THE THIRD HARMONIC OF TYPE III SOLAR RADIO BURSTS

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Abstract. Two examples of pairs of 'J-shaped' type III bursts with 2:3 frequency ratio are given. It is suggested that these could be the second and the third harmonics of undetected fundamental radiation. The 80 MHz heliograph source of the third harmonic showed an apparent brightness temperature of $10^9.6$ K, while the order of $10^{16}$ K seems to be required theoretically. This may imply that the apparent radio source was composed of many unresolved small sources of much higher brightness temperature.

1. Introduction

The third harmonic is not generally observed in solar radio bursts. A triplet of 'U' bursts showing frequency ratio of 1:2:3 was found by Haddock and Takakura (Kundu, 1965). A type V bursts with structure showing 2:3 frequency ratio was reported by Benz (1973).

The distribution of frequency ratios of 15 harmonic pairs of type III bursts showing J or U shape was obtained by Stewart (1962). Using the low-frequency edges of the components, he found that the frequency ratio of the two components had a wide distribution, with most values lying in the range from 2 to 1.6; two values were about 1.5. Stewart suggested that the wide distribution may be the effects of (a) differential group retardation of the fundamental radiation, and (b) the 'afterglow' from decaying plasma waves after the passage of a type III disturbance. However, it may be difficult to explain frequency ratios as low as 1.5 to 1.7 in this way. On the other hand, a theoretical estimate (Zheleznyakov and Zlotnik, 1974) has shown that the third harmonic of type IIIIs may have appreciable intensity in some cases when the energy density of the plasma waves is high.

The purpose of the present paper is to show two pairs of J-shaped type III bursts showing definite 2:3 frequency ratio. These could be the second and third harmonics of undetected fundamental emission; the latter may easily escape detection, because of the directivity caused by refraction.

2. Observations

We have examined spectral records obtained with the Culgoora spectrograph covering the range from 8 to 8000 MHz. The frequency ratio of a harmonic pair of type III bursts observed at the same moment is strongly affected by the group delay during the propagation of radio waves because of the fast frequency drift rate of type III bursts.

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Fig. 1. Type III burst showing 2:3 frequency ratio on 1973 February 28.