

Hyperfine structure radio lines from hot ISM in elliptical galaxies

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Abstract. Hyperfine structure (HFS) line of ^{14}N VII ion with rest frequency of $\nu = 53.04$ GHz should be detectable from the interstellar medium in some of the densest and coolest cores of elliptical galaxies at redshifts exceeding 0.15 or so.

Keywords. galaxies: elliptical, galaxies: ISM, radio lines: ISM

Hyperfine structure (HFS) lines of highly-charged ions may open a new window in observations of hot plasmas, as first discussed by Sunyaev & Churazov (1984). Some of the relevant isotopes and ions are abundant at temperatures around $10^5 - 10^7$ K, characteristic of the hot interstellar medium (ISM) in elliptical galaxies, as well as many other types of astrophysical objects. Observations of these lines might complement soft X-ray observations with micro-calorimeters, but, in contrast to soft X-rays, they are not attenuated by the Galactic ISM and Earth atmosphere (except for the ^{14}N VII line), and allow to study observed target bulk and turbulent motions with much higher spectroscopic and angular resolution, provided that the radio telescope has sufficient sensitivity.

We estimate feasibility of HFS emission and absorption line observations from this astrophysical source type using simple theoretical estimates of spectral line absorption cross-section and emissivity (see Sunyaev & Docenko (2007), Docenko & Sunyaev (2007a) and Docenko & Sunyaev (2007b) for more details).

These estimates show that the most promising HFS line to be detected on modern instruments is one of the ^{14}N VII (rest wavelength $\lambda = 5.652$ mm) at redshifts $z > 0.15$. Using planned radio telescopes and interferometers it appears possible to observe also HFS lines of several other Mg, Si and Fe ions, including ^{57}Fe XXII line at 1.05 cm.

Acknowledgements

D.D. gratefully acknowledges the IAU travel grant.

References

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