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Observations of agyrotropic electron distributions in the absence of magnetic reconnection

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Agyrotropic electron distributions are frequently taken as an important indicator of the electron diffusion region in magnetic reconnection[1,2]. As these agyrotropic electron distributions are generated by the finite electron gyro-radius effect, whether they can be found in the absence of magnetic reconnection remains unclear. In this study, we present Magnetospheric Multiscale (MMS)[1] observations of agyrotropic distributions at the non-reconnecting magnetopause[3,4] and also in the foreshock transients[5]. Although these agyrotropic distributions are generated by the similar electron gyration effect at electron-scale boundaries, and can be unstable to drive high frequency electrostatic waves, we find that the signatures of magnetic reconnection is lacking. In addition, we provide a new possibility to generate agyrotropic electron distributions with a sufficiently strong and local electric field, which can directly accelerate part of electrons out of the original electron core to form agyrotropic distributions. These results are further confirmed by the test particle results[4], indicating that agyrotropic electron distributions can be more frequently observed in space plasma.

References

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(3) Tang et al., Geophysical Research Letters, 46(6): 3024-3032, (2019)
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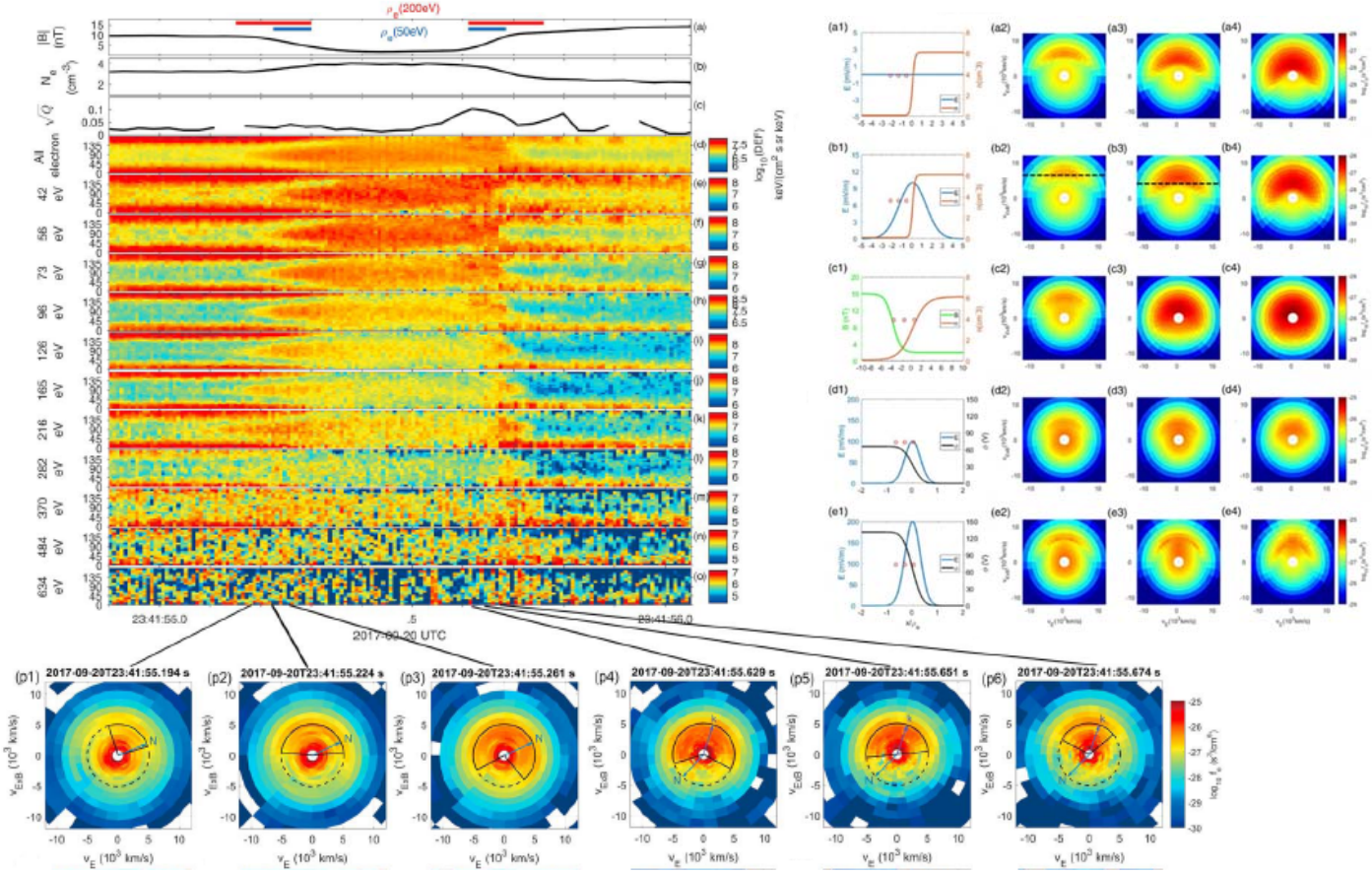

Figure. (Left) MMS observations of agyrotropic electron distributions at the non-reconnecting magnetopause. (Right) agyrotropic electron distributions generated by test particle simulations.