

Kilic

PROBLEM 3

In this problem you are asked to discuss and compare two types of H fusion which occur in stars along with the chemical evolution of nitrogen.

- a. (1 point) Write down the three reaction steps in the PPI reaction. Show all isotopes and bi-products involved.
- b. (1 point) Write down the six reactions in the CN cycle. Show all isotopes and bi-products involved. Identify the two relatively fast reactions and the slowest reaction of the six. Why is carbon referred to as a catalyst?
- c. (2 points) Make a qualitative comparison of PPI and the CN cycle in terms of the threshold temperature and temperature sensitivity of the energy generation coefficient ϵ , i.e., $d\epsilon/dT$. Discuss the relative amount that each cycle contributes to the total energy generation in the Sun's core.
- d. (3 points) Explain the relevance of the CN cycle to the evolution of the total nitrogen abundance in a galaxy. Explain what stellar types (mass ranges) are thought to produce significant amounts of N.
- e. (3 points) The nearby figure shows the universal behavior of the N/O abundance ratio as a function of metallicity, as measured by O/H. Note the flat behavior at low metallicities and the upward turn starting at around solar metallicity of about 8.7. Explain this change in slope.

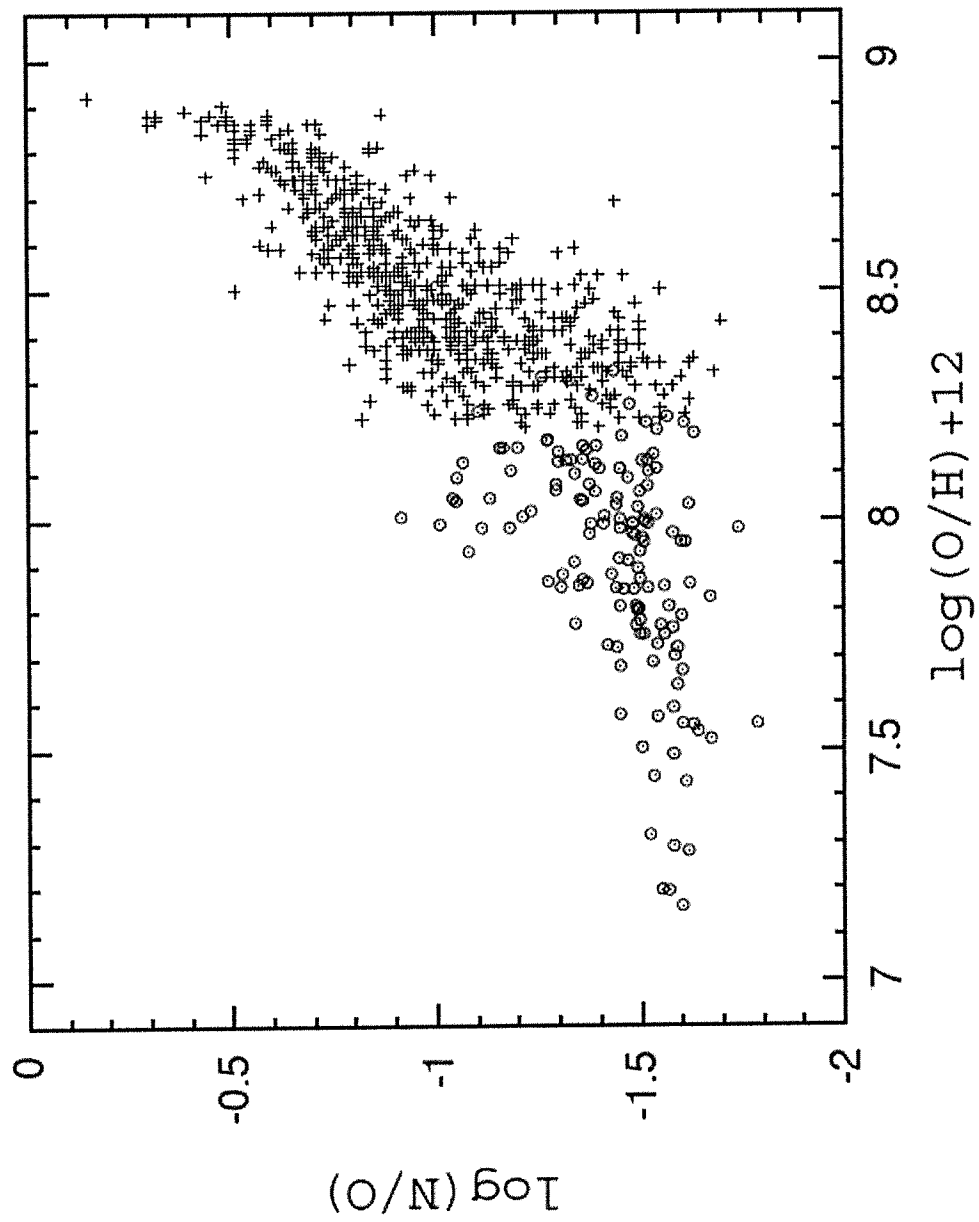


Fig. 4. The $N/O-O/H$ for H II regions in spiral (pluses) and irregular (circles) galaxies.

