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Comment on angeo-2022-7

Anonymous Referee #2

Referee comment on "Classification of spectral fine structures of Saturn kilometric radiation" by Georg Fischer et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2022-7-RC2, 2022

The paper studies fine structure of Saturn kilometric radiation (SKR) using data obtained by the Cassini Wideband Receiver (WBR), a part of the Radio and Plasma Wave Science (RPWS) instrument. These features are believed to result from physical processes associated with the generation of SKR, presumably by the cyclotron maser instability. Seven different classes of fine structure are identified in detail, ranging from dots, lines with different slope, to areal stuctures. A 7th class identifies special structures based on unique morphologies on f-t spectrograms. Carefully conducted statistical studies of the occurrence of these different classifications yield a number of intriguing results, which the authors discuss in great detail. For instance, lines with a positive slope are much more common at medium frequencies (near 325 kHz) than at low frequencies (below 80 kHz), and vertical lines are almost absent at low frequencies. "Striations" (group of narrowbandedlines with predominantly negative slopes) are quite common below 80 kHz, but less common near 325 kHz. At medium frequencies striations appear a "rain" or interrupted striations. Sub-classifications of "worms" and "caterpillars" are formally discussed for the first time. The authors present a long discussion of the results of the survey in light of the CMI, and possible explanations (or lack thereof) for a number of the classifications.

We find the work to be well-written with an extensive Introduction briefly discussing the cyclotron maser instability and observations of AKR and SKR along with a review of finestructure observed at Earth and Saturn to date. While there are no scientific conclusions explicitly given in this work, the analysis is essentially a necessary first step in the process of understanding the physical explanation for the "zoo" of finestructure observed resulting from the CMI.

Some highlights:

>Excellent description of the RPWS WBR along with modes of operation.

>Detailed description of the 7 types of classifications. Occurrence probabilities are described for each category in detail, including how some complications were handled, such as dots associated with rain or striations.

>Detailed Discussion of the emissions where a number of questions arise, such as identifying the not always definitive modes of the emission.

Here we list some enumerated comments and a few questions.

L 79--Please define "areal" in this context.

L 157--Replace "own" with "unique"?

L 180--Have you checked for instrumental signatures for the VERT signals, perhaps due to another instrument starting or changing modes, etc.? [I see you do discuss this later near Lines 397-399]

L 177-Could this feature be Z-mode or O-mode?

Figure 4, right side: How about the 3 or 4 narrow features that have the shape of a shallow upward parabola? Are these POSSn?

L247-248: Do you mean "...but we count only the number of spectra WITH classified linear, areal or special structures"?

L352--"...is one of THE areal fetures..."

L374-377-These "absorption features" might perhaps also be refractive attenuation signatures as discussed by Gurnett et al., 1998 (GRL, doi:10.1029/98GL01400) for Jovian hectometric radiation. The refraction is due to grazing incidence of HOM near the edge of the Io torus. Gurnett et al., referred to these features as "attenuation bands" (see their Figure 3).

L440-443: The oscillating worms may be the result of the source region plasma

characteristics oscillating. Density gradients near or within the edge of the Enceladus torus may slowly change with longitude as an extended source region rotates into or out of view. This might also be consistent with your study of the position of the features in the Saturn magnetosphere.