CHEMICAL ABUNDANCES OF EARLY TYPE STARS

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1. Introduction

X-rays from early-type stars are emitted by the corona or the stellar wind. The materials in the surface layer of early-type stars are not contaminated by nuclear reactions in the stellar inside. Therefore, abundance study of the early-type stars provides us an information of the abundances of the original gas. However, the X-ray observations indicate low-metallicity, which is about 0.3 times of cosmic abundances. This fact raises the problem on the *cosmic abundances.*

In this work, we obtained chemical abundances of six early-type stars, λOri, ζPup, τSco, ζOri, δOri and ζOph, from the *ASCA* observations. The abundances derived from simple isothermal optically-thin model fits for those stars are significantly smaller than cosmic abundances for certain elements. We show that if emitting region is substantially optically thick the abundances we derived are underestimated.

2. Analysis and Results

We fitted each spectrum of the six early type stars with an ionizition-equilibrium thin thermal plasma model. Absorption by neutral gas was

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taken into account. Two stars required an additional power-law component (Torii 1997, private communication). Observed spectra were well fitted by this single(or two)-component model.

We plotted the relative abundances to the cosmic value in figure 1. In comparison with the cosmic abundances, the result says all stars' abundances are small. And these six stars show similar tendencies each other, *i.e.* low O and Fe.

3. Discussion

To interpret this low matallicity, we considerd the effect of resonance scatterings in the gas. Since cross section of resonance scattering is large, photons which form resonance lines have to pass through long paths in order to escape the X-ray emitting plasma. In other words, for line photons optical depth becomes thicker than that of continuum photons. So line intensities will be suppressed, *i.e.* abundances will be apparently small.

We made rough estimation of cross sections for resonance scattering and photoelectric absorption for each element. Then we calculated effective optical thicknesses of the hot plasma as a function of the column density of the X-ray emitting plasma. We derived the expected abundances when we analyse the X-ray emission from the cosmic abundance plasma using an optically thin plasma model. The results were shown in figure 1 by solid lines.

We can see that the caluculations and observational data shows similar tendency, such that the abundance of Fe is low. The value of column density, $10^{22.5}$H cm^{-2}, seems to be most plausible, and this column density is a reasonable value for the coronae of early type stars.

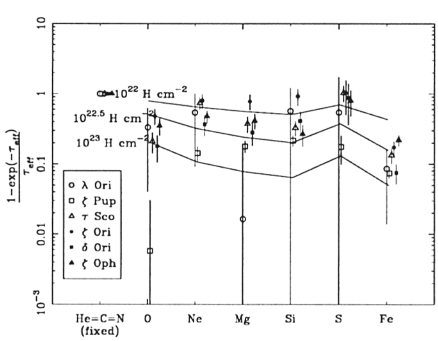

Figure 1: Derived abundances (marks) and expected apparent abundances for three values of column densities of X-ray emitting plasma (solid lines).

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