Review of Kilometric Continuum

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Abstract. Kilometric continuum radiation is a non-thermal magnetospheric radio emission. It is one of the fundamental electromagnetic emissions in all planetary magnetospheres [cf. the review by Kaiser, 27]. We review its observational properties in view of their agreement with theoretical models. Although this emission has been observed and studied for more than 35 years, there are still several unverified theories on how this emission is generated. It is by now quite certain that it is emitted from the plasmasphere, in particular from the plasmapause and from density notches and cavity gradients. Mode conversion at density gradients plays an important role. Observations show that the radiation consists of a magnetospherically trapped and an escaping component. It exhibits a narrow-band fine structure that is barely understood, but beaming models can be safely excluded based on the observations of the frequency-time structure of the radiation. We investigate its relation to geomagnetic activity and solar activity.

Key words: Magnetosphere, continuum radiation, non-thermal radiation, plasmapause source

2.1 Introduction

A magnetospheric electromagnetic emission that is associated with intense narrow-band electrostatic emissions in the vicinity of the plasmapause at the geomagnetic equator is the non-thermal continuum (NTC) radiation (see for example: [17, 29]). NTC is observed over a very broad frequency range from as low as 5 kHz [Gurnett, 15]. Its highest frequency was known to be 200 kHz [Kurth et al., 30] before the identification of “kilometric continuum” by Geotail [Hashimoto et al., 19]. The conventional lower frequency component of continuum has been called the “normal continuum” by a number of authors.
[eg., 19, 28] and as terrestrial myriametric radiation [Jones, 23] based on its wavelength range ($\lambda \sim 10$ km at $f \sim 30$ kHz). On the other hand, a new component, kilometric continuum, is its high-frequency extension with frequencies up to as high as 800 kHz.

The NTC is generated in the free space L-O mode above $f_p$, where $f_p$ is the local electron plasma frequency, from sources at or very near the plasmapause. The strong electrostatic bands occur at frequencies where the frequency of the electrostatic upper hybrid resonance ($f_{uh}$) is equal to the frequency of the electrostatic $(n + \frac{1}{2})f_g$ resonance, where $f_g$ is the local electron cyclotron frequency [Kurth, 31]. The kilometric continuum is not merely a high frequency extension. It triggered new investigations since this frequency range is above the maximum plasma frequency of a few hundred kHz observed at the plasmapause. This is believed to be generated in events separate from the lower frequency non-thermal continuum. Recent NTC research has focused on improving our understanding of the source location, emission cone characteristics, propagation characteristics, and detailed spectral measurements primarily in the kilometric frequency range.

Much of what has emerged from these studies in terms of source location is summarized in Fig. 2.1 adapted from Green et al. [12]. The lower frequency trapped and escaping continuum is typically generated in the pre-noon sector and has been called the “normal continuum”, the continuum enhancement is generated in the morning sector [6, 13, 28], and the kilometric continuum

![Fig. 2.1. The observed source locations of the escaping after [5], trapped [16], kilometric [19] and continuum enhancement [28] emissions [12]](image)