

# Magnetospheric multiscale observations of Kappa distributions in the magnetosheath on small scales

Dariusz Wójcik<sup>1,2</sup>, Wiesław Marian Macek<sup>1,2</sup>

<sup>1</sup>Space Research Centre (CBK PAN), Warsaw, Poland, <sup>2</sup>Institute of Physical Sciences, Cardinal Stefan Wyszyński University, Warsaw, Poland

We discuss the results of statistical analysis of magnetic field fluctuations in the magnetosheath using the data from the Magnetospheric Multiscale (MMS) mission on extremely small kinetic scales [1]. We have shown that the turbulence cascade exhibits features characteristic for Markov processes. The solutions of the Fokker-Planck equation agree with experimental probability density functions, from the kappa distributions to the normal Gaussian distribution for large inertial scales, which exhibit a universal global scale invariance through the kinetic domain. We compare the characteristics of turbulence at various regions in Earth's space environment: behind the bow shock, inside the magnetosheath, and near the magnetopause. It is interesting to note that on kinetic scales magnetic turbulence is consistent with a generalized Ornstein-Uhlenbeck process. The obtained results especially on kinetic scales could be important for a better understanding of the physical mechanism governing turbulent systems in laboratory and space plasmas.

## *Acknowledgments*

This work has been supported by the National Science Center, Poland (NCN), through grant No. 2021/41/B/ST10/00823.

## References

[1] W. M. Macek, D. Wójcik, J. L. Burch, 2023, Magnetospheric Multiscale Observations of Markov Turbulence on Kinetic Scales, *Astrophys. J.*, 943, 152 (2023).