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Source Region Characteristics of Non-thermal Continuum Radiation

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Non-thermal continuum radiation (NTC) is a fundamental inner magnetospheric radio emission observed in every magnetosphere in the solar system. For the Earth, there are three main types of NTC that are distinguished by their frequency range and source location. The normal continuum radiation (also referred to as the trapped and escaping continuum) is typically in the 5 to 100 kHz frequency range generated at the plasmapause in the morning sector. The continuum enhancement is observed from 10-100 kHz coming from night-side plasmapause source regions. Kilometric continuum is also generated at the plasmapause, near the magnetic equator, deep in notch structures of the plasmasphere over a frequency range from 100 to 800 kHz. Observations of NTC from IMAGE, Cluster, and Geotail are revealing important new characteristics in and near the source region that will place additional constraints on any generation theory. NTC is believed to be generated by the linear (Z-to-O mode at the “radio window”) or non-linear conversion process. New observations of NTC show that the emission is associated with density ducts in the plasmapause region. Both the plasmapause and density ducts can concentrate Z-mode waves thereby enhancing the Z-to-O mode conversion for the generation of NTC. The Radio Plasma Imager (RPI) on the IMAGE spacecraft frequently detects radiation patterns of NTC as it crosses the magnetic equator. These radiation patterns often take on a ’Christmas tree’ like appearance in frequency-time spectrograms, with the lower frequency components more spread out in magnetic latitude about the equator than that of the higher frequency components. Some of these patterns have a hollowed out appearance with the radiation intensity diminishing around the magnetic equator consistent with

off- equatorial beaming from the source, while others do not show such a diminishing in intensity around the equator. One possible explanation of this radiation pattern is a very sharp plasmapause coupled with an off-equatorial beaming angle that is dependent upon the ratio of fce/fpe as predicted by many theories. Some of these patterns appear to be qualitatively consistent with theories like linear mode conversion that predict off equatorial beaming, while other patterns seem to be inconsistent.