



Spirographic motion in a vortex

Sumithra Reddy Yerasi¹, Rama Govindarajan², Dario Vincenzi¹

¹University Côte d'Azur, CNRS, LJAD, Nice, France

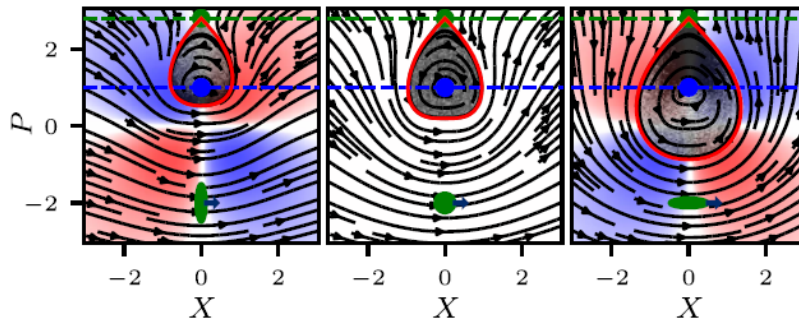
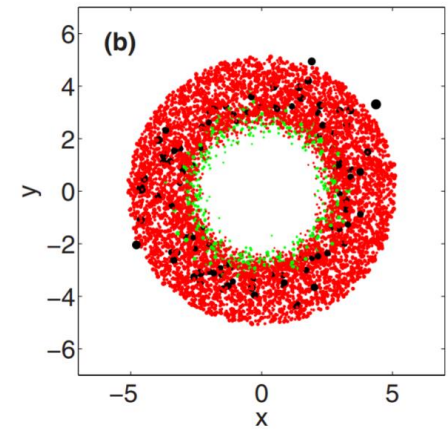
²ICTS-TIFR, Bangalore, India



Particle dynamics in a single vortex

Droplets and heavy particles

Microswimmers



Arguedas-Leiva et al., NJP 22, 053051, (2020)

Deepu et al., PRF 2, 024305 (2017)

✓ Point-like particles



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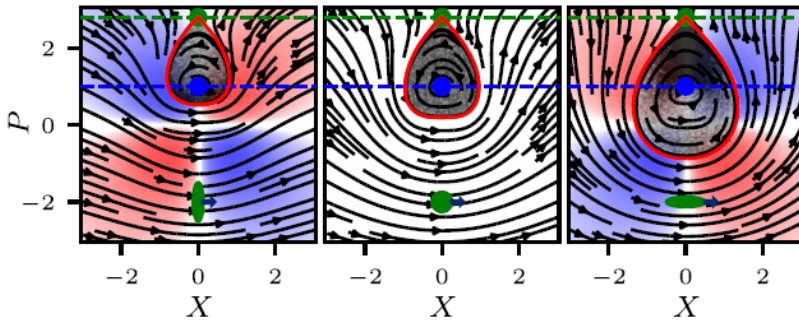
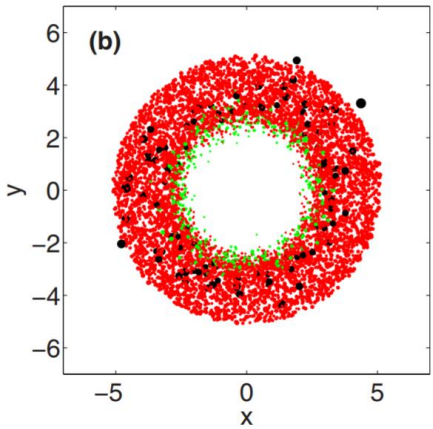
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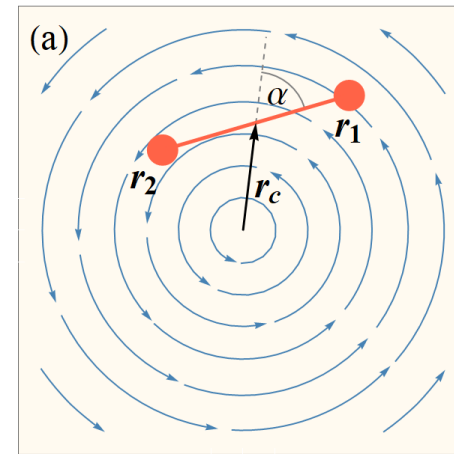


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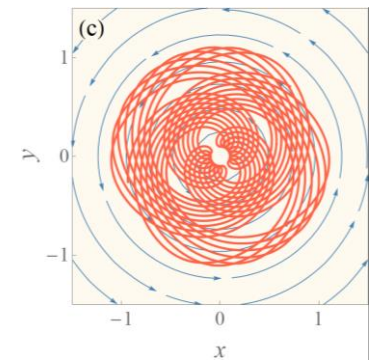
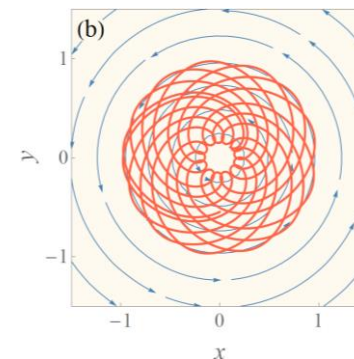
✓ Point-like particles

Dumbbell dynamics in a 2D vortex



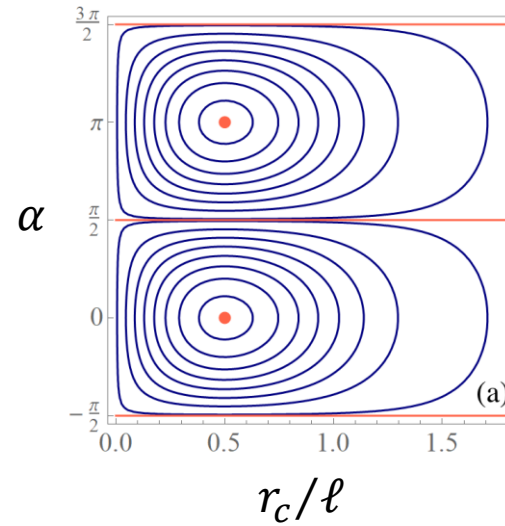
✓ Non point-like

Spirographic trajectories

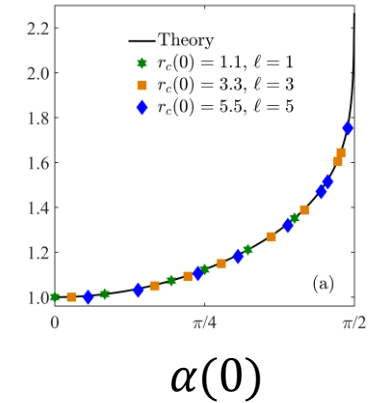
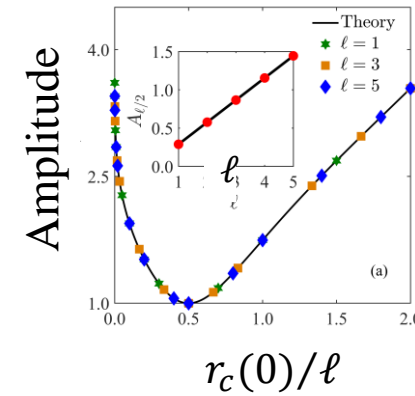


$(r_c/\ell) e^{-2r_c^2/\ell^2} \cos \alpha$ is a constant of motion
irrespective of the functional form of the vortex

Decreasing
angular velocity

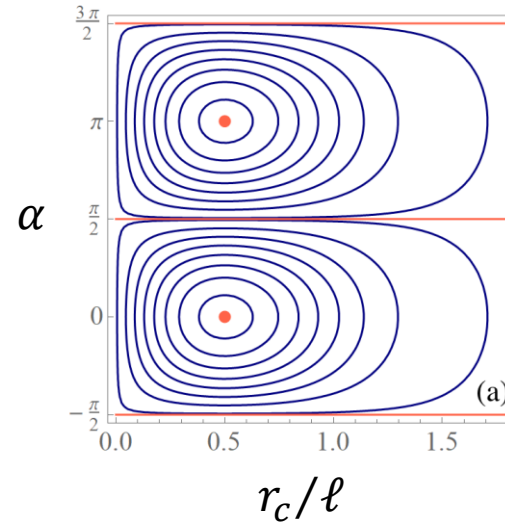


Trajectories form a family of closed orbits

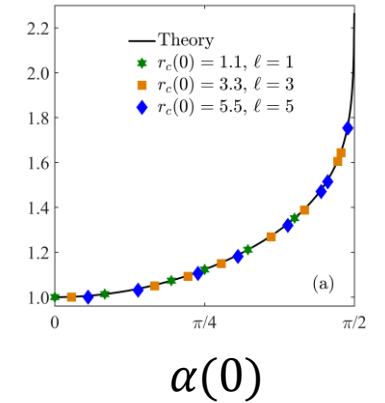
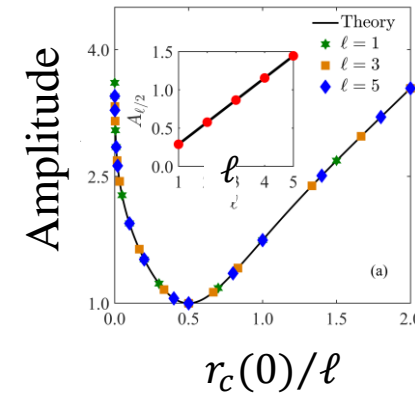


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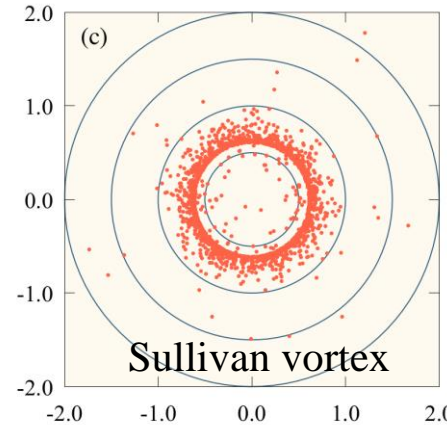
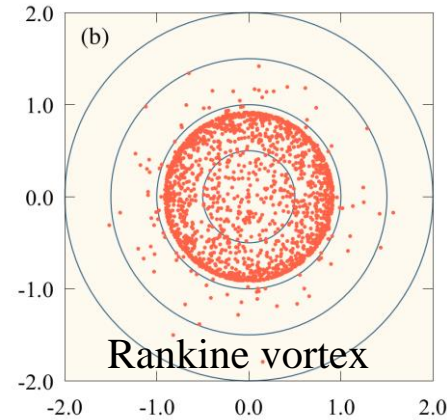
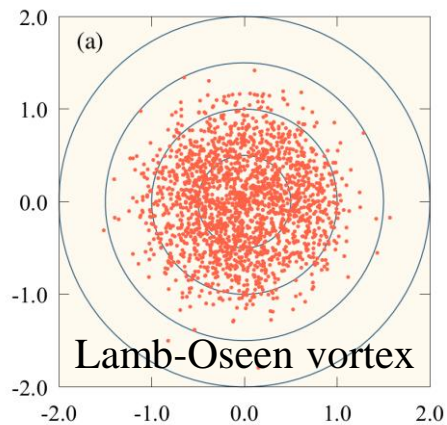
Decreasing
angular velocity



Trajectories form a family of closed orbits



Non-decreasing angular velocity



- Attracting set acts as a transport barrier
- Specific pattern emerges in the spatial distribution of multiple dumbbells