IUE OBSERVATIONS OF THE GASEOUS COMPONENT OF THE LOCAL INTERSTELLAR MEDIUM

Daya P. Gilra
S M Systems and Research Corporation
Lanham, Md. 20706, U.S.A.

ABSTRACT

Discovery of interstellar Ge, Ga, and Kr is reported. Several intercombination lines of Fe II are detected. The depletion is most pronounced in Ca, Ti, and V. The highly ionized gas C IV and Si IV is not coextensive with the Si II and C II gas nor with the O VI gas. The molecular gas (CO) shows very small velocity dispersion (b~1 km/sec).

INTRODUCTION

About 350 high resolution IUE spectra of about 40 stars (mostly in C Ma, Ara, Scorpius and Orion Nebula) were obtained from the IUE VILSPA data bank to study interstellar absorption lines. To handle such large amounts of data, several computer programs were developed and preliminary scientific results were reported (Gilra et al. 1982a,b). In the present work a modified version of the programs was used.

RESULTS

Averaging of several spectra has helped in detecting weak lines. However, the final limitation is due to the fixed pattern noise. Highlights of the results are given below:

1. Several intercombination lines of Fe II and several Ni II have been detected. With the observations of the intercombination lines, the column densities can be easily derived since the lines are on the linear part of the curve of growth (Gilra 1982, Gilra et al. 1982b).

2. Depletion - Ca, Ti, V (and probably Sc) are the most depleted elements, the second place being taken by Cr, Mn, Fe, Co and Ni. Discovery of Ge, Ga, and Kr shows that elements with atomic number greater than 29 are very little depleted (atomic number of Zinc is 30). Elements occupying neighboring places in the periodic table show similar depletion.

3. Higher ionized species - The lines of C IV, Si IV are broad and show multiple components, often with no corresponding components in C II, Si II etc. Even in neighboring stars the C IV and Si IV lines show components at different velocities. N V lines have proved elusive with a probable detection in just one case. The C IV and Si IV gas is not coextensive with the C II and Si II gas, nor with the O VI gas.

4. Neutrals - There is a probable detection of one Fe I line. On the other hand, 6 Mg I lines have been detected (many for the first time). Apart from the much higher depletion of Fe,

https://doi.org/10.1017/S0252921100098043 Published online by Cambridge University Press

the ratio [Fe I] / [Fe II] is much lower than the [Mg I] / [Mg II] ratio.

5. Recombination - An apparently unsuccessful attempt was made to detect interstellar lines from highly metastable levels of excited terms. Specifically, no line was detected from the Mg I ^3P_o level (life time = 10^{12} seconds). This fact combined with the strength of the lines from the ground level of Mg I has important bearing on the ionization, recombination and collision processes in interstellar space.

6. Molecules - A specific search for molecules other than CO was apparently unsuccessful. However, in the IUE spectrum of Zeta Oph there is an unidentified interstellar line which is almost certainly of molecular origin. Two "forbidden" $C^{12}O$ bands were also observed.

CONCLUDING REMARKS

HD 149404 has the richest interstellar spectrum (except molecules) of all the stars in this study. Ground-based work will be very useful. In particular, one should look for Zr II, Sc II, Y II, Rb I, and Fe I resonance lines, and, Mg I metastable lines near 3850 Å.

HD 147889, the heavily obscured star in the Rho Oph cloud, has the strongest interstellar CO spectrum. Noisy nature of the spectra precludes detection of other molecules. Space Telescope (ST) observations will be very useful.

Space Telescope high resolution spectrograph observations will resolve many blends, even of C IV and Si IV lines.

Interstellar CO line observations, e.g., in HD 147889, will be very useful in determining the instrumental profile of the ST high resolution spectrograph.

REFERENCES

Gilra, D.P., Pwa, T.H., Arnal, E.M., and Vries, J.de 1982a, in Proceedings of the Third European IUE Conference, Madrid, ESA Special Publication, ESA SP 176. pp 385-390.

Gilra, D.P., Pwa, T.H., and Arnal, E.M. 1982b, in ibid, pp 391-397.

Gilra, D.P. 1982, in ibid, pp 139-141.

https://doi.org/10.1017/S0252921100098043 Published online by Cambridge University Press