Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Waltzing worms: the dynamics of plant-animal collective vortex structures GEORGE FORTUNE, Univ of Cambridge, ALAN WORLEY, ANA SENDOVA-FRANKS, NIGEL FRANKS, Univ of Bristol, KYRIACOS LEPTOS, Univ of Cambridge, ERIC LAUGA, DAMTP, University of Cambridge, RAYMOND GOLDSTEIN, Univ of Cambridge — Circular milling, a stunning manifestation of collective motion, is found across the natural world, from fish shoals to army ants. It has been observed recently that the plant-animal worm *Symsagittifera roscoffensis* exhibits circular milling behaviour, both in shallow pools at the beach and in Petri dishes in the laboratory. Here we investigate this phenomenon, through experiment and theory, from a fluid dynamical viewpoint, focusing on the effect that an established circular mill has on the surrounding fluid. Unlike systems such as confined bacterial suspensions and collections of molecular motors and filaments that exhibit spontaneous circulatory behaviour, and which are modelled as force dipoles, the front-back symmetry of individual worms precludes a stresslet contribution. Instead, singularities such as source dipoles and Stokes quadrupoles are expected to dominate. A series of models is analyzed to understand the contributions of these singularities to the azimuthal flow fields generated by a mill, in light of the particular boundary conditions that hold for flow in a Petri dish. A model that treats a circular mill as a rigid rotating disc that generates a Stokes flow is shown to capture basic experimental results well, and gives insights into the emergence and stability of multiple mill systems.

George Fortune
Univ of Cambridge

Date submitted: 13 Nov 2020 Electronic form version 1.4