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The primordial CH molecule as a possible probe for the first structures formation epoch

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Abstract. The role of primordial CH molecules in the first structures formation epoch is considered. We discuss the plausibility of observing protostructures in the Dark Age epoch of the Universe by studying the rotational structure of the CH molecule. It is stressed that considerable abundances of this molecule could be formed for different Inhomogeneous BBN models, which could lead to observable spectral-spatial fluctuations in the CMBR spectrum. The calculation is carried out for the Lambda-CDM cosmology and for typical first structures physical conditions. The chemical evolution of the structures is followed numerically, and the optical depth for the most important ground rotational transitions of the CH molecule are proposed. It is shown that under reasonable conditions the primordial CH molecule can be observed with mm-telescopes under construction.

Keywords. Galaxies, Molecules, Structure formation

To discriminate between the Non-standard BBN models we need to know the primordial abundances of heavy elements. CH molecule is an excellent candidate for this because of 1) rather high abundance of C in NBBN models (up to 10^{-8}), 2) CH is rapidly formed at epoch z ≈150, 3) the redshifted rotational emission falls into mm region. We calculate observational properties of the primordial haloes. Optical depth in ground rotational transitions of the CH molecule for 3σ and 6σ haloes is $\tau \approx 2.10^{-6}$ for z = 20 - 40. And for already collapsed haloes can reach values up to 0.03 for the same z (see for details Galli & Palla (2002) and Nunez-Lopez, Lipovka & Avila-Reese (2006)) The corresponding temperature fluctuation of the secondary anisotropies at z = 20 -50, for the case of the 3σ - 6σ haloes is $\Delta T/T \approx 3.10^{-10} - 10^{-9}$. For already collapsed haloes $\Delta T/T \approx 10^{-5}$. For the modern telescopes (LMT, CARMA, ALMA) with the noise temperature T_n = 40 - 80 K one can estimate the integration time as 2 - 5 hours for the already collapsed haloes, whereas for the 3σ - 6σ haloes it is still too large. It must be stressed that this estimations were made for $[C]/[H] = 10^{-10}$, but for some IBBN models this value is as high as 10^{-8} (see Rauscher, Applegate, Cowan, *et al.* (1994)), so in this case even 3σ - 6σ haloes could be observed.

References

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