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Determination the parameters of Post-AGB stars and the fraction of Ba isotopes

ABSTRACT

Neutron capture process is mainly divided into slow neutron and fast neutron capture process. In recent years, it has been suggested that there is a process between the two, namely the intermediate process (i-process). The astrophysical site of i-process is still unclear. From the perspective of observation, the intermediate processes are all related to AGB star, but they are not supported by the relevant star evolution theory. Many questions remain about the i-process and need further discussion. At present, in the study of neutron capture nuclearsynthesis related to the enrichment of neutron capture elements in stars, the abundance of element is used as the observed constraint, but there are limitations. Because the same abundance can actually correspond to different isotopic proportional combinations. Isotopes can provide us with more stringent observation constraints. In order to obtain more reliable information about the process of neutron capture nuclear synthesis, it is necessary to carry out relevant research from the isotope.

POST-AGB stars are generally considered as the astrophysical site where the i-process may occur, and r/s stars are suggested to be formed by the i-process. Therefore, we selected two POST-AGB stars with r/s star characteristics as the samples:IRAS 08143-4406, IRAS 14325-6428. The atmospheric parameters of the two POST-AGB stars IRAS 08143-4406 and IRAS 14325-6428 were measured by spectroscopic method. The determination of atmospheric parameters of stars, we optimized the process of measuring atmospheric parameters, and carried out zero point correction for the gf value of each iron line. That is to say, the contour of the iron line in the solar spectrum was fitted by the solar iron abundance, which was the final gf value(namely the solar gf value), guaranteeing the reliability of our measurement results to the greatest extent.

1. INTRODUCTION

1.1 Sidereal atmospheric parameter

The physical process, state and chemical composition of stellar atmosphere can be studied by analyzing stellar spectra.The basic task of studying stellar atmosphere is to establish the theoretical model of stellar atmosphere, which is abstracted from the actual stellar atmosphere.Stellar atmosphere model mainly studies the distribution of various physical parameters of stars, including temperature, density and pressure with depth.

Stellar atmospheric parameters include four basic physical parameters: effective temperature(Teff), metal abundance ([Fe/H]), surface gravity (logg) and microscopic gas velocity (epsilon), which are the basic parameters for calculating stellar atmospheric model.The four parameters are also constrained by each other in the atmosphere model.In general, the content of the research determines which atmospheric models we use.When we need to explain the properties of continuous spectrum of stars, the accuracy of atmospheric model is low.When studying the spectral lines of stars, we must demand the accuracy of the atmospheric model.The research methods of atmospheric parameters in this work all adopt spectral method, and the study of element abundance and isotope ratio all need to rely on the accurate stellar atmosphere model, so the accurate determination of atmospheric parameters is very important for this work.

2. MEASUREMENT OF STELLAR ATMOSPHERE MODEL AND PARAMETERS

2.1 Effective temperature (Teff)

Effective temperature is an important parameter of stellar atmosphere, which generally refers to the characteristic temperature of stellar atmosphere emitting radiation.We measure the effective temperature through the relationship between iron abundance and excitation potential. When there is no correlation between iron abundance and excitation potential, the standard is that the absolute slope of linear fitting of the abundance value is less than 0.01, then the effective temperature can be determined.Figure 1 shows the relationship between iras08143-4406 final excitation potential and iron abundance.It can be seen that the effective temperature measured at this time is reliable.

2.2 surface gravity (log g)

Triangular parallax method is a method to measure the gravity on the surface of stars. Such stars need to have triangular parallax information provided by gaia or ibaku, which is calculated by using the relationship between mass, effective temperature and thermal magnitude.The trigonometric parallax method is reflected in the following functional form

$$logg = logg \odot + log(M/M\odot) + 4log(Teff/Teff\odot) + 0.4(MbolMbol\odot) \tag{1}$$

$$Mbol = Vmag + BC + 5log\varpi + 5AV \tag{2}$$

2.3 Metal abundance (Fe/H) and microscopic turbulent velocity(epsilon)

The initial values of metallicity and microscopic turbulence velocity were obtained from the literature.

The metallic abundance of the two stars was determined by the iterative method.Metallicity of the initial value into the atmosphere in the model calculation, the total time to determine the wire abundance take the average value, and initial pay weighted, get new abundance value computation again new atmospheric model, it constantly for send, until the last input metallicity value and determination of wire abundance value is nearly equal, at this time we will metallicity value [Fe/H]=-0.67 as the final metallicity.The microcosmic turbulence velocity is also measured by spectral method.We use the selected iron lines and use the direct integration method to determine the equivalent width of the spectral lines, change the micro turbulent velocity, and measure the equivalent width again, so as to adjust, when the measured metallities and equivalent widths show no correlation, then we can determine the micro energetic flow velocity.Figure 2 shows the relationship between the metallicity and equivalent widths of iras08143-4406.There is no correlation between the two, so the microcosmic turbulence velocity is reliable

3. CONCLUSION

1.This work optimizes the process of measuring atmospheric parameters.In the process of determining atmospheric parameters, we take each iron the gf value of the line was zero corrected, namely, the iron abundance of the sun was used to fit the outline of the line in the solar spectrum, and was the last gf value (sun gf value).

2.The work of the atmospheric parameters of post-AGB star IRAS08143-4406, respectively Teff=6800K, log g=0.6dex, [Fe/H]=-0.67, epsilon=4.5km/s,) and literature of the atmospheric parameters (IRAS08143-4406 Teff=7250k, log g=1.5dex, [Fe/H]=-0.36 epsilon=5.5km/s,) far more.In this work, the spectral method is used, that is, the fe abundance of FeI spectral line is independent of the excitation potential to determine the effective temperature of the star, the fe abundance of FeI and FeII is consistent to determine the surface gravity, and the micro turbulent velocity is independent of the fe abundance of FeI spectral line and the equivalent width to determine.The atmospheric parameters measured by this method are reliable.

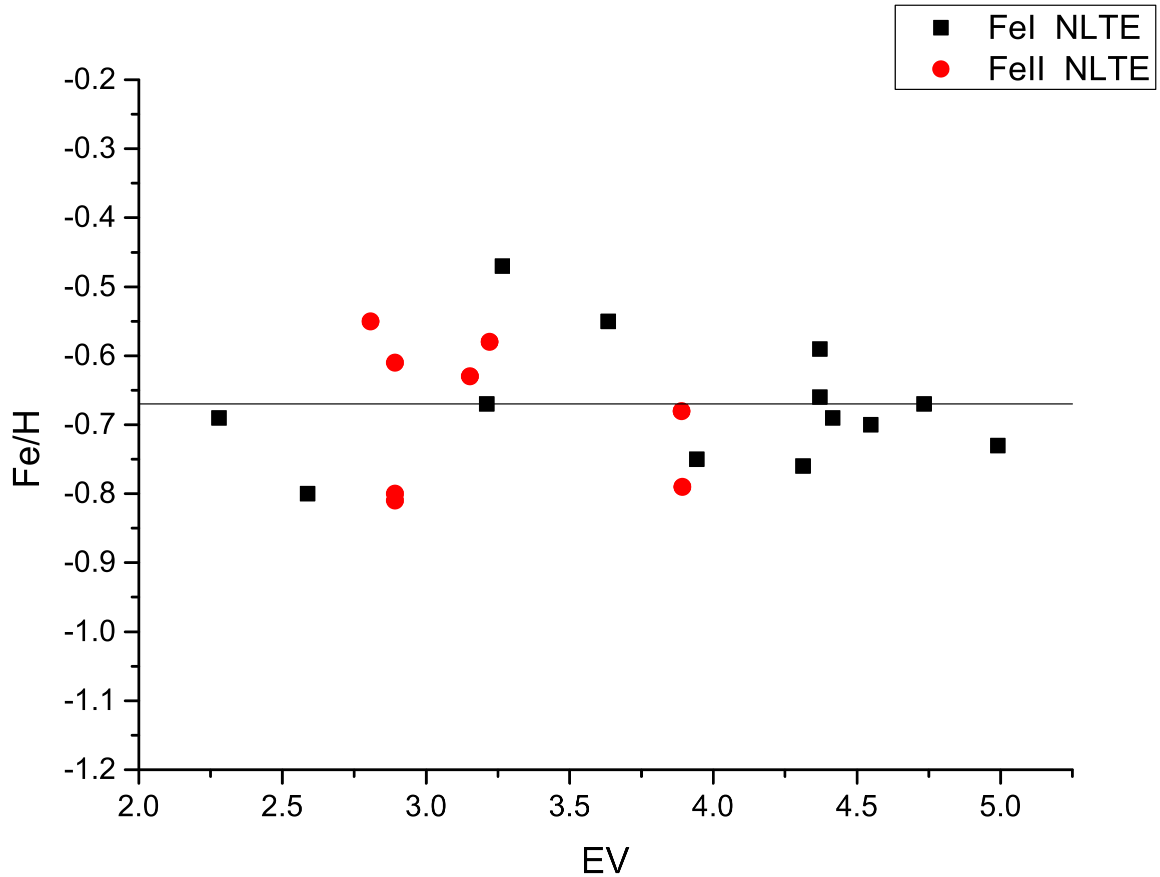

Figure 1. The relationship between excitation potential and iron abundance

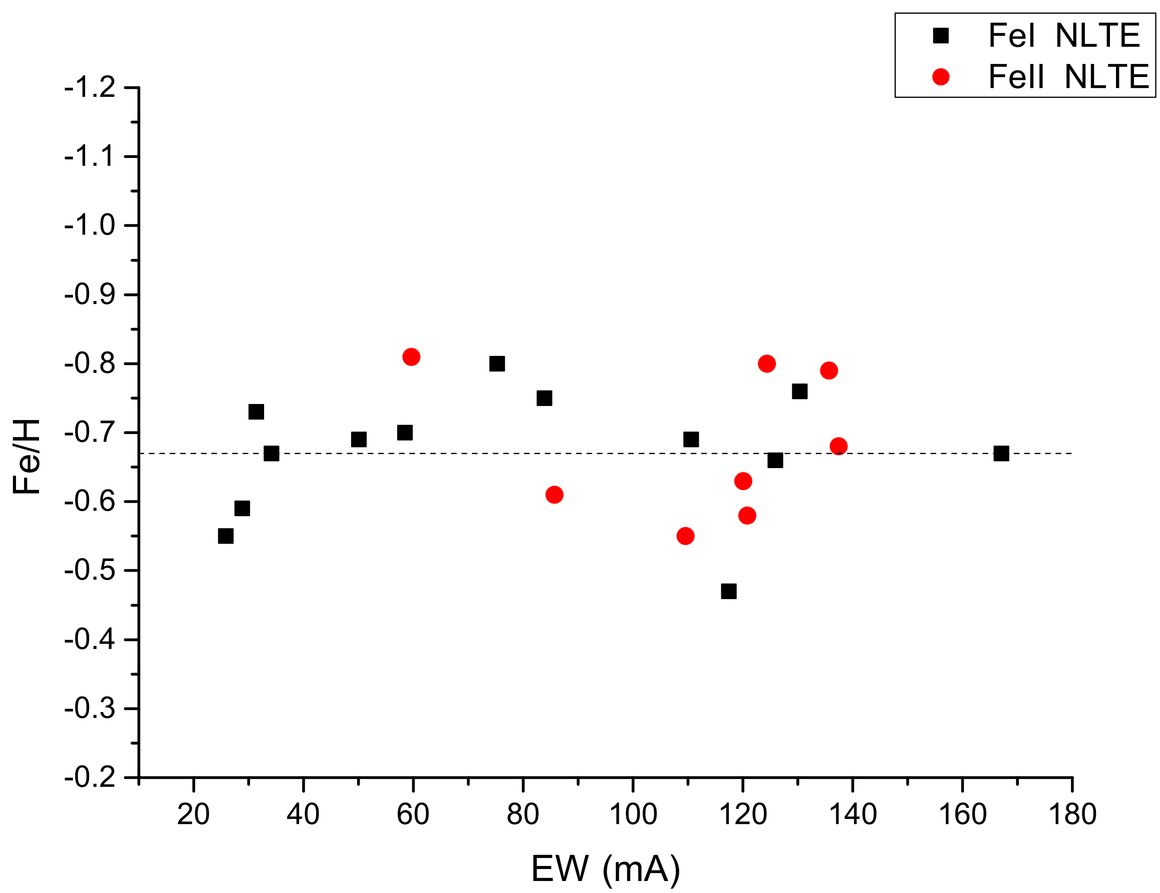

Figure 2. The relationship between equivalent and iron abundance