**Interstellar C2 Molecule as Seen in HST/STIS Data**

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**Abstract.**

Carbon chains are sometimes considered as possible carriers of some diffuse interstellar bands. Spectroscopic observations in UV band carried by spectrometer STIS fed with HST, give us the possibility to detect many interstellar molecules. We focused our attention on C2 molecule and we detected it in spectra of three reddened stars (HD27778, HD147933, HD207198). Interstellar molecule C2 was detected as a set of absorption lines around 2313 angstroms.

1. **Introduction**

Spectroscopic observations of the early spectral type stars in visible light give us a rich astrophysical information about the nature of Diffuse Interstellar Bands (DIBs). DIBs were first detected about 85 year’s ago by Heger (1922). From the beginning they are the subject of intensive examination and analysis. Up today, these absorption structures of interstellar origin are not identified. We still do not know what the carriers of DIBs are (Herbig-1995, Wszołek and Godłowski-2003).

Some authors (e.g. Fulara 1993) claim that DIBs may originate due to interaction of light with interstellar molecules named carbon chains (like C2, C3, C4,...). To verify the hypothesis about carbon chains as DIBs’ carriers one needs to examine mutual correlation between intensities of DIBs’ and lines given by these molecules.

First detection of short carbon chains in interstellar clouds announced in literature, mobilized us to check whether diffuse clouds producing DIBs contain
C2 - which probably is the most abundant molecule among interstellar carbon chains.

2. Observational Data

We did make use from spectroscopic UV data given by Space Telescope Imaging Spectrograph (STIS) at HST. The access to HST data archive is possible by visiting homepage: http://archive.stsci.edu/. We have got UV spectra for our sample of reddened stars. This sample contained 12 stars (HD): 22591, 23180, 24398, 24534, 27778, 34078, 147933, 192639, 198478, 206267, 207198 and 210839.

Archive spectra are accessible as binary FITS files. Spectra were achieved with use of echelle technique therefore each FITS file is divided into many orders.

Furthermore in some cases observations were made many times.

After decoding STIS data, using software package IRAF, there became clear that retrieved spectra meet our criteria (quality, wavelength band, number of observing repetitions) only in three cases, namely for stars: (HD) 27778, 147933 and 207198.

3. Data Analysis

Three software packages were used for data analysis and presentation:

IRAF - helped us to achieve ASCII files (lambda, intensity) from original FITS files.

REWIA v. 1.4 - sofware package written by Jerzy Borkowski (Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences, Toruń, Poland) was used for normalizing spectra and for dividing them by continuum. Averaging procedure was carried out also with the help of this program.

Finally, ORIGIN package was used for graphic presentation of spectra.

We focused our attention on D-X (2313 angstroms) band of C2 molecule. This band contains a set of numerous and well separated rotational lines, named as Mulliken System. We have used high-resolution STIS spectra with R=110000. Each star from our 3 - element sample was observed 8 times. To maximize S/N ratio we averaged observations and finally we achieved satisfying result.

We detected D-X band of C2 in spectra of all our stars. Figure 1 is to show how good is detection of this band for our target stars. Nineteen rotational lines of considered band is well visible. In the case of HD207198 the Doppler splitting of lines is seen. That means that we have to deal with more then one cloud on the line of sight and that these clouds have different radial velocities.

4. Conclusions

The most important result of our analysis is that C2 molecules are present in those interstellar clouds, which produce DIBs. Furthermore 2313 angstroms band of C2 is easily detectable in STIS data. Unfortunately STIS observations are very inhomogeneous (different wavelength regions, different resolutions, different gratings) and they make some difficulties when we want to acquire numerous sample of spectra covering such wavelength region as we wish. A sample
Figure 1. STIS/HST spectra of reddened stars HD147933, HD207198 and HD27778 in the region of C2 D-X (2313 angstroms) band. In description of spectrograms there are given in brackets values of small shifts of two spectra, which were done to draw all spectrograms in common frame.
of target stars with DIBs’ detection counts about 100. From the other hand the only few stars of this sample has satisfactory C2 detention. To solve the problem whether C2 may be a crucial molecule as far as DIBs’ carriers are concerned, one needs much more observations of C2 lines.

References

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