

# ACTIVE VORTICES UNBIND and SUPERDIFFUSE

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Read our 4-page paper!

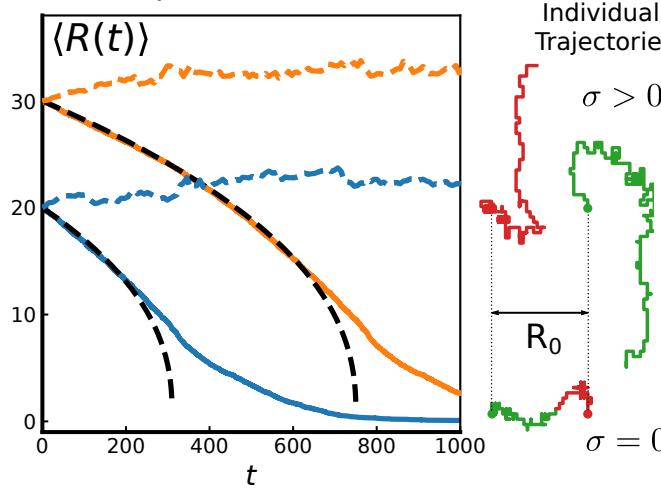
→ What is the role/behavior of vortices away from equilibrium ? → Is the BKT picture still valid ?

The **Active XY Model**  
(2D square lattice)

$$\dot{\theta}_i = \sigma \omega_i + \sum_{j \in \partial_i} \sin(\theta_j - \theta_i) + \sqrt{2T} \nu_i(t); \quad \omega_i \stackrel{iid}{\sim} \mathcal{N}(0, 1)$$

## VORTICES UNBIND

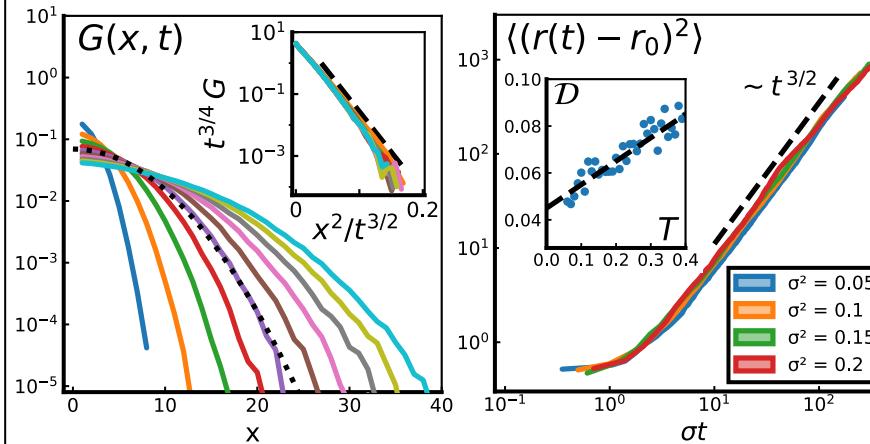
We create a lattice with 2 vortices with initial distance  $R_0$  and monitor their separation  $R(t)$  over time.



In the standard XY Model (solid), vortices feel an attractive log potential while in the active XY Model (dash), **vortices are always free !**  
Breaks the BKT picture !

## VORTICES SUPERDIFFUSE

**Vortices** preferentially **ride on domain boundaries** (cf. Movie), yielding superdiffusion :  $\text{MSD} \sim t^{3/2}$  and providing an efficient dissipation mechanism.

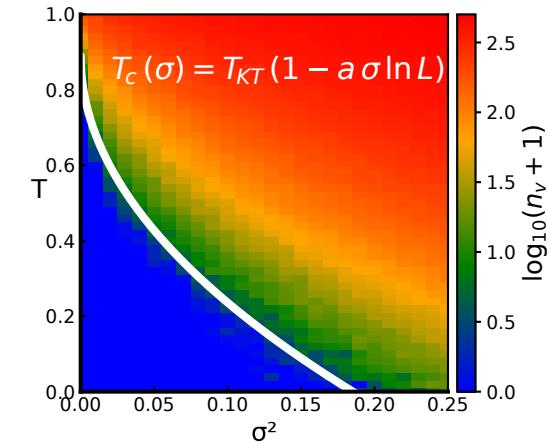


**Gaussian** pdf of displacements !

$$G(x, t) \propto \exp \left[ -\frac{x^2}{4\mathcal{D}(\sigma t)^{3/2}} \right]$$

## NUMBER OF VORTICES

We classify vortices (free/bounded):  
The optimal pairing (Hungarian algorithm) minimizes the sum of intra-pair separations.



The number of vortices **no longer controls** a **phase transition**. Indeed, in the blue region, (no free vortices), the charact. length is finite  
 $\xi \sim 1/\sigma$  indep. of system size