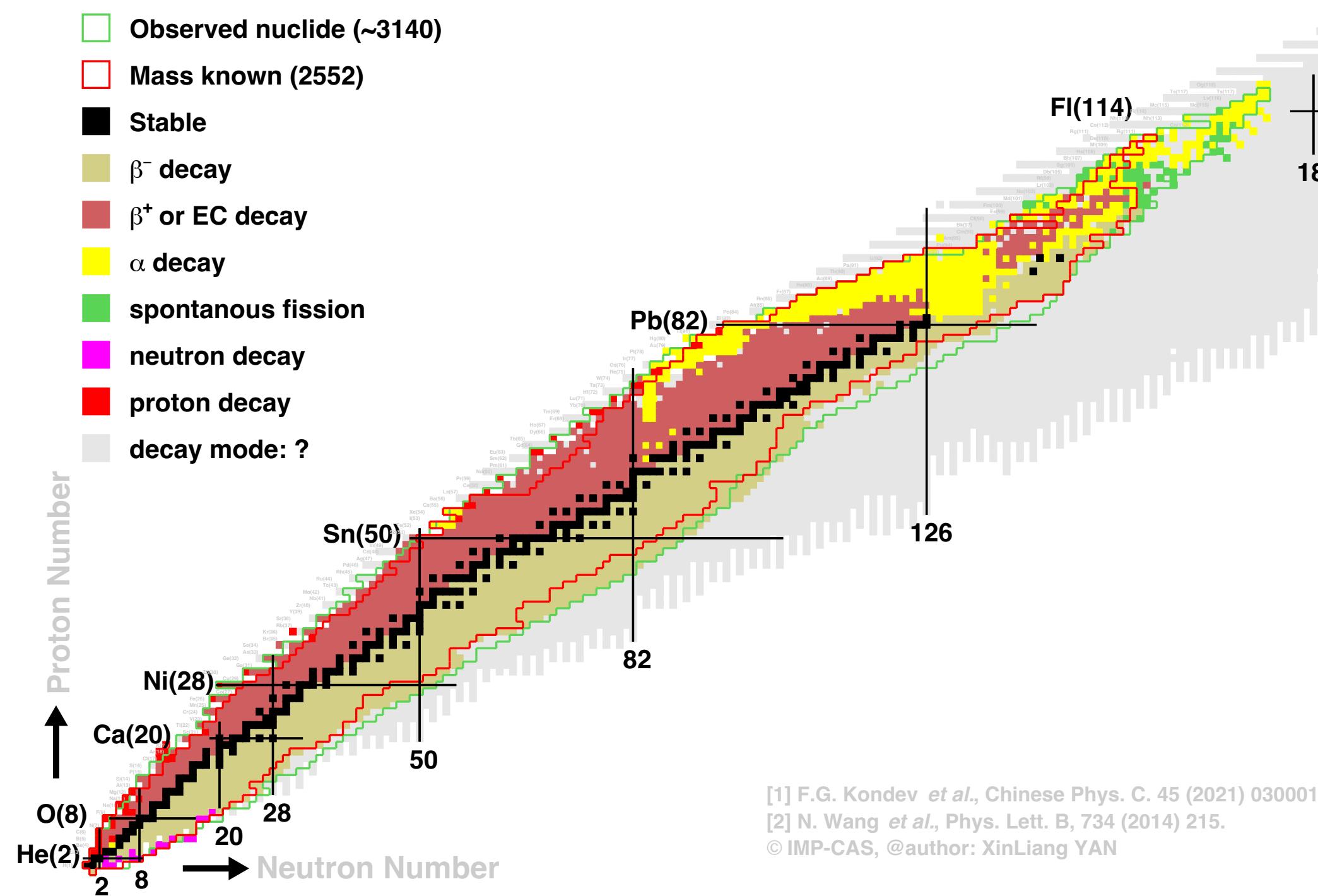
# Synthesis of the Elements in Star

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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)



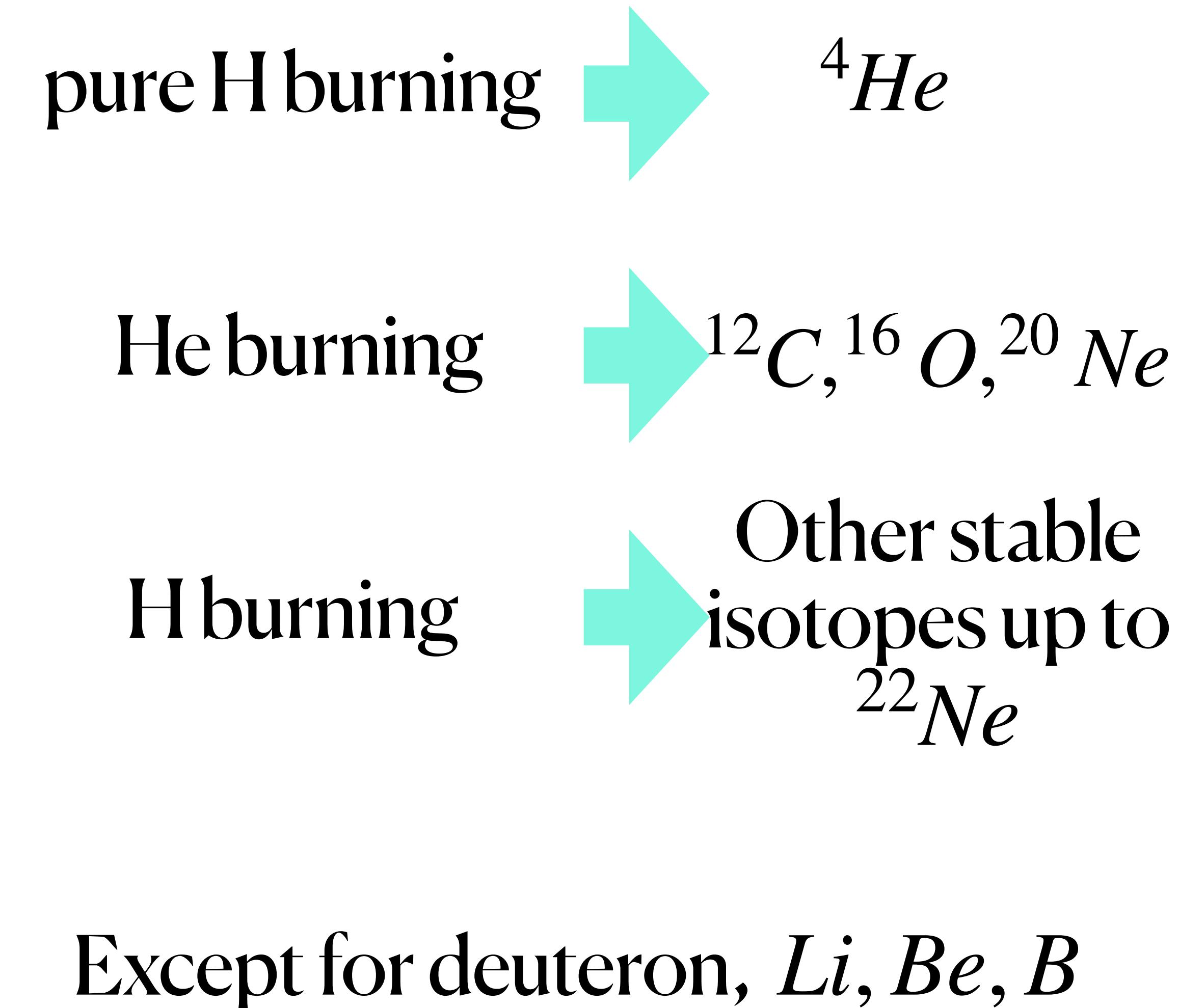
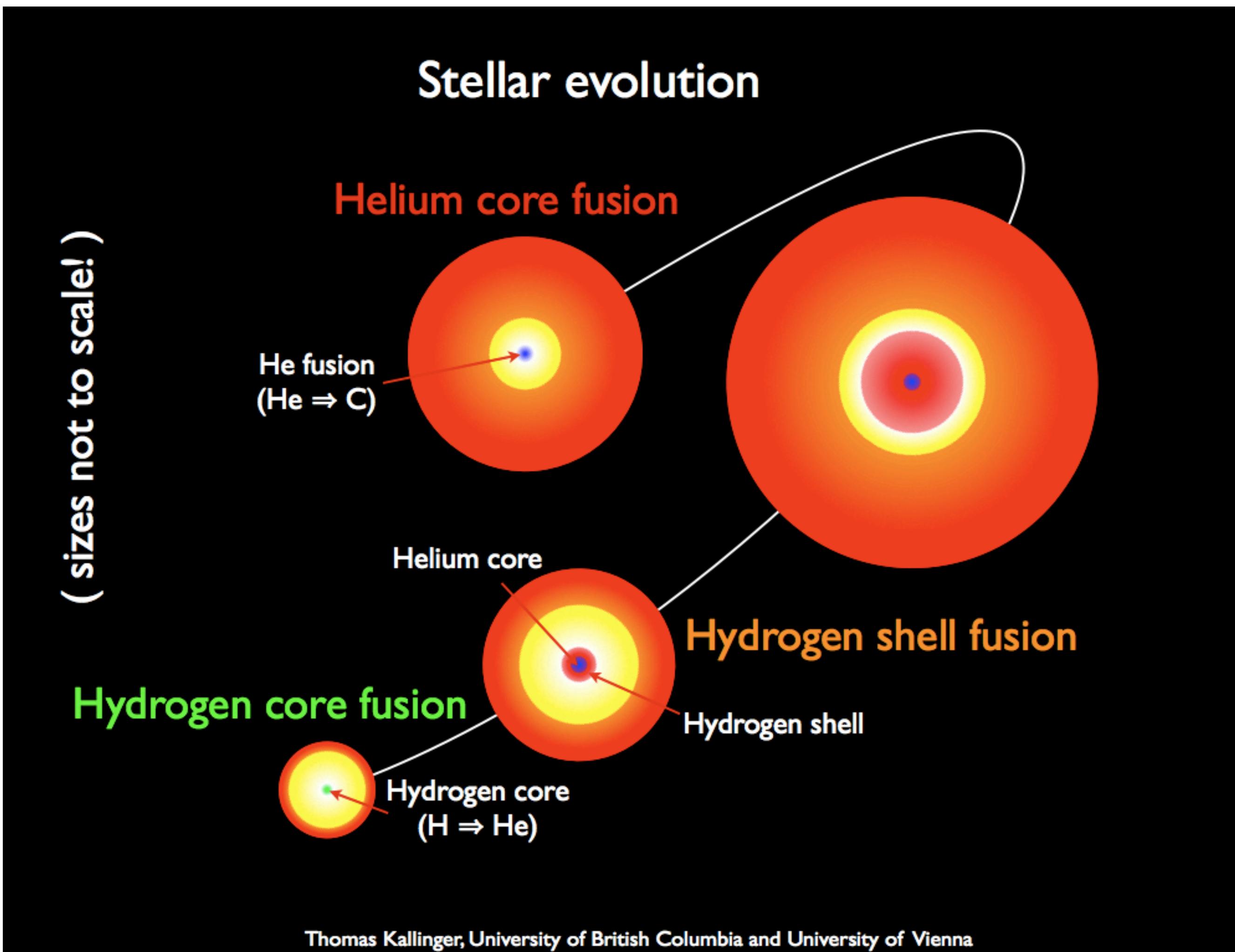
[1] F.G. Kondev *et al.*, Chinese Phys. C. 45 (2021) 030001.

[2] N. Wang *et al.*, Phys. Lett. B, 734 (2014) 215.

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# Overview

Let's begin with the pure H burning.

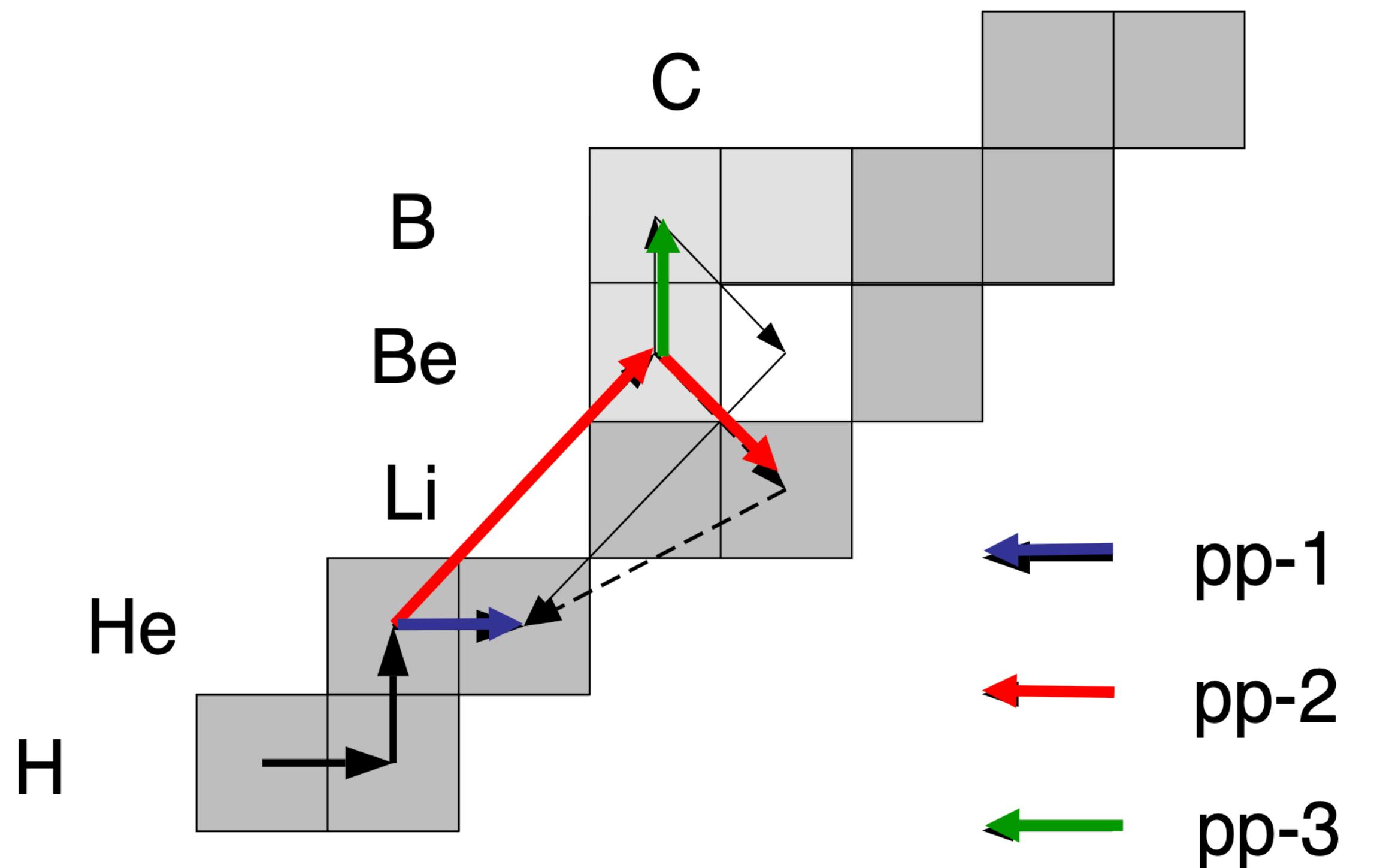
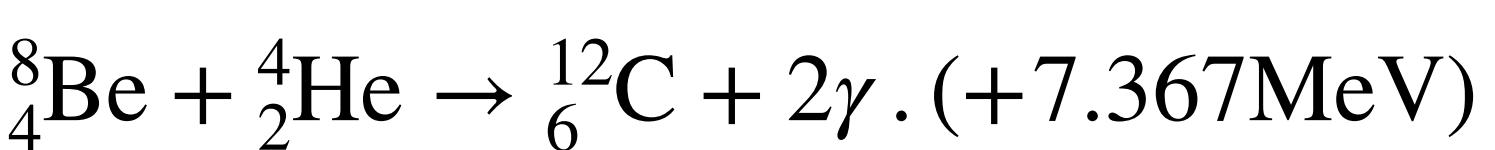


# Some difference

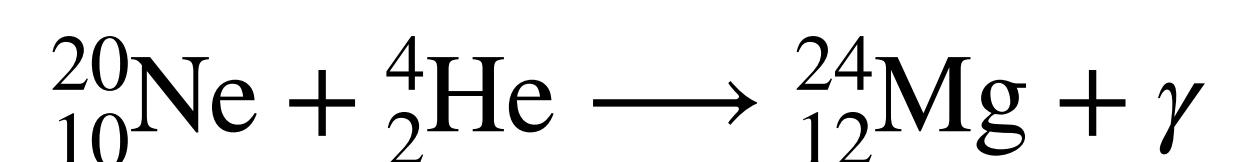
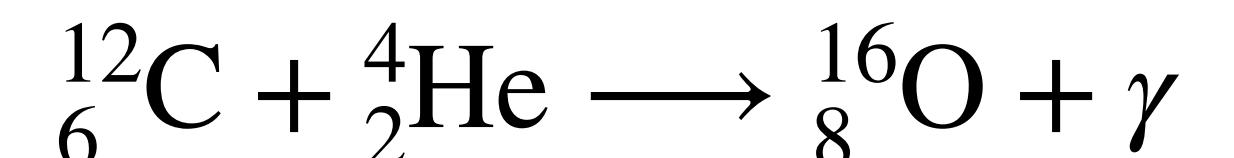
Now we say the x process is part of the p-p chain.

And the He burning, we usually divide it into triple- $\alpha$  process and  $\alpha$ -process.

triple- $\alpha$  process



$\alpha$ -process



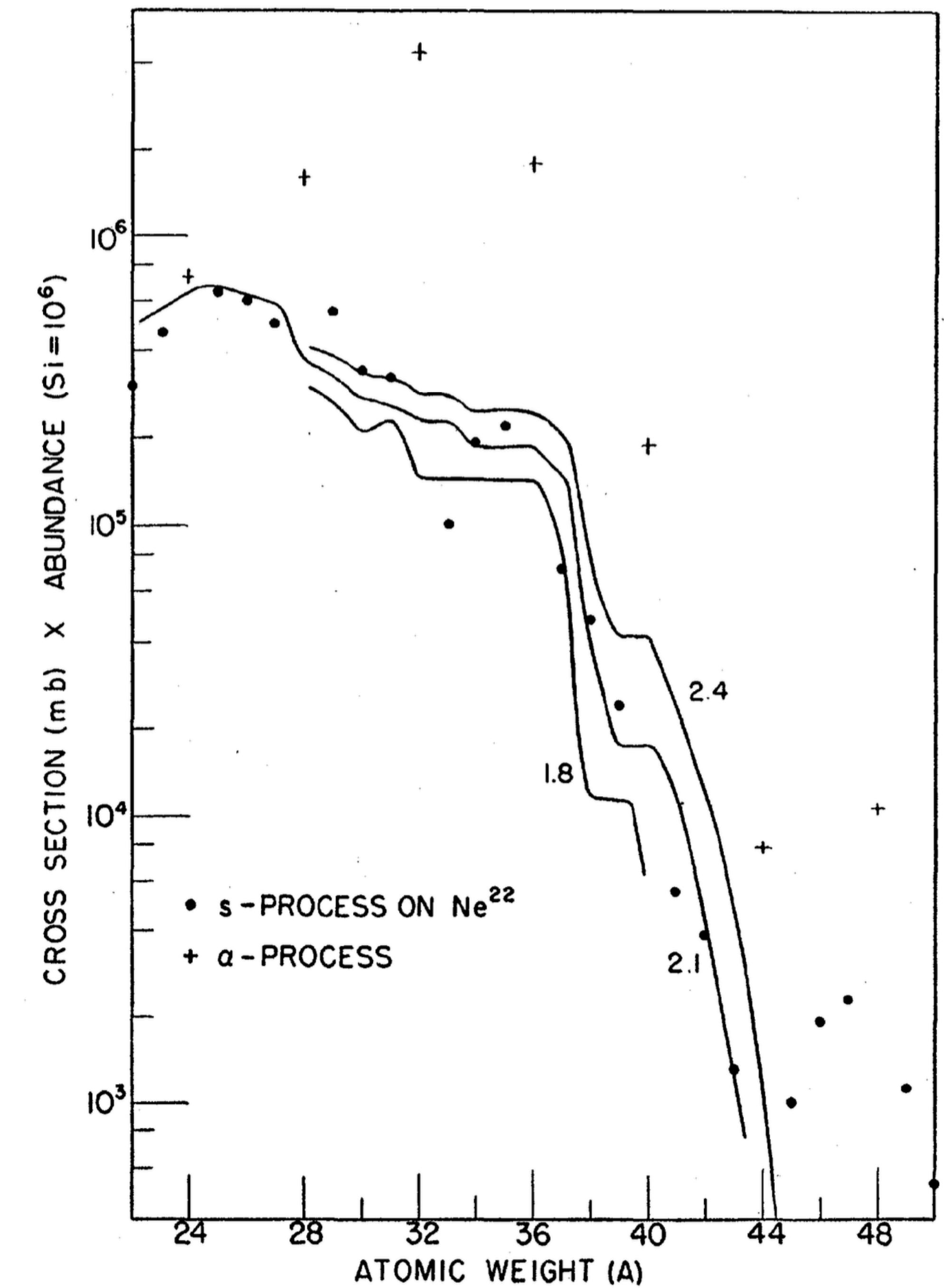
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# Assignment

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

Four-structure nuclei: like

$^{16}_8\text{O}$ ,  $^{20}_{10}\text{Ne}$ ,  $^{24}_{12}\text{Mg}$ ,  $^{28}_{14}\text{Si}$ ,  $^{32}_{16}\text{S}$ ,  
 $^{36}_{18}\text{Ar}$ ,  $^{40}_{20}\text{Ca}$ ,  $^{44}_{22}\text{T}$ ,  $^{48}_{24}\text{Cr}$



# Assignment

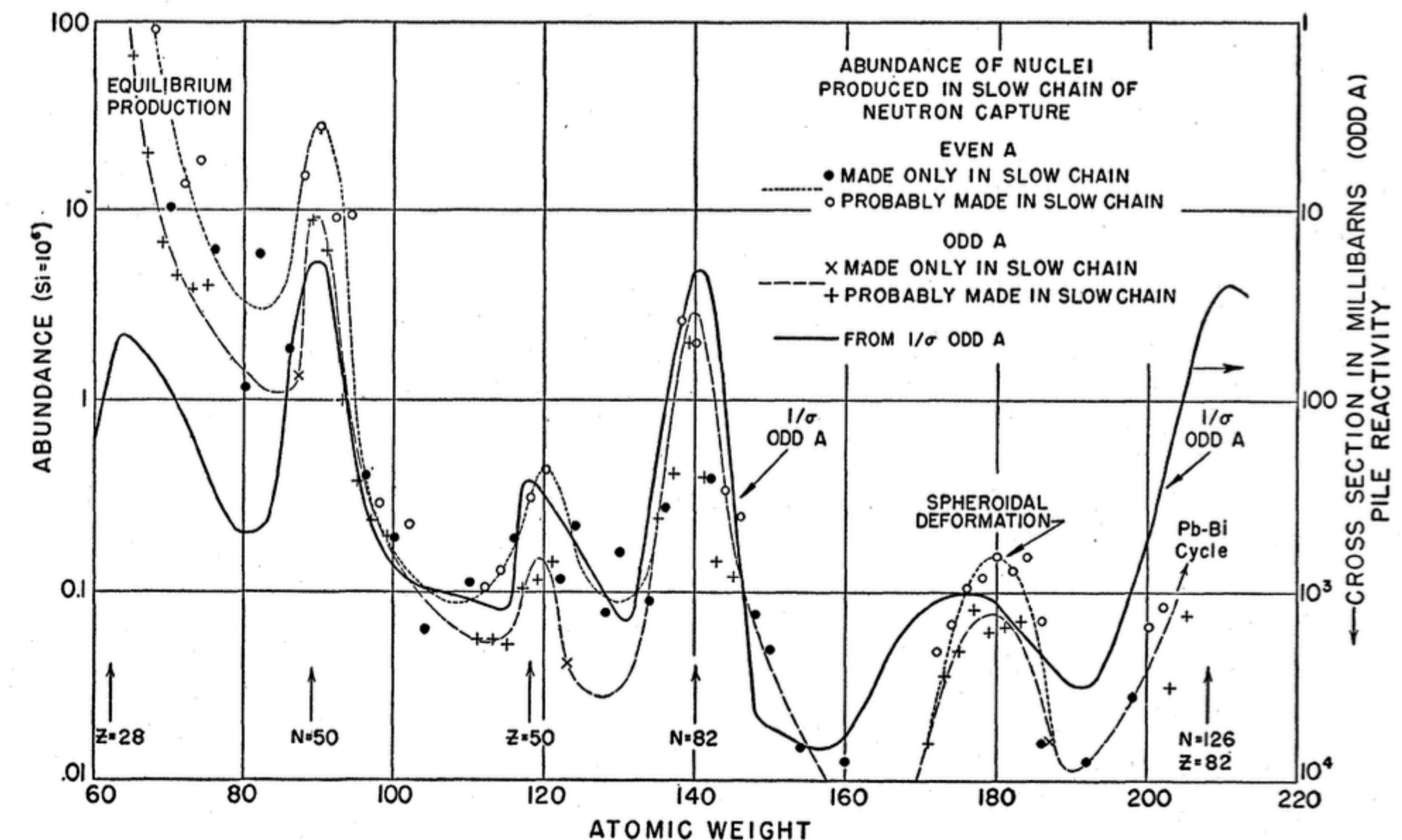
Assignment of the nuclei in the iron peak to the e-process.

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

At  $A=90, N=50$ ;  $A=138$ ,

$N=82$ ;  $A=208, N=126\dots$

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.

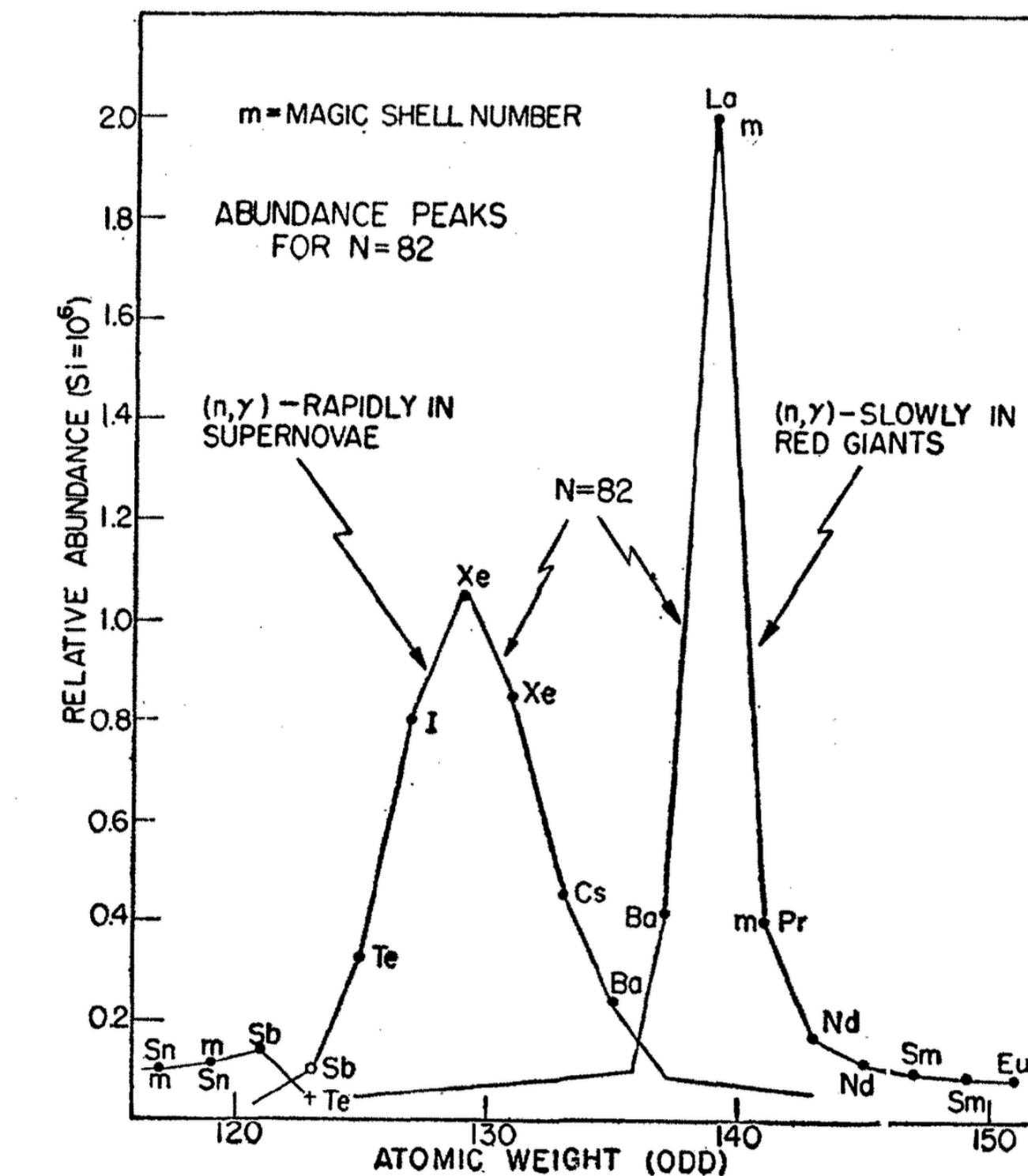


FIG. II,2. The odd  $A$  abundance peaks near  $A = 129$  and 139 shown on a linear scale. See Fig. II,1 for comments.

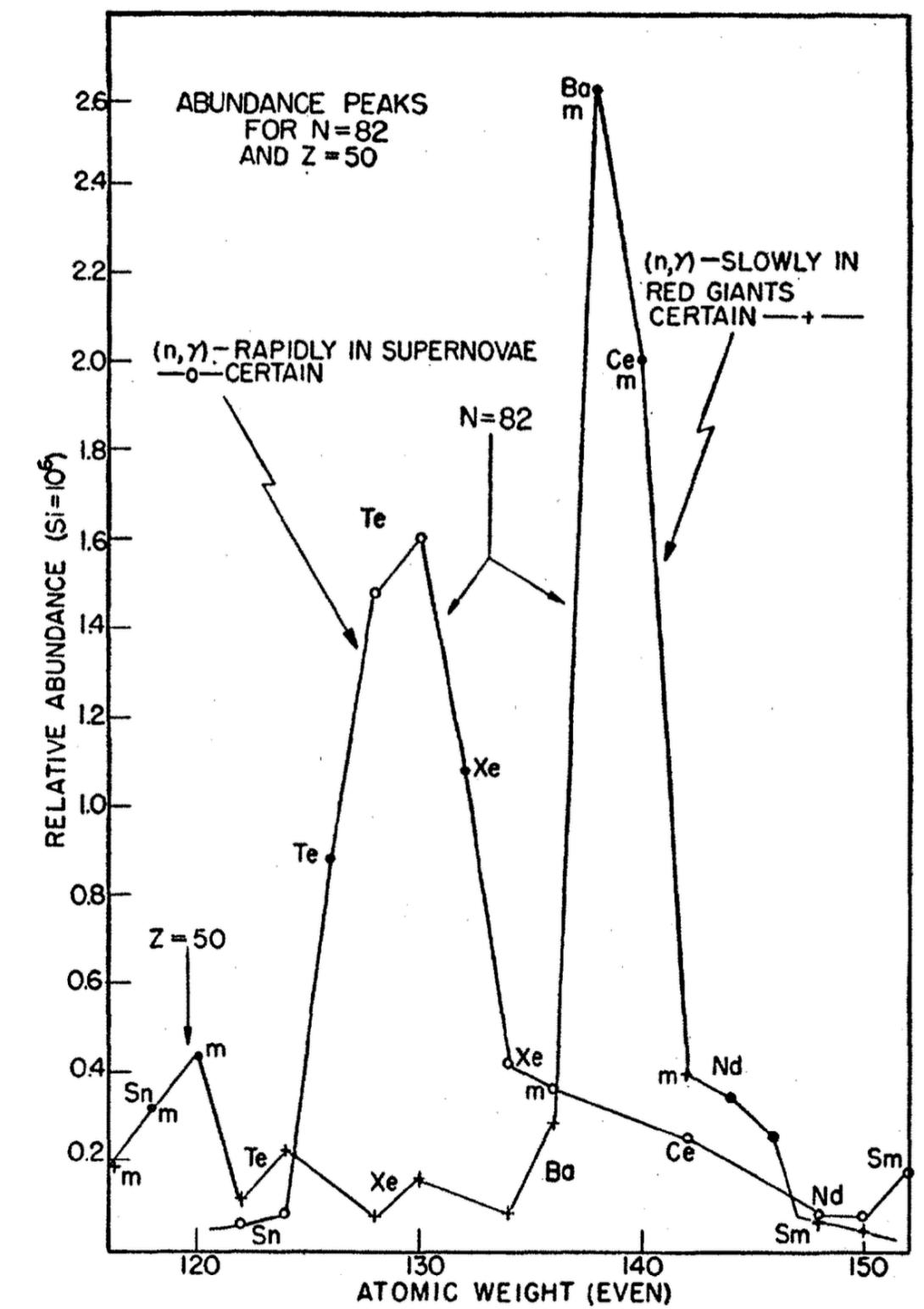


FIG. II,3. The even- $A$  abundance peaks near  $A = 130$  and 138 shown on a linear scale. See Fig. II,1 for comments.

# Time scale

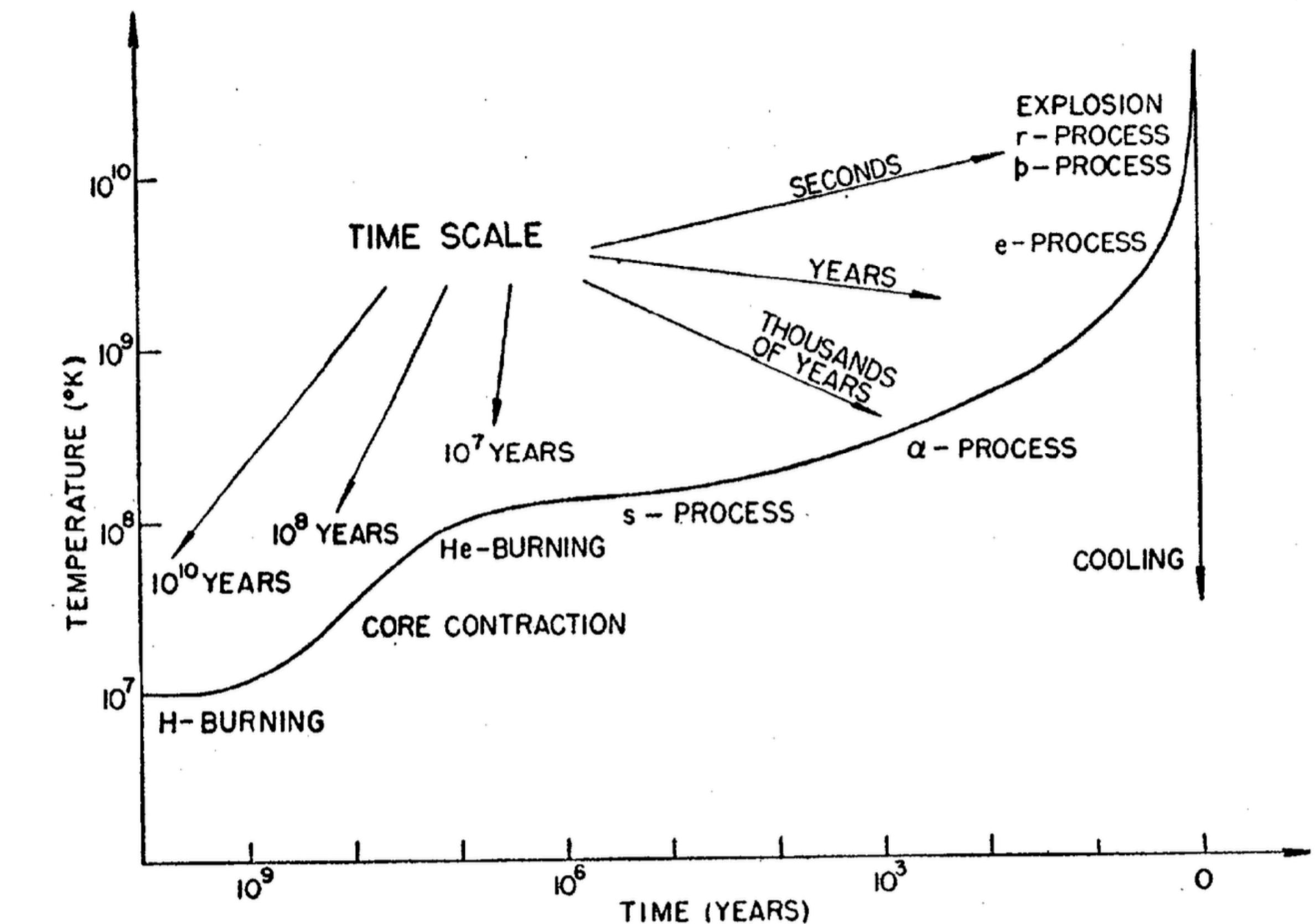
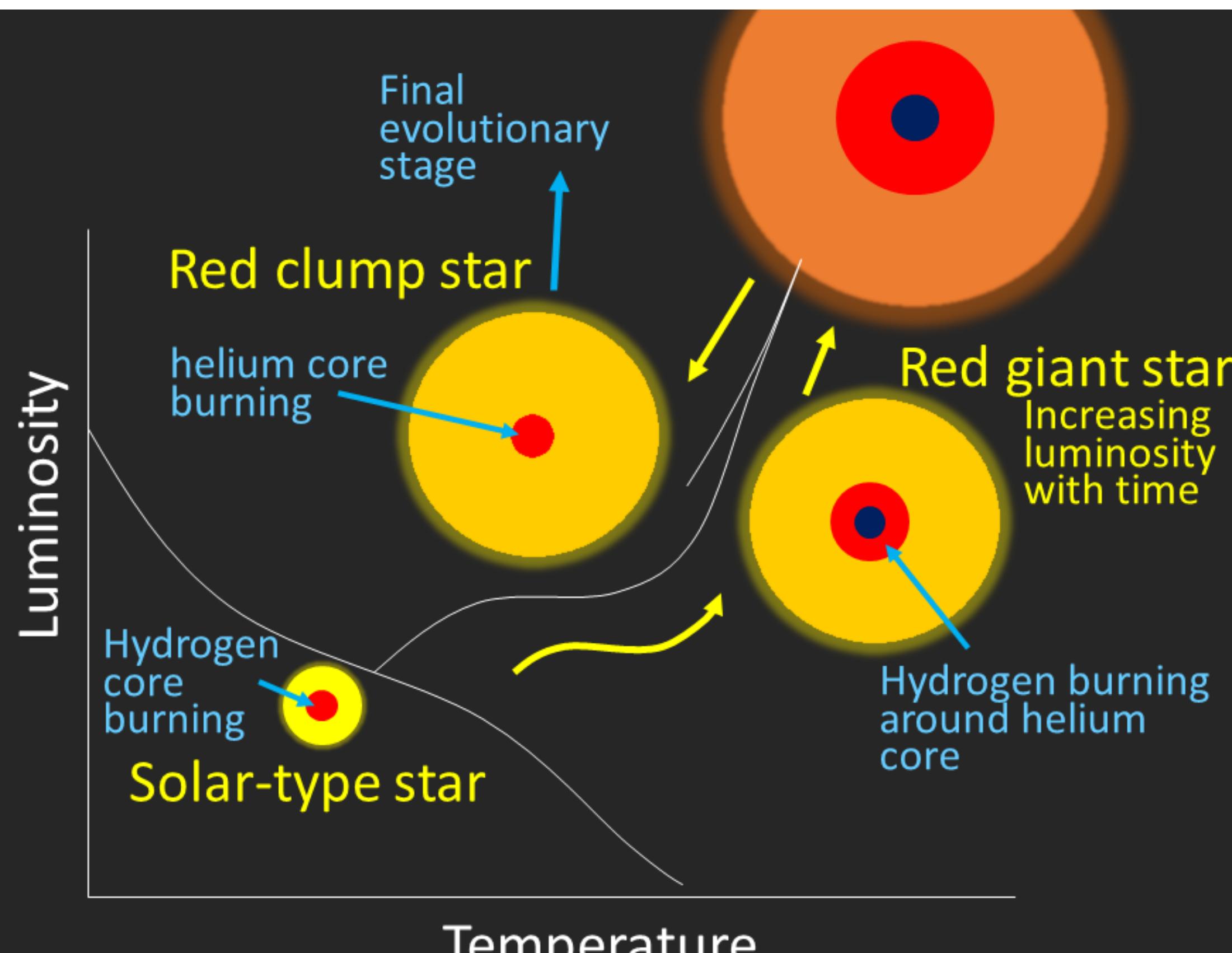


FIG. II,4. The time-scales of the various processes of element synthesis in stars. The curve gives the central temperature as a function of time for a star of about one solar mass. The curve is schematic.

# Time scale

