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HIGH PRECISION DIFFUSE INTERSTELLAR MEDIUM RADIO SPECTROSCOPY THROUGH LOW-FREQUENCY CARBON RADIO RECOMBINATION LINES (12+3)

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The main obstacles for low-frequency radio spectroscopy of the interstellar medium lie in the low intensities of studied features and high level of terrestrial interferences. Growing interest to carbon radio recombination lines (RRLs) studies at decametric wavelengths encourage world radio astronomers to search for new methods and hardware which are able to overcome the existing difficulties. Huge experience obtained at UTR-2 observatory in this field makes reliable foundation for developing of this branch of the low-frequency radio spectroscopy. During more than forty years of the carbon RRLs studies using UTR-2 radio telescope the sign correlometers of various constructions were used as back-end facilities. Previously they operated in rather narrow frequency band which was been widened up to 1.2 MHz for the last model of such equipment. But this value is still not adequate to the modern requirements because improving of sensitivity and reliability of spectral experiments requires expanding of the analysis band. The other disadvantage of the sign correlometers consists in the limited dynamic range. In order to resolve existing problems a modern spectrometer based on 16-bit analog-to-digital converter and efficient digital signal processors has been chosen for spectral observations at UTR-2 observatory. This device is called DSP-Z and is widely used for various radio astronomical investigations. Huge dynamic range and analysis band up to 32 MHz open new opportunities for high precision radio spectroscopy with UTR-2 radio telescope. Good illustrations of the new perspectives arisen with installing of this modern equipment are given by results of our observations carried out in the directions to Cassiopeia A in October 2019. Spectra with more than hundred low-frequency carbon RRLs within the bandpass have been measured. Line parameters are in good agreement with those obtained during similar studies with different world instruments and allow us to associate the line formation medium with diffuse HI clouds lying in the line of sight. An experimental test of previously announced theoretical assumptions regarding the dependence of line intensity as a function of frequency for Cassiopeia A direction has been made. Also, additional ways for achieving even greater sensitivity are discussed. Taking into account the advantages of new proposed methods, we may hope that great prospects for high sensitive low-frequency spectroscopy with Ukrainian radio telescopes UTR-2, URAN, GURT (including cooperation with European and world instruments) will be opens up.

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