



## **Seminar**

Tuesday, 9 July 2024 - h. 14:30

*Fisica della Materia room (Department of Physics)*

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## **“Vortex Gas Model: Simplifying 3D turbulence’s circulation statistics”**

### *Abstract*

Velocity circulation is the subject of one of the most celebrated theorems of fluid dynamics, Kelvin’s Theorem. Almost 30 years ago the study of circulation started to show its relevance in the context of Turbulence through the seminal work of A.A. Migdal [1]. Nowadays, hardware improvements have made possible the deep exploration of such a variable in numerical solutions of NSE at extremely high resolution [2], [3]. In this sense, this seminar aims to present the phenomenology of circulation statistics in 3D turbulence. We present an interesting framework for interpreting some results on the circulation statistics, the Vortex Gas Model [4]–[7], a simple analytical approach that accounts for planar circulation contours using discrete distributions of Gaussian vortices.

- [1] - Migdal, A. A. (1994). Loop equation and area law in turbulence. *Int. J. Mod. Phys. A*, 9(08), 1197-1238.
- [2] - Iyer, K. P., Sreenivasan, K. R., & Yeung, P. K. (2019). Circulation in high Reynolds number isotropic turbulence is a bifractal. *PRX*, 9(4), 041006.
- [3] - Iyer, K. P., Bharadwaj, S. S., & Sreenivasan, K. R. (2021). The area rule for circulation in three-dimensional turbulence. *PNAS*, 118(43), e2114679118.
- [4] - Apolinário, G. B., Moriconi, L., Pereira, R. M., & Valadão, V. J. (2020). Vortex gas modeling of turbulent circulation statistics. *PRE*, 102(4), 041102.
- [5] - Moriconi, L., Pereira, R. M., & Valadão, V. J. (2022). Circulation statistics and the mutually excluding behavior of turbulent vortex structures. *PRE*, 106(2), L023101.
- [6] - Moriconi, L., & Pereira, R. M. (2022). Statistics of extreme turbulent circulation events from multifractality breaking. *PRE*, 106(5), 054121.
- [7] - Moriconi, L., Pereira, R. M., & Valadão, V. J. (2024). Vortex polarization and circulation statistics in isotropic turbulence. *PRE*, 109(4), 045106.

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