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Inverse turbulent cascade in swarming sperm[1] ADAMA CREPPY, OLIVIER PRAUD, XAVIER DRUART, PHILIPPA KOHNKE, FRANCK PLOURABOUE, None, INRA, CNRS, UMR, F-37380 NOUZILLY, FRANCE TEAM[2], UNIVERSITÉ DE TOULOUSE, INPT, UPS, IMFT,UMR 5502, FRANCE TEAM[3] — Collective motion of self-sustained swarming flows has recently provided examples of small scale turbulence arising where viscosity effects are dominant. We report the first observation of an universal inverse enstrophy cascade in concentrated swarming sperm consistent with a body of evidence built from various independent measurements. We found a well-defined k^{-3} power-law decay of velocity field power-spectrum and relative dispersion of small beads consistent with theoretical predictions in two-dimensional turbulence. Concentrated living sperm displays long-range, correlated whirlpool structures the size of which provides turbulence's integral scale. We propose a consistent explanation for this quasi-two-dimensional turbulence based on self-structured laminated flow forced by steric interaction and alignment, a state of active matter that we call "swarming liquid crystal." We develop scaling arguments consistent with this interpretation. The implication of multi-scale collective dynamics of sperm's collective motility for fertility assessment is discussed.

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[2]Physical experiment aspect in MOTIMO contract
[3]Biological experiments in MOTIMO contract

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