

Recombination Radio Lines at Very Low Frequencies

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Abstract. Investigations of carbon low frequency radio recombination lines measured with the world biggest decameter wavelength array UTR-2 are described.

Carbon radio recombination lines (RRL) at low frequencies are convenient means for interstellar medium diagnostics (Konovalenko 1990). Decameter radio telescope UTR-2 provides the possibility to observe them at the lowest frequencies. During the last years new results were obtained with this telescope and 128-channel digital correlometer (Stepkin 1996).

Fig. 1 shows the high accuracy spectrum of carbon RRL near 26 MHz ($n \sim 630$) towards Cas A (integration time is near 700 h). New methods of Voigt profile fitting are used. Obtained data correspond to the model with line formation in a diffused non-homogeneous and comparatively warm partially ionized gas, including dielectronic-like recombination process. New observations show absorption lines outside of Cas A limb (up to few degrees from its center). It confirms the presence of distributed CII regions in this direction.

The most low frequency spectral lines were detected near 12 MHz, $n \sim 812$ (Fig. 2a). Their width $\Delta\nu_L$ is increased dramatically as we can see from Fig. 2b ($\Delta\nu_D$ is Doppler broadening, $\Delta\nu_R$ is radiative broadening).

Fig. 3 shows the detection of the biggest principal quantum number (upto 868) by the observations of β -lines near 20 MHz. Such strong excited atoms are very sensitive to the physical conditions in the low density interstellar plasma.

Progress of these investigations is connected to improvement of sensitivity. This is possible when a series of such lines is observed simultaneously (for example, in frequency range 20 – 30 MHz almost 100 α -lines and few hundreds β -lines could be investigated). Modern digital techniques can solve this task. It is important to investigate this phenomenon in the Galaxy at very low ($\nu < 30$ MHz) and low ($\nu \sim 300$ MHz) frequencies.

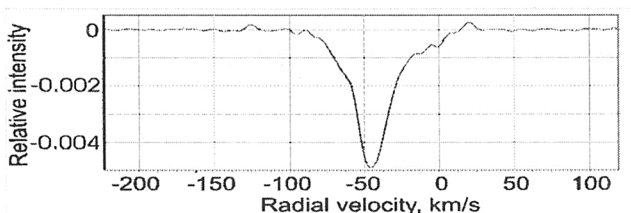


Figure 1. Carbon RRL near 26 MHz towards Cas A.

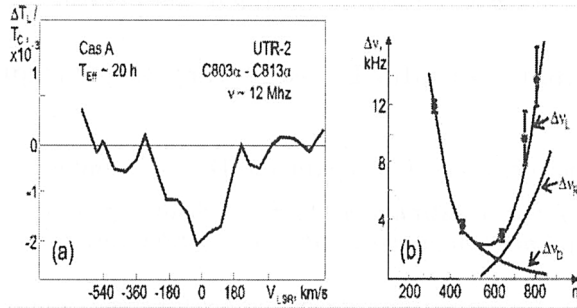


Figure 2. (a) – The spectra of the lowest frequency RRL; (b) – RRL broadening at very low frequencies.

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References

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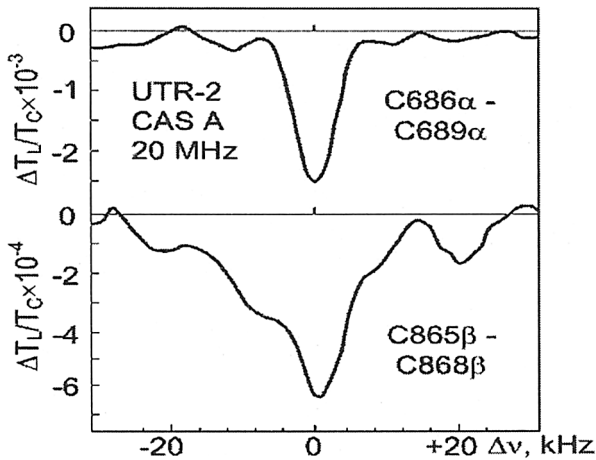


Figure 3. The detection of the highest principal quantum number of space atoms near 20 MHz.