

# SISTEMAS DE CRESCIMENTO COM DEFEITO COLUNAR

Vladas Sidoravicius

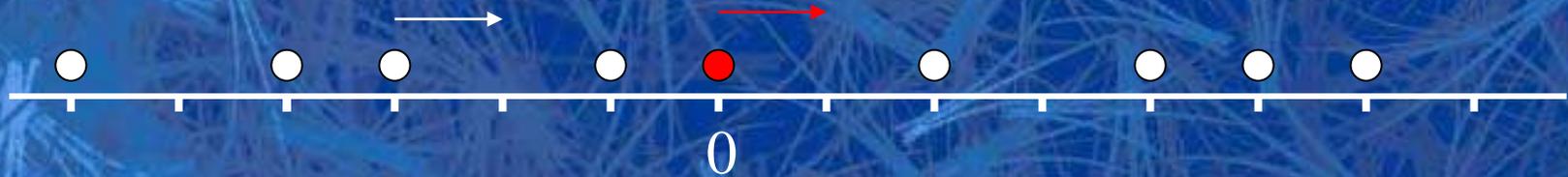
Joint work with

V. Beffara (ENS-Lyon) and M.E.Vares (CBPF)

Colóquio Inter-Institucional  
CBPF-IMPA-LNCC-UFRJ

# Totally asymmetric exclusion process with slow bond

Consider one-dimensional totally asymmetric exclusion process with the particle density  $\rho$ , particles jump at rate 1, except at the origin, where jump rate changes from 1 to  $1 - \lambda$ ,  $\lambda \geq 0$ .



If the density  $\rho$  of particles equals  $1/2$ , does the current in the system change for any value of  $\lambda$  ?

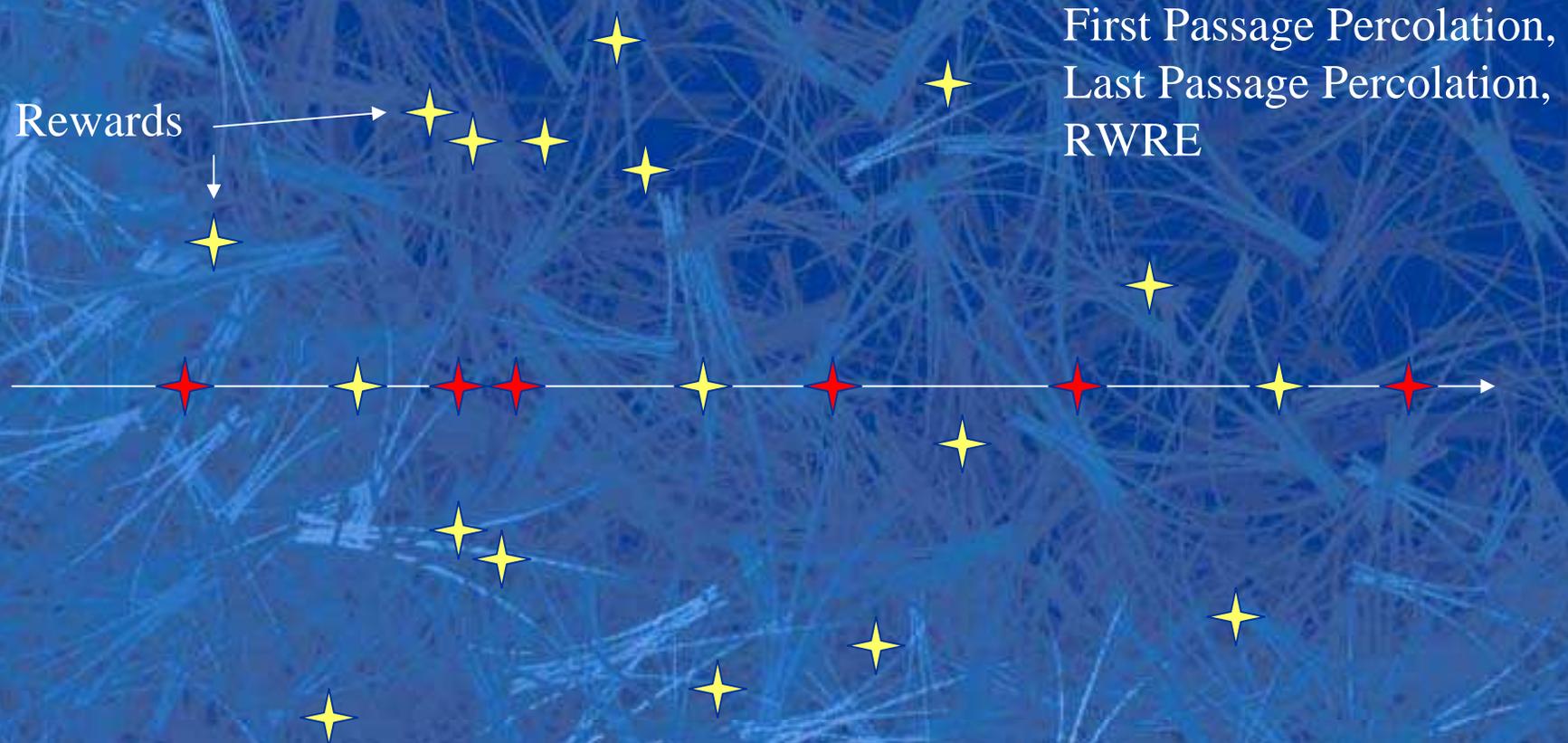
S.A. Janowski, J. L. Lebowitz 1992,

T. Liggett 1994, F. Rezakhanlou et al. 1996, T. Seppalainen 2002

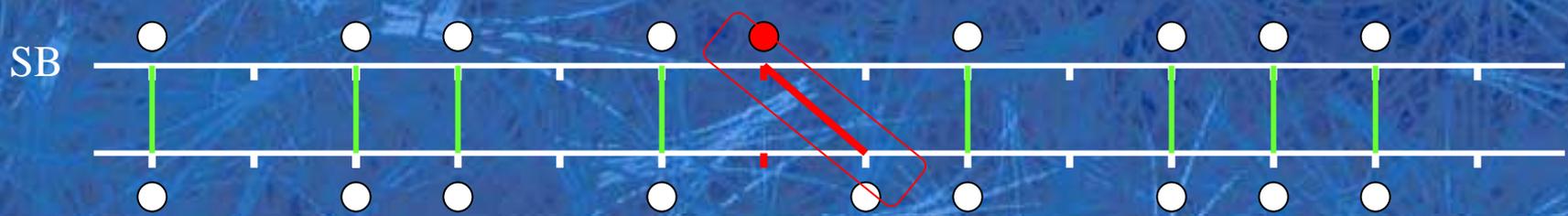
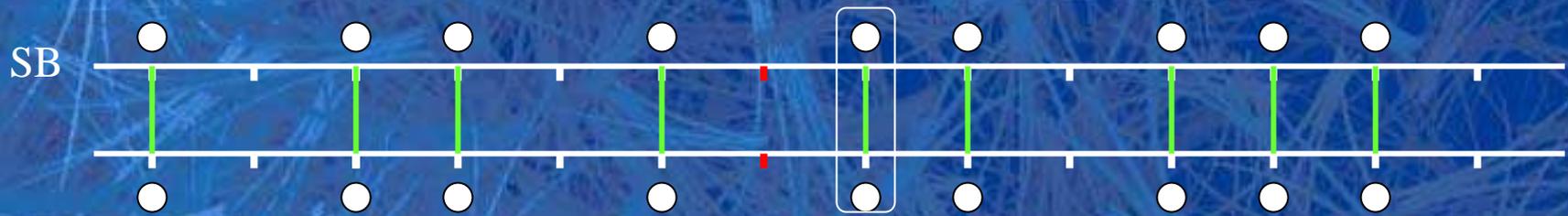
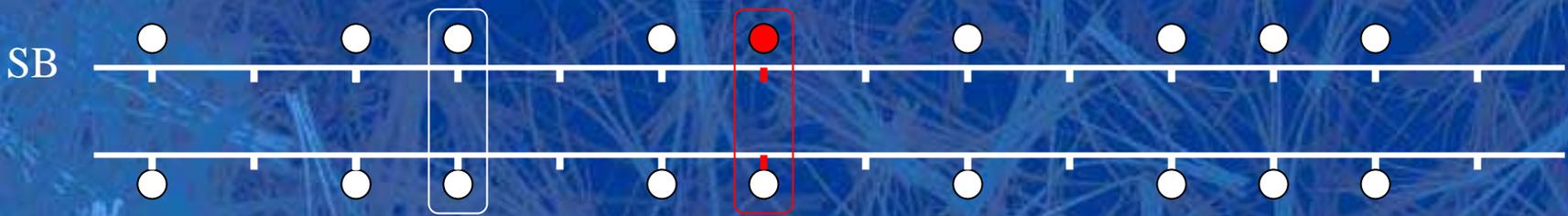
M. den Nijs et al., 2003

Statement (V. Beffara, V.S., 2006)  $\lambda_c = 0$ .

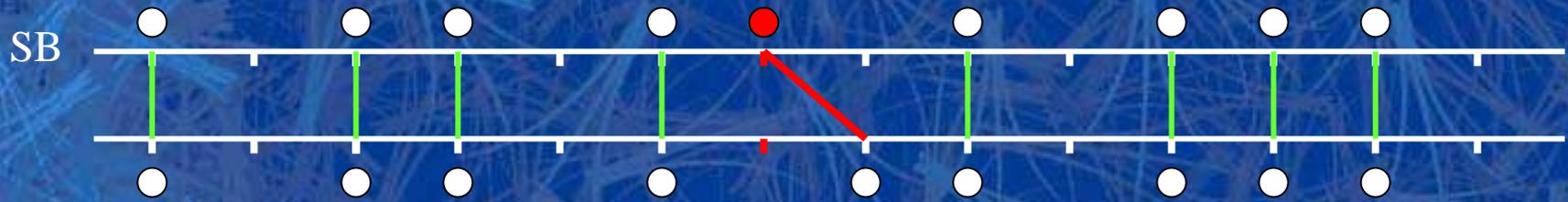
- This statement is a corollary of more general theorem characterizing long term behavior of certain class of growth models.
- Pinning/depinning transition for directed polymer in presence of bulk disorder.



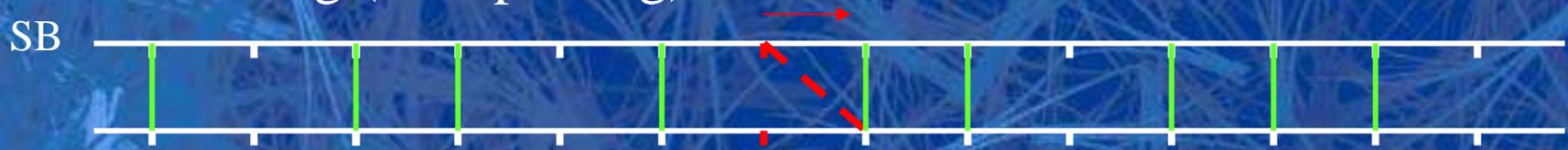
- Coupling:
- initially all particles are at the same positions and use the same clock while not at 0.
  - basic coupling of independent clocks at 0.



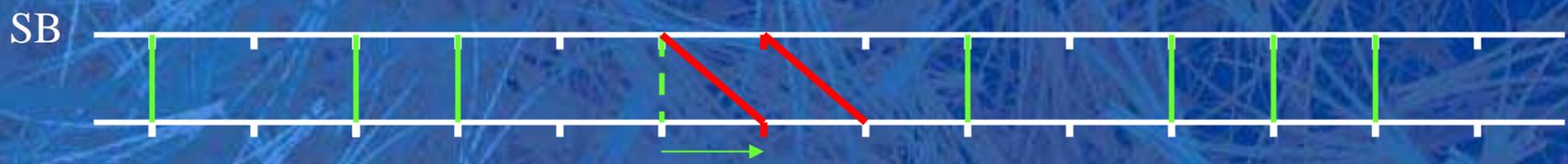
# Evolution of discrepancy:



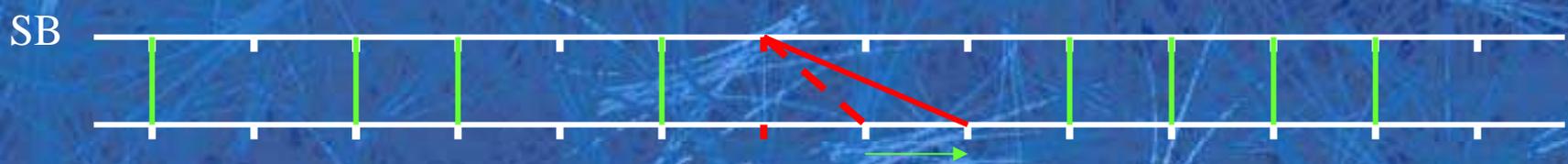
## Shrinking (disappearing)

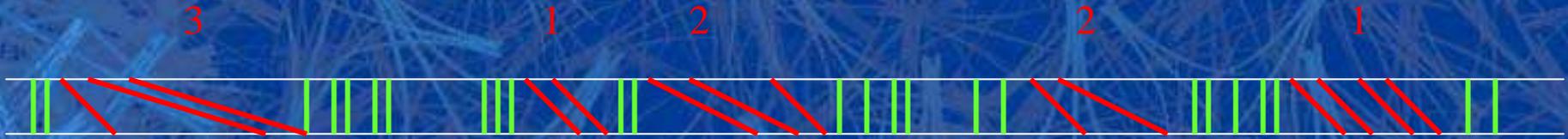


## Expanding



## Growing

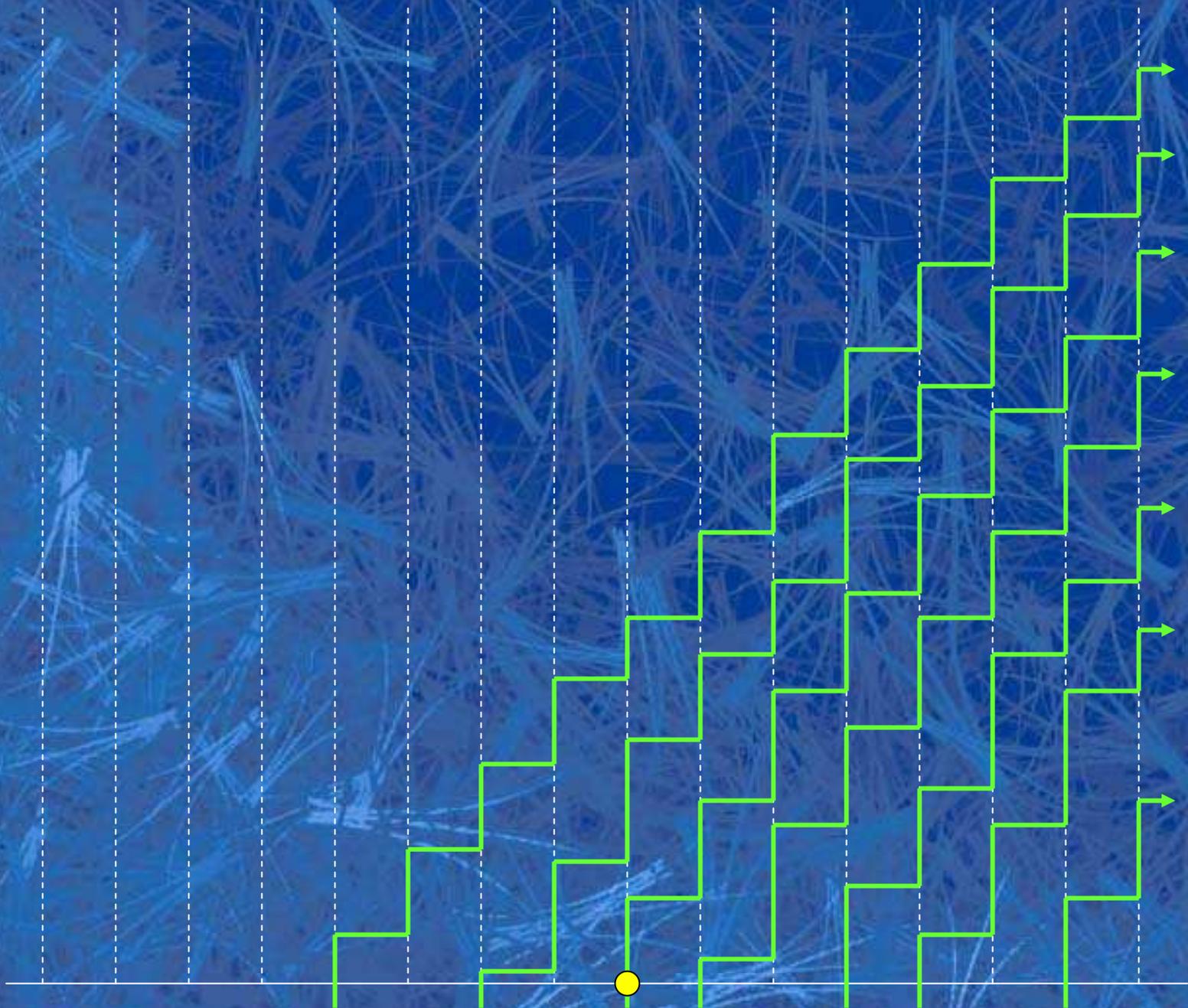


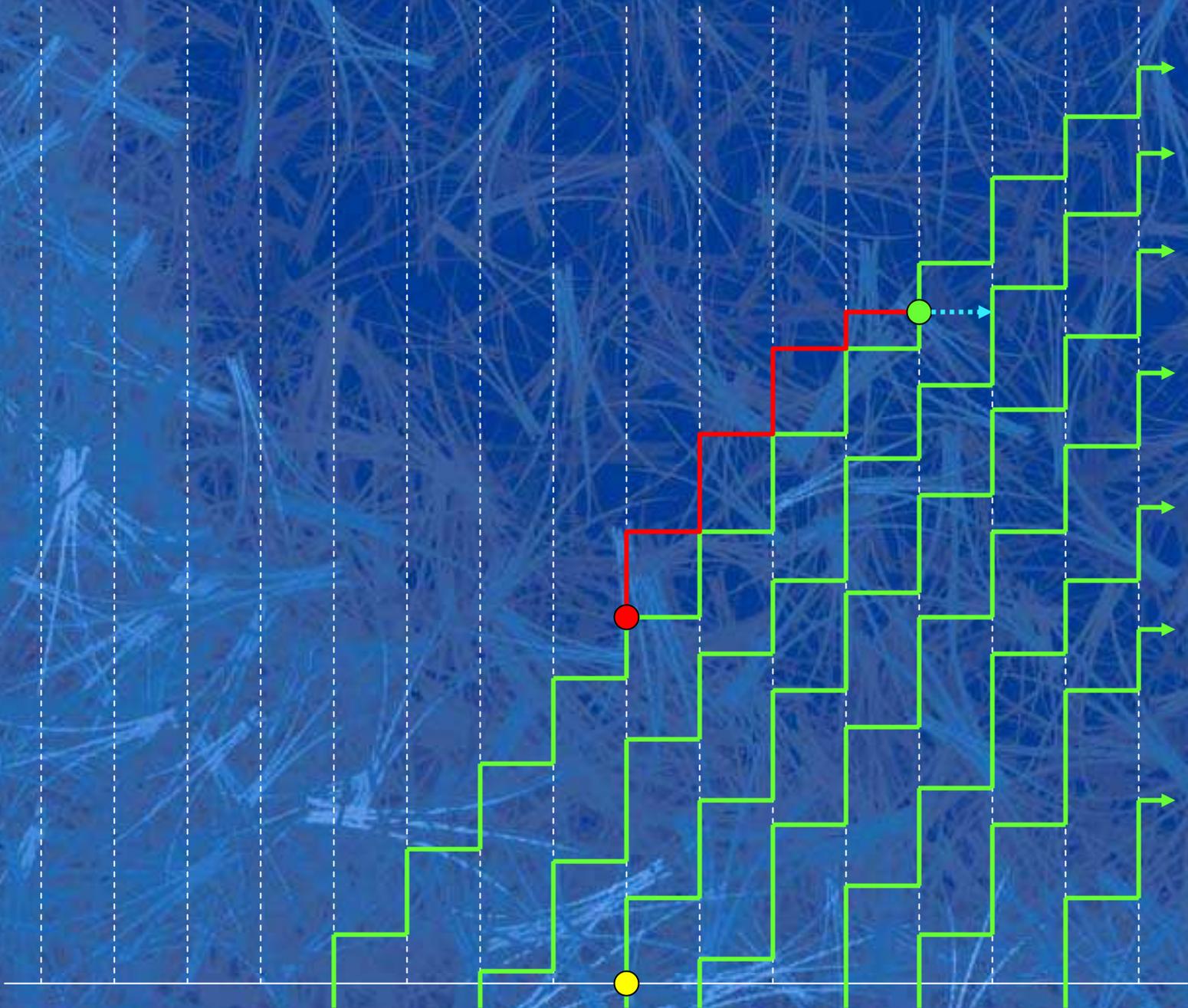


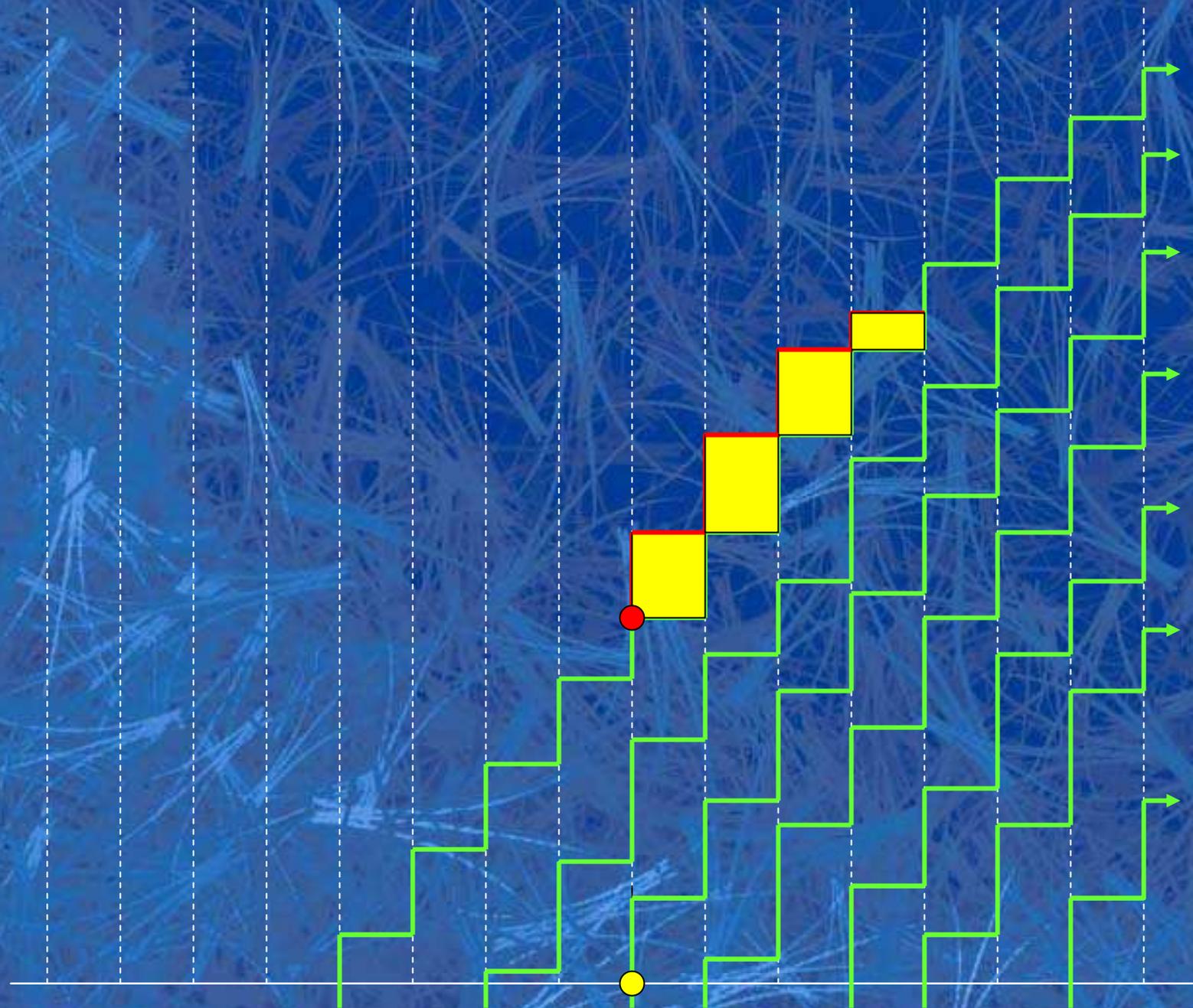
- LLN: the current in TASEP with slow bond is changed if and only if the “slope” between decoupled particles is growing linearly in time.

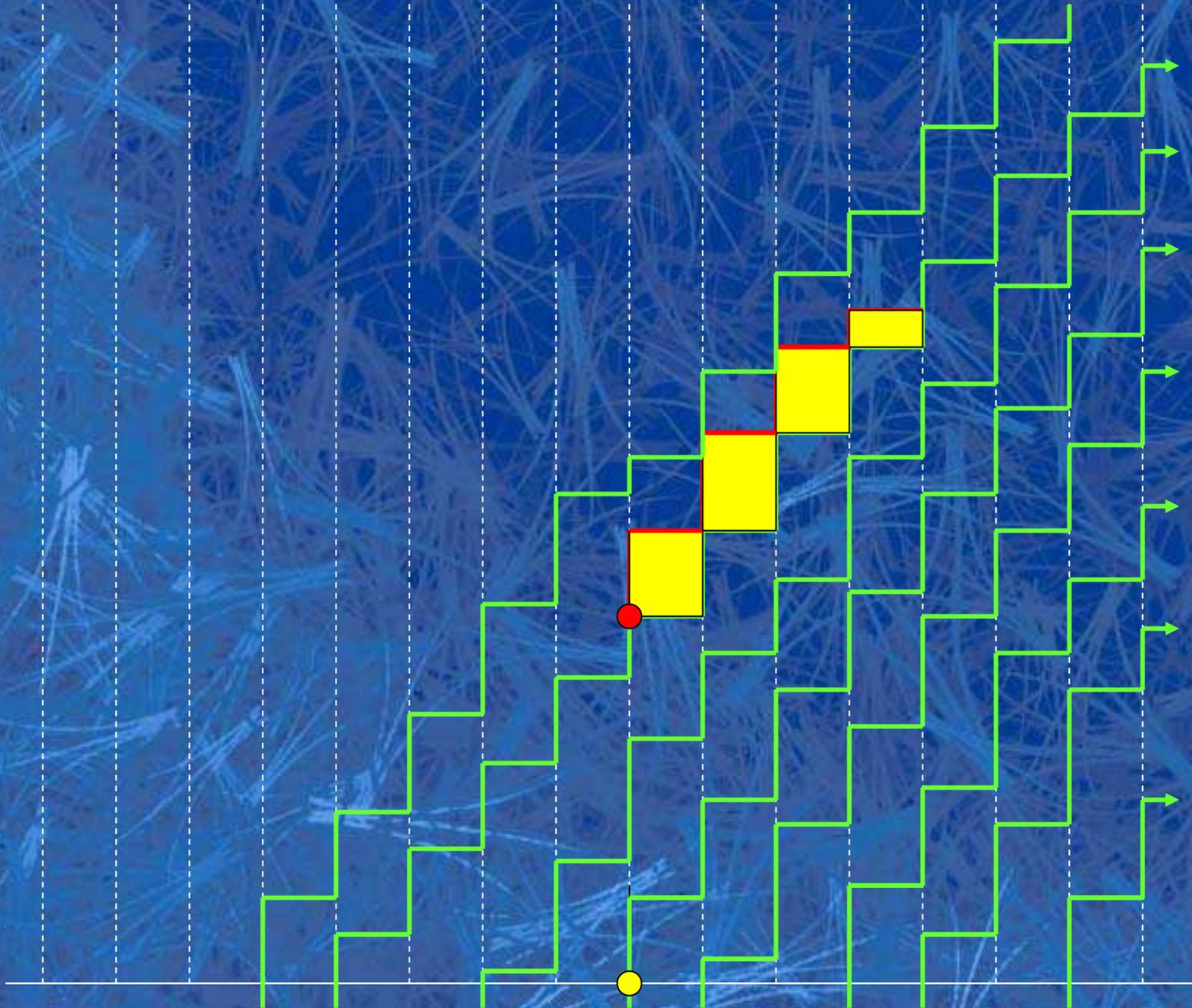


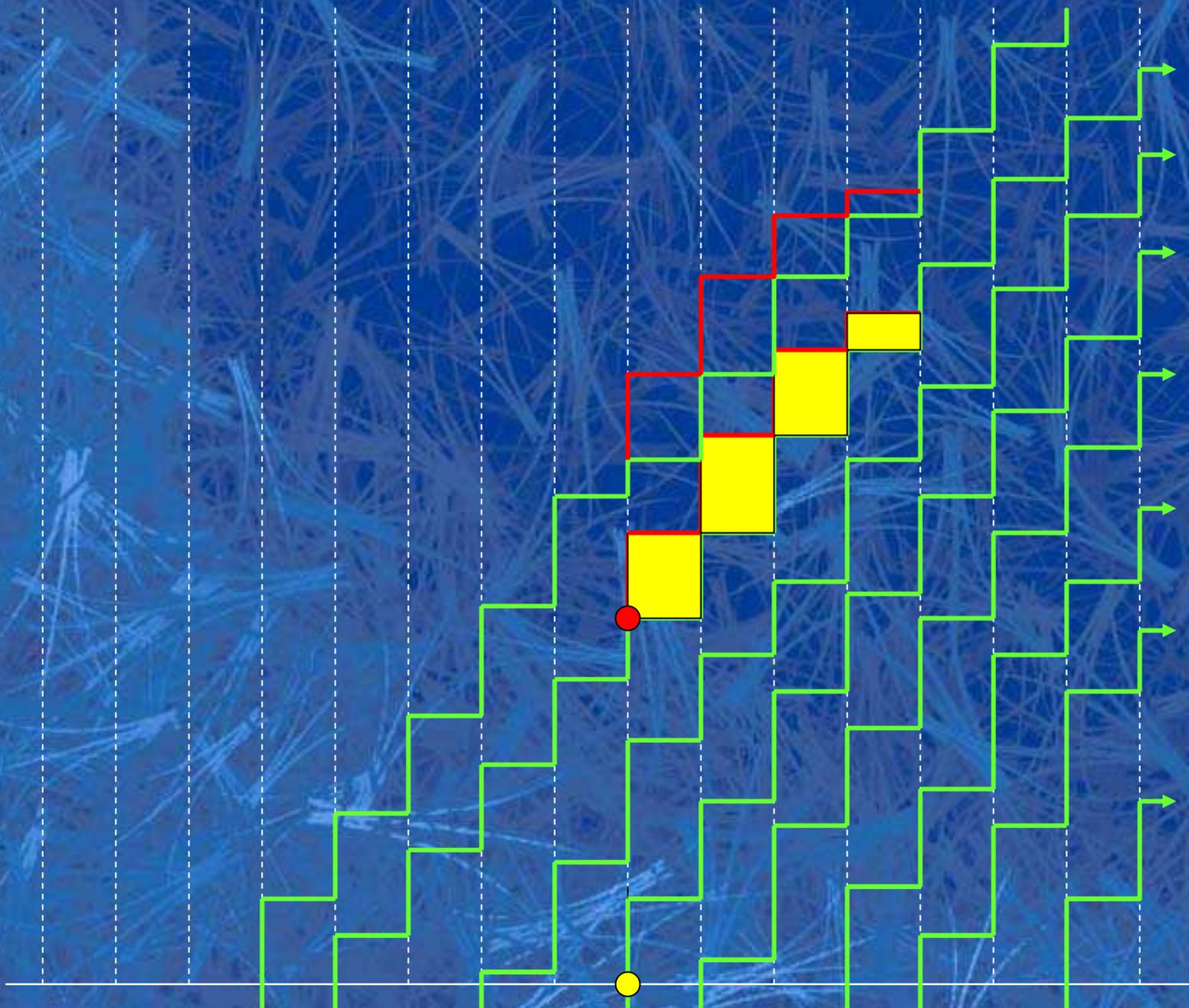
- Droplet growth representation.

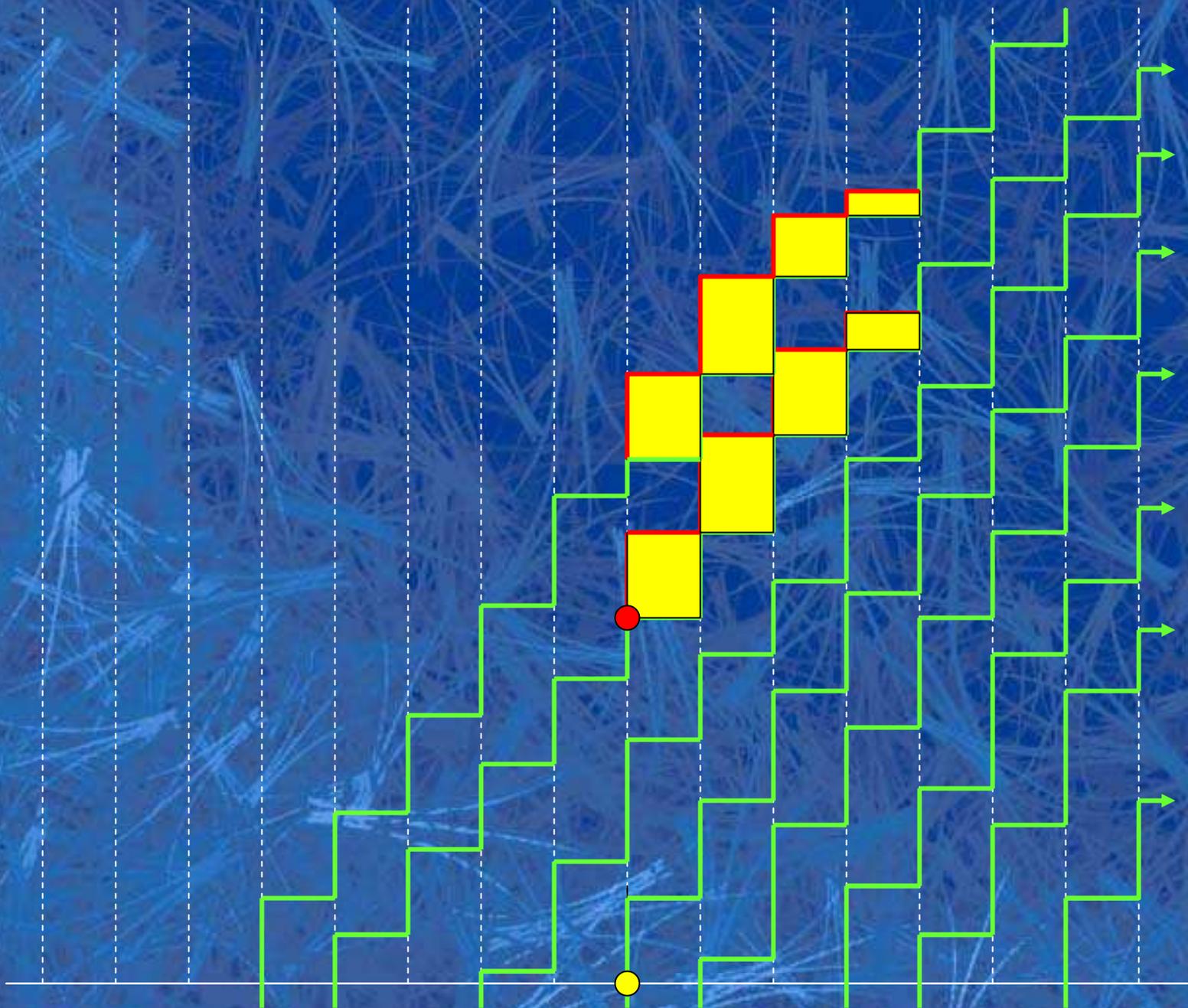










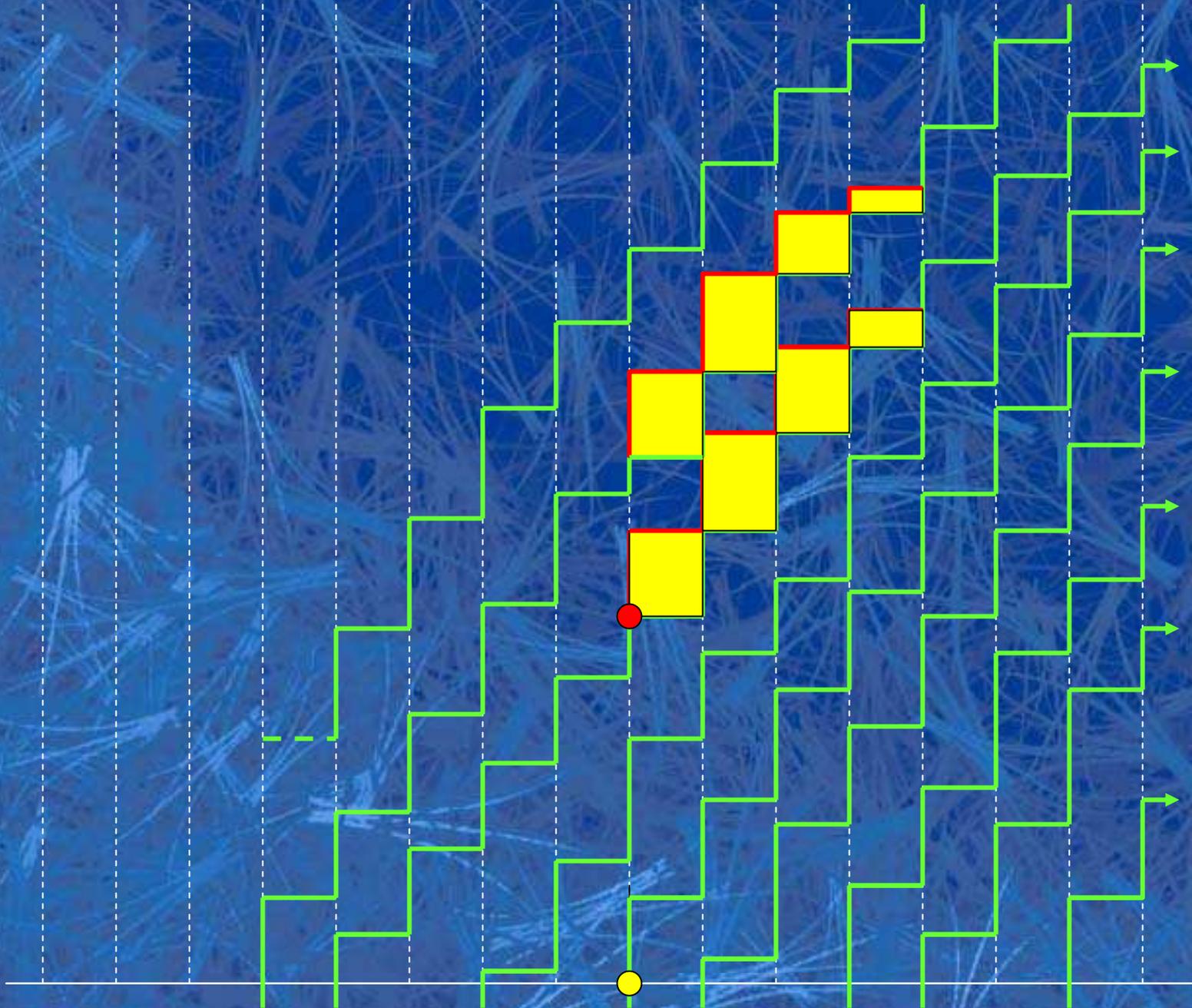




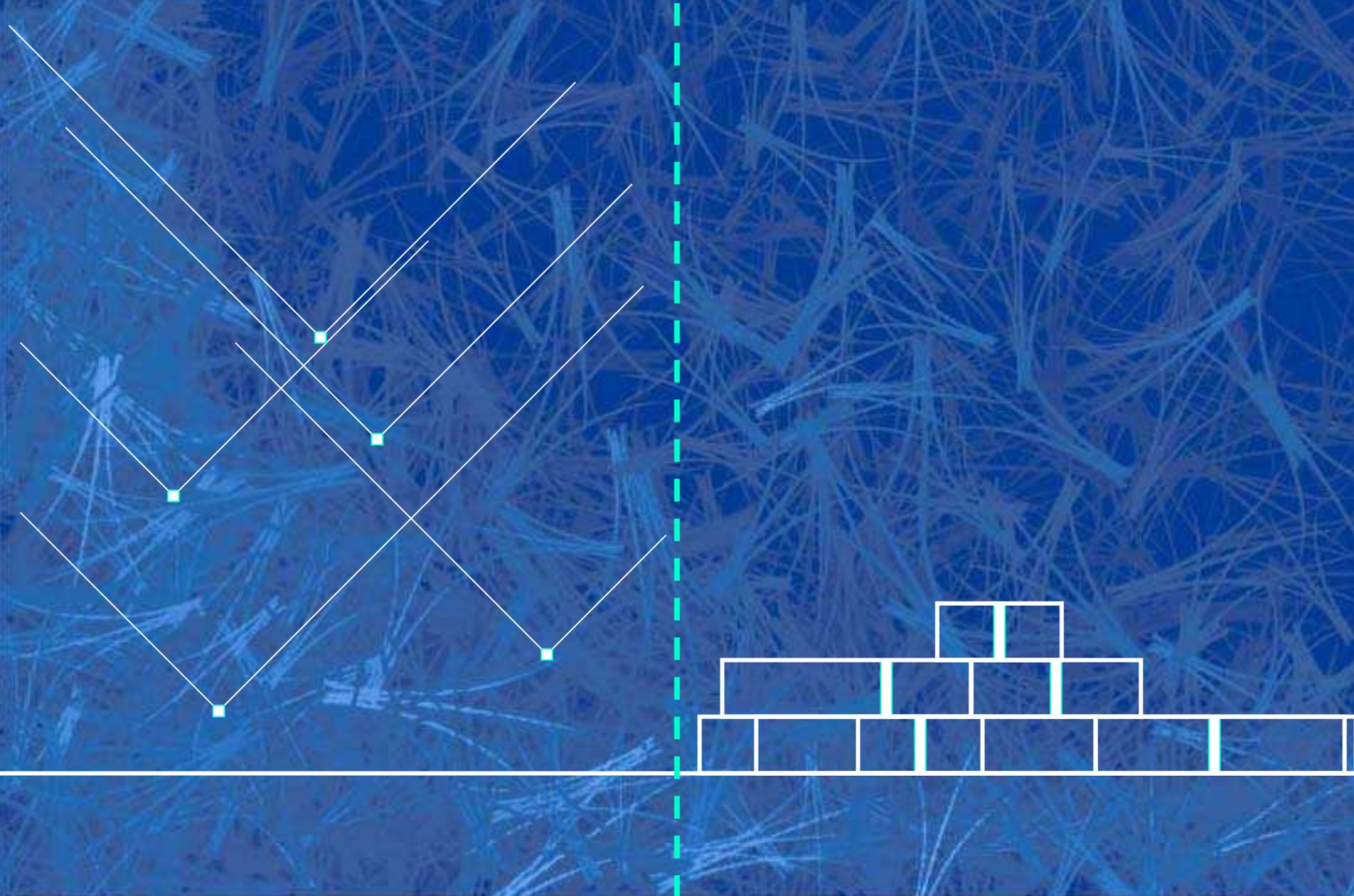




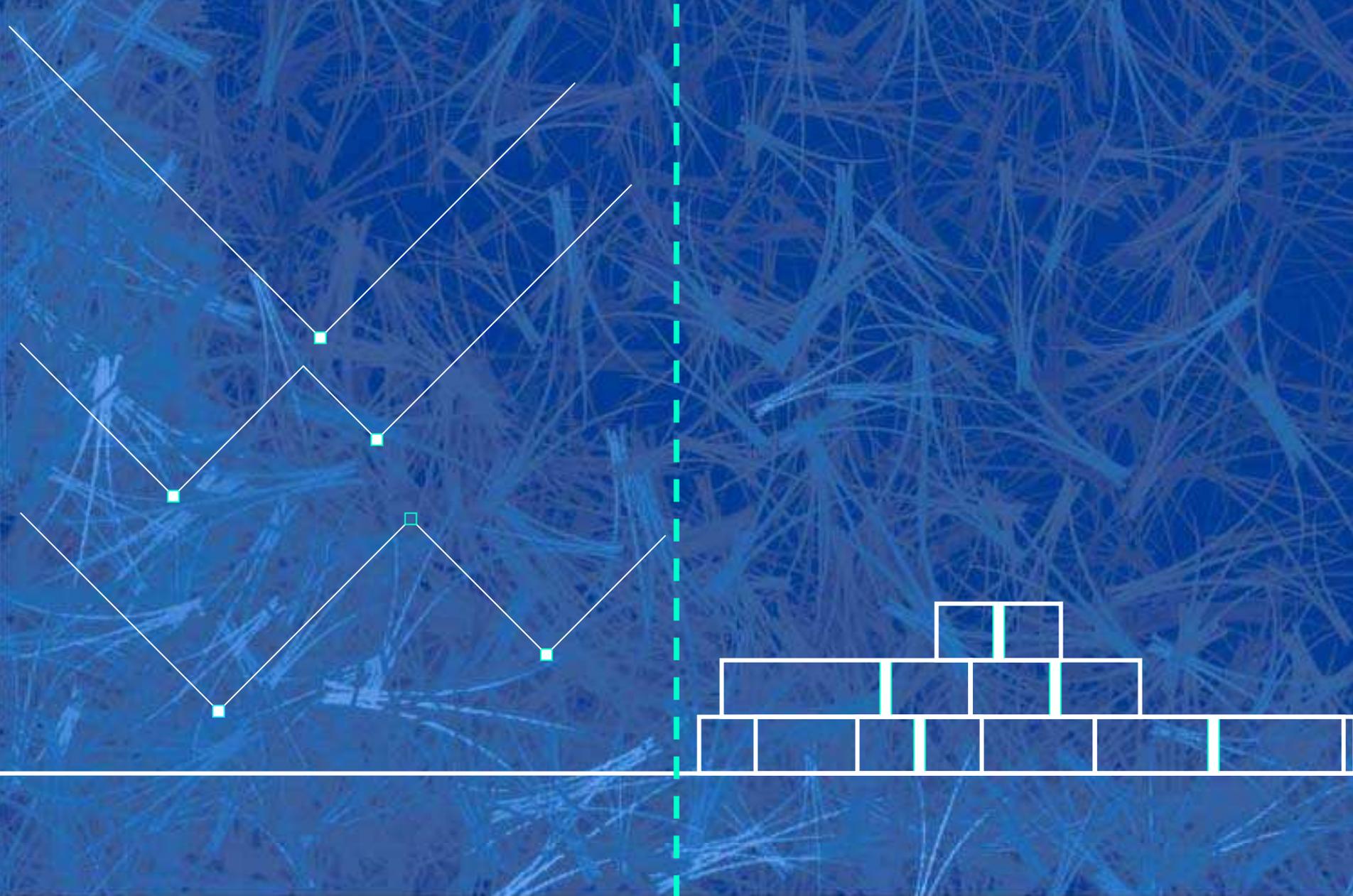


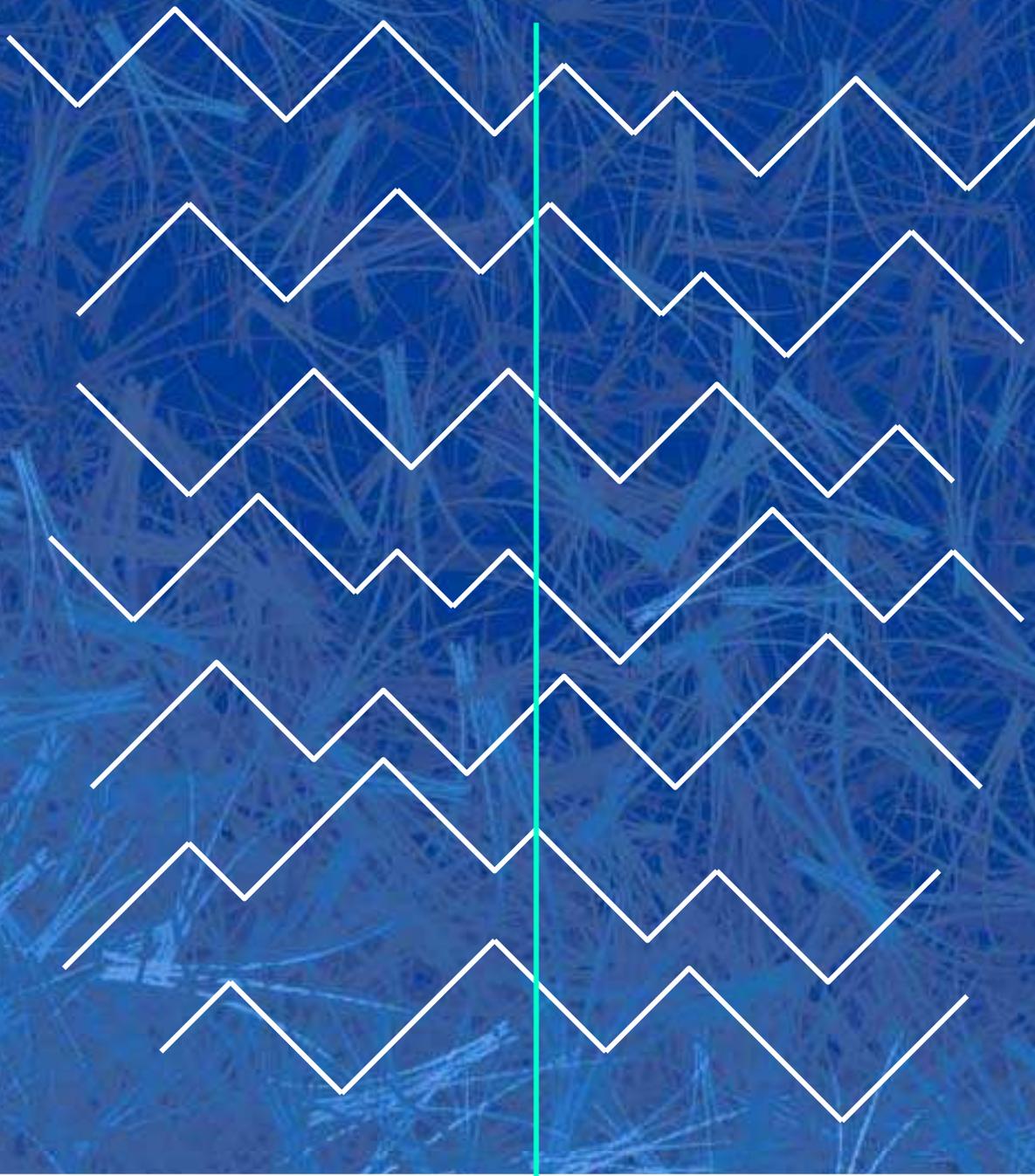


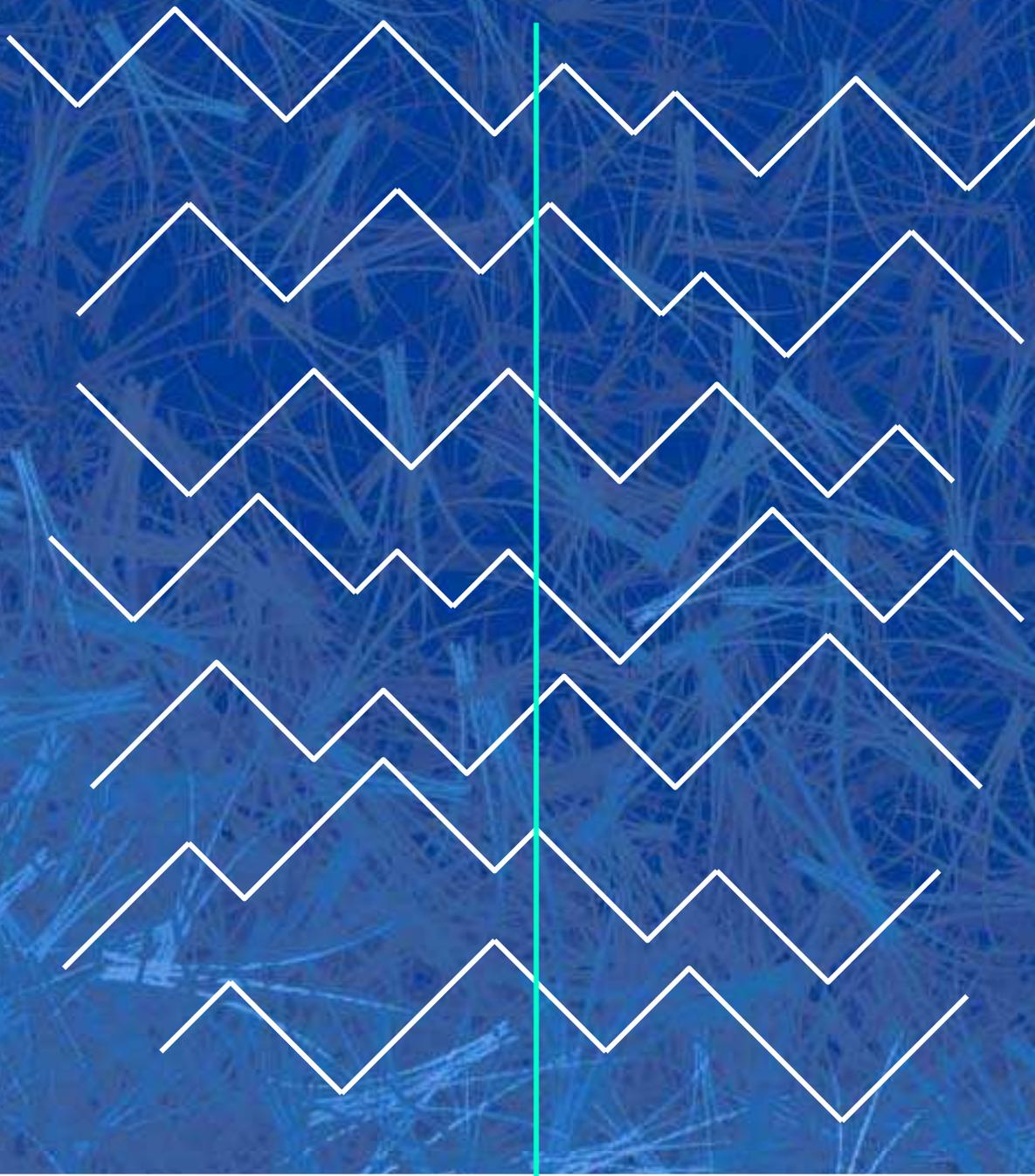
# Polynuclear Growth Model - PNG

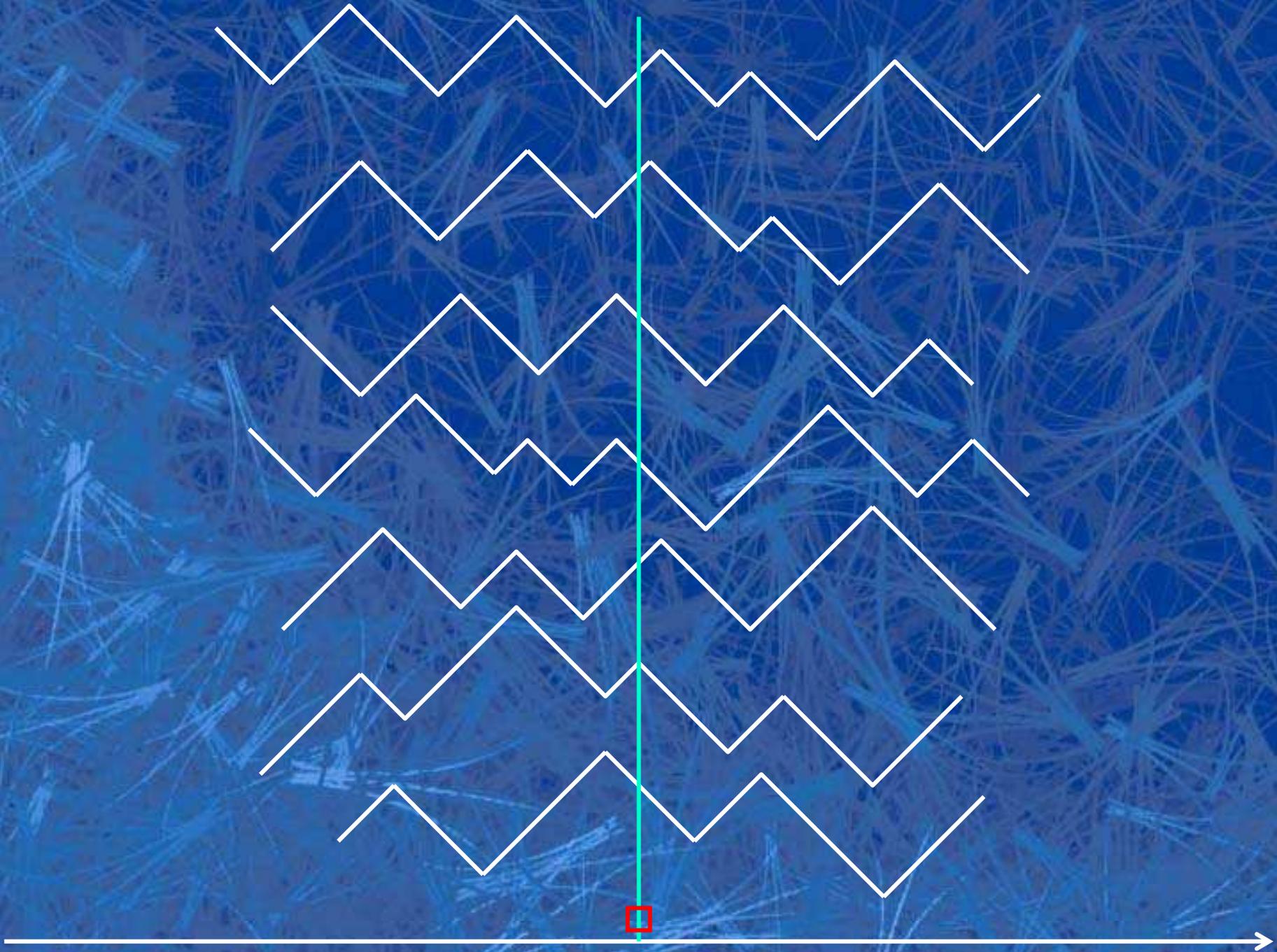


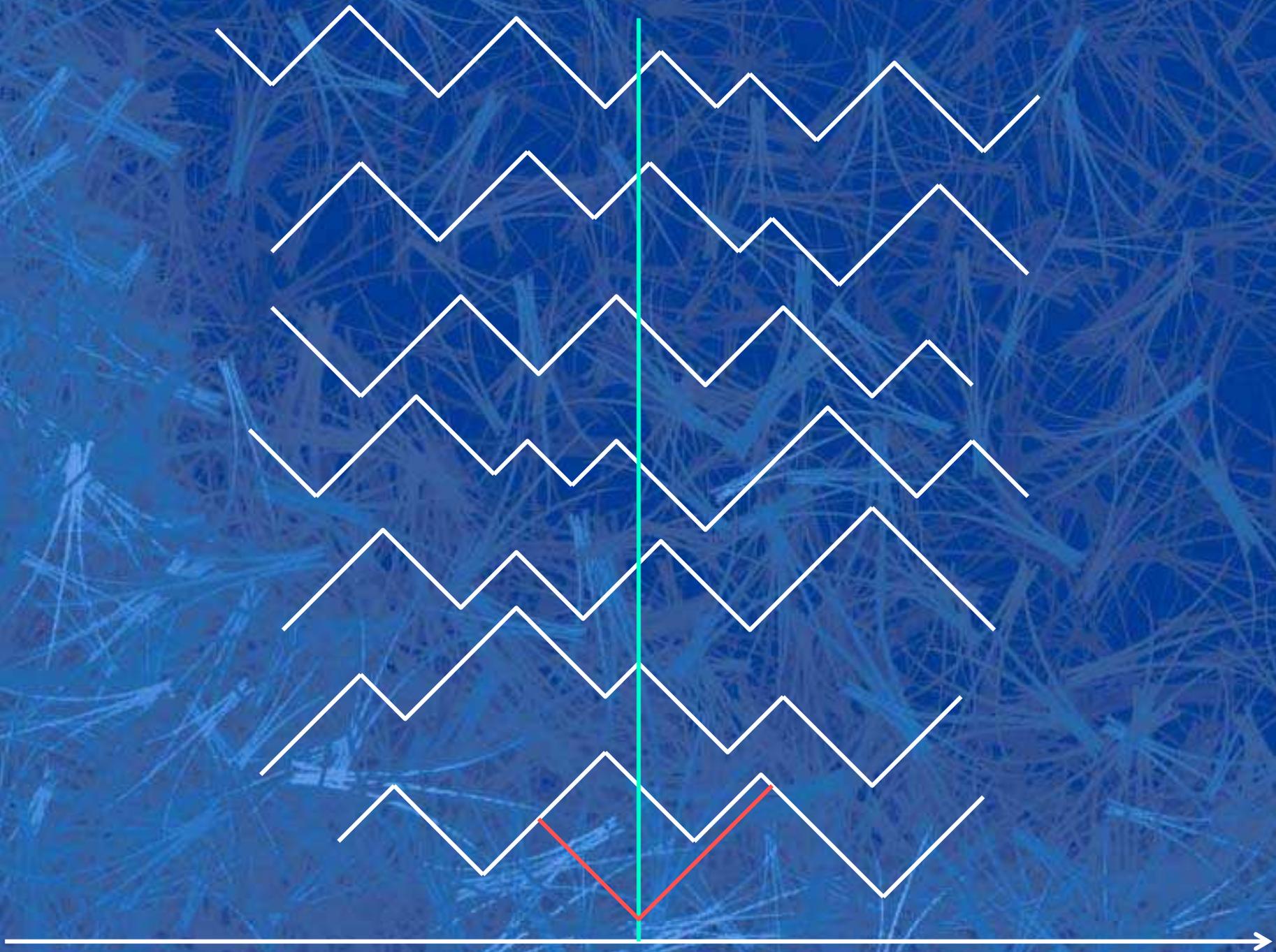
# Polynuclear Growth Model - PNG

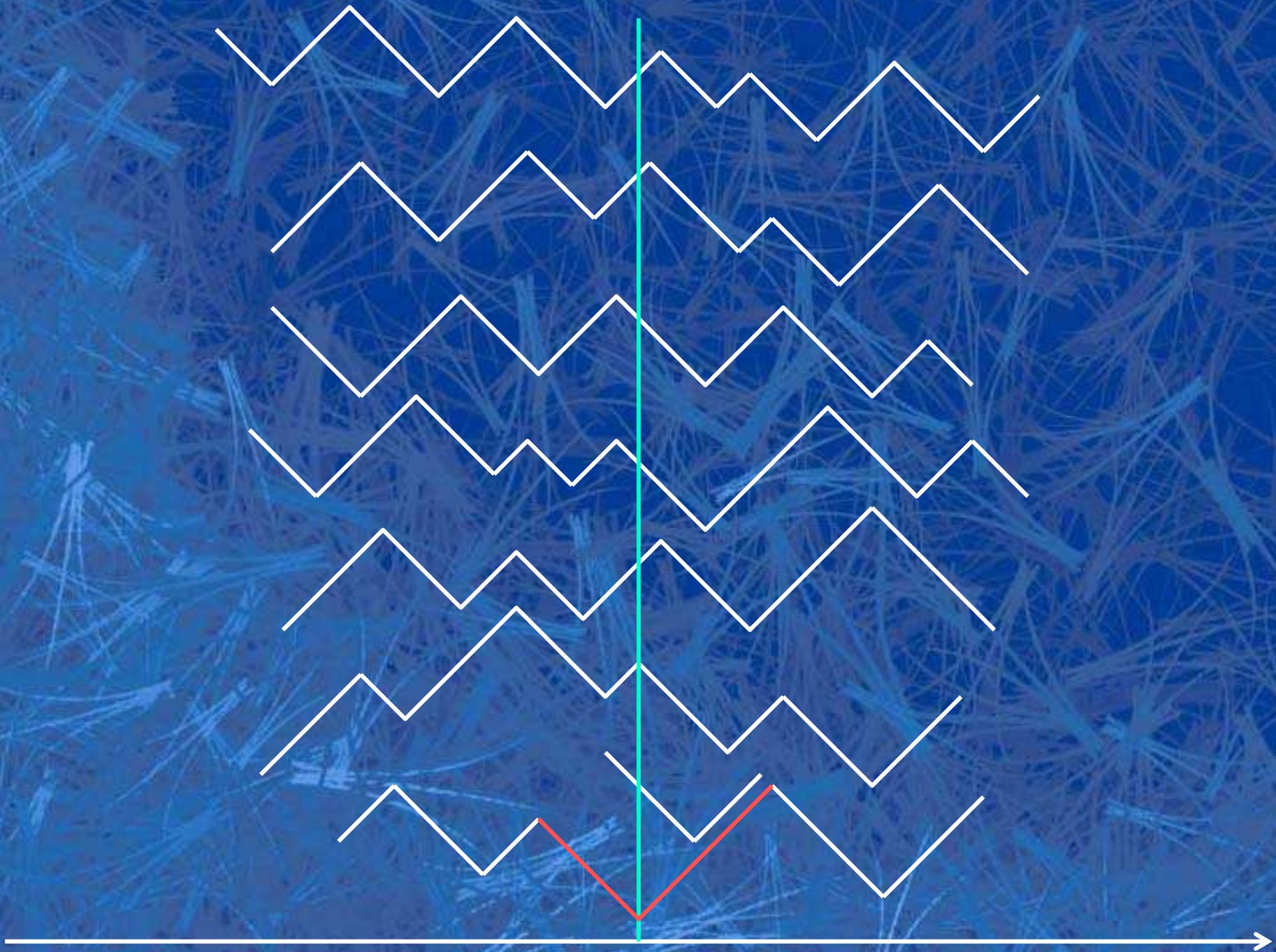


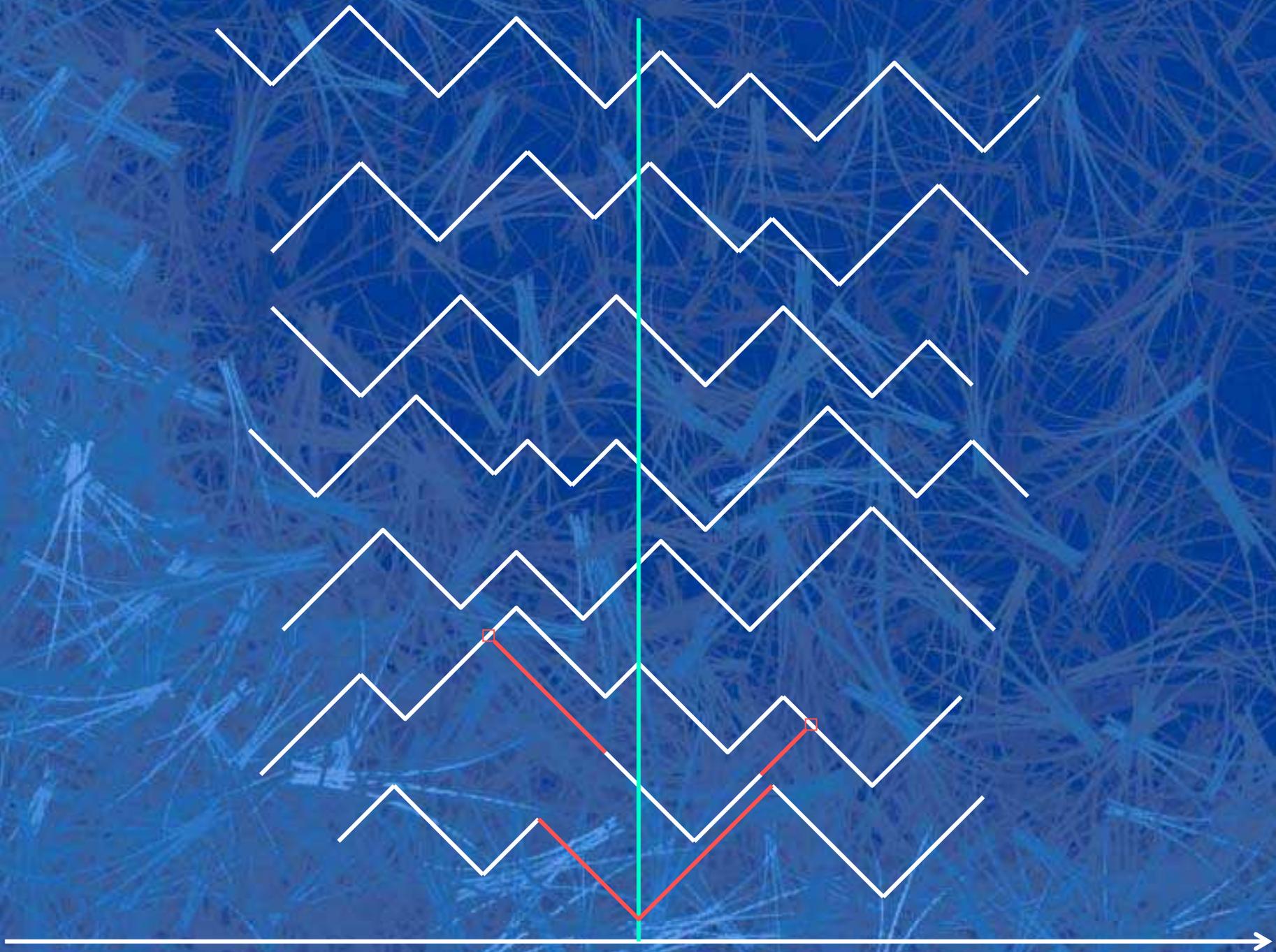






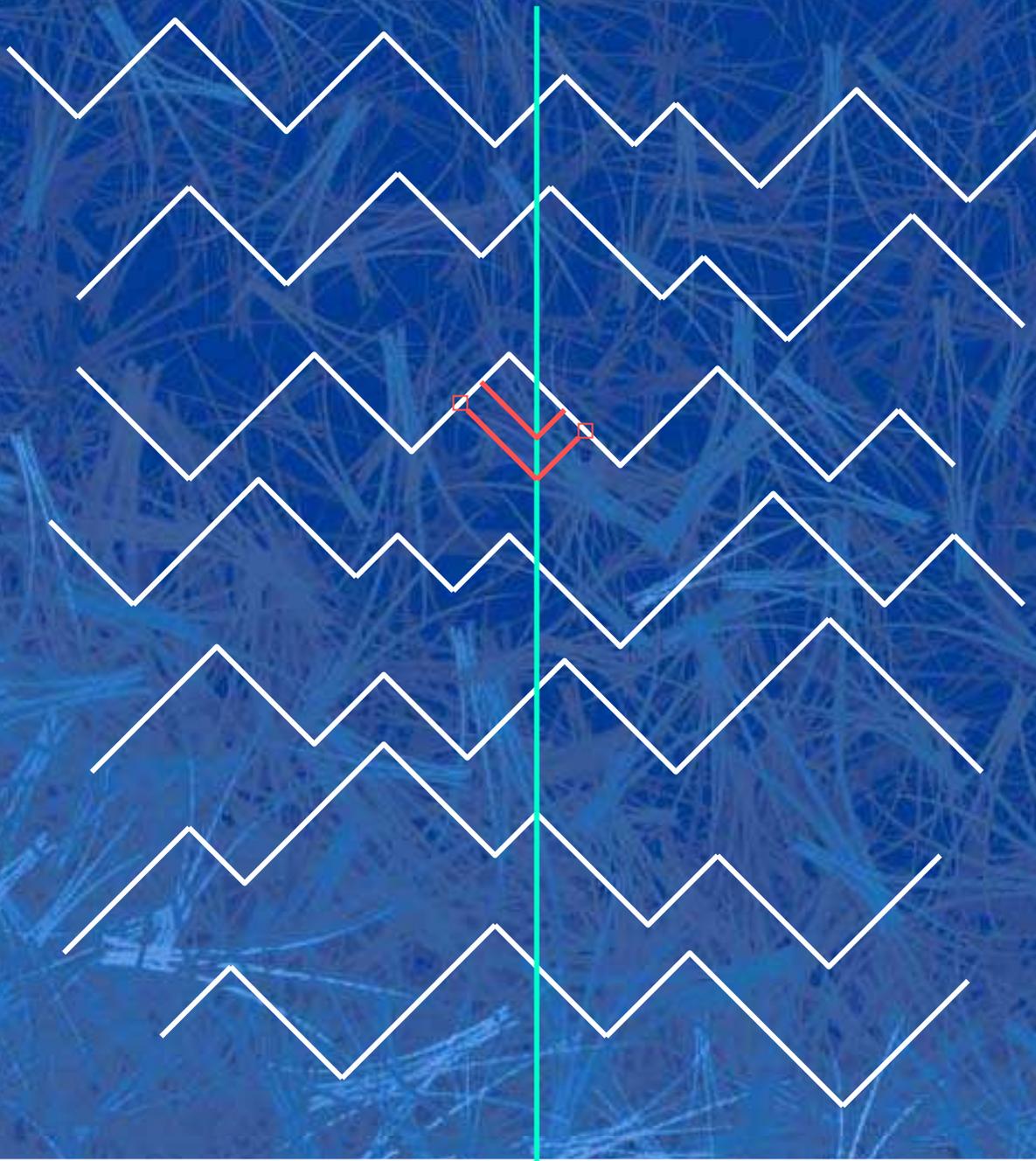


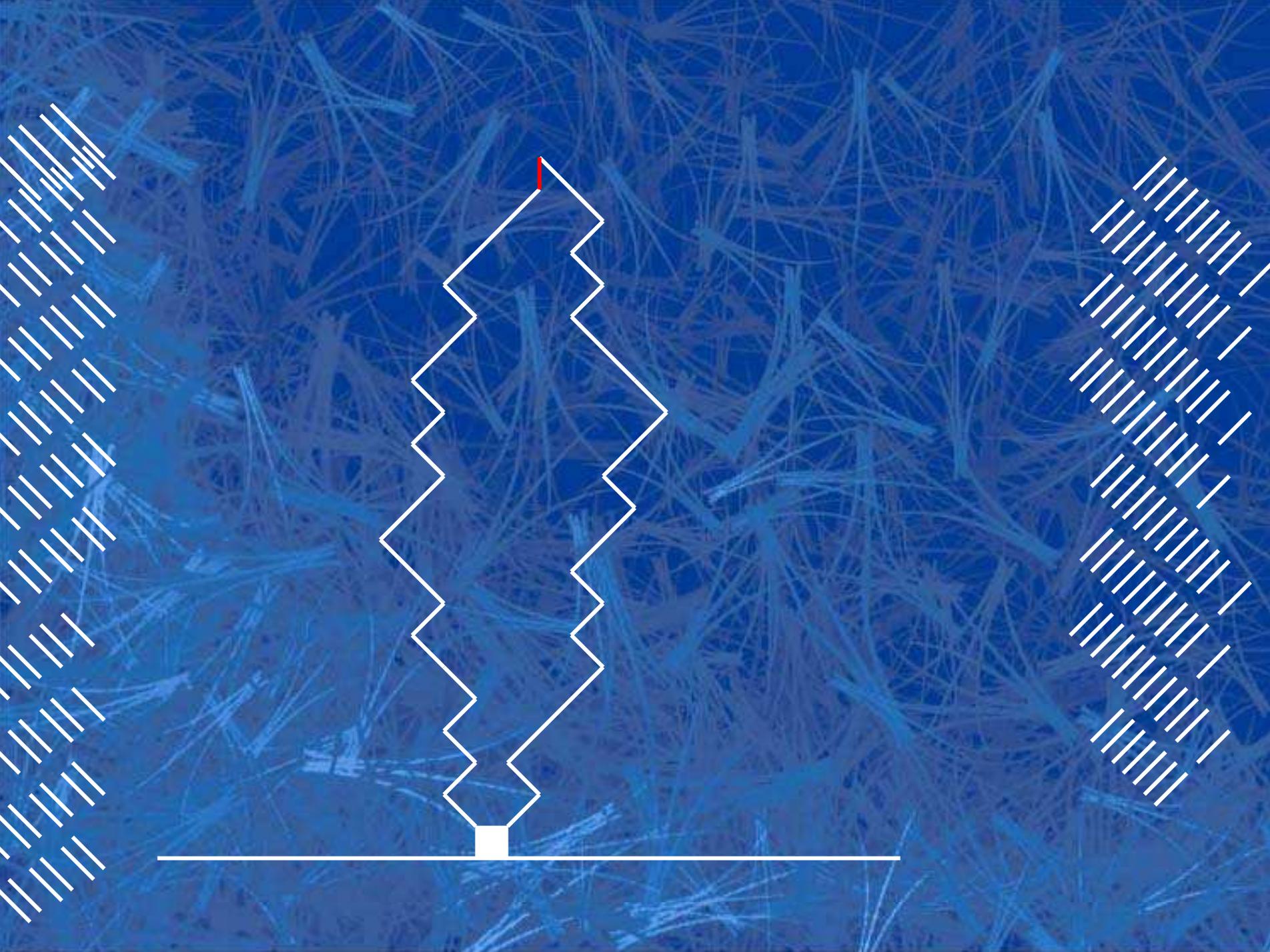


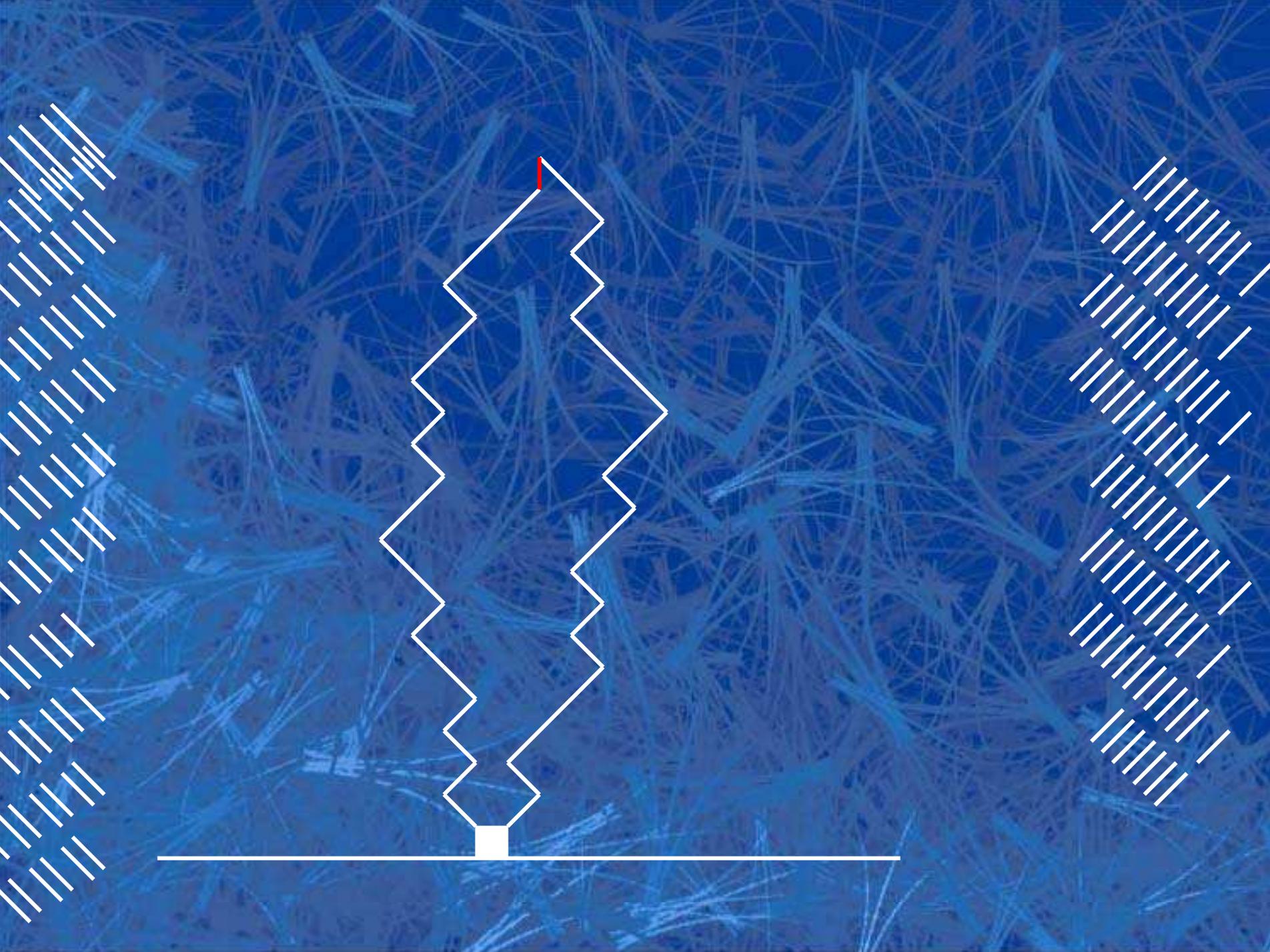








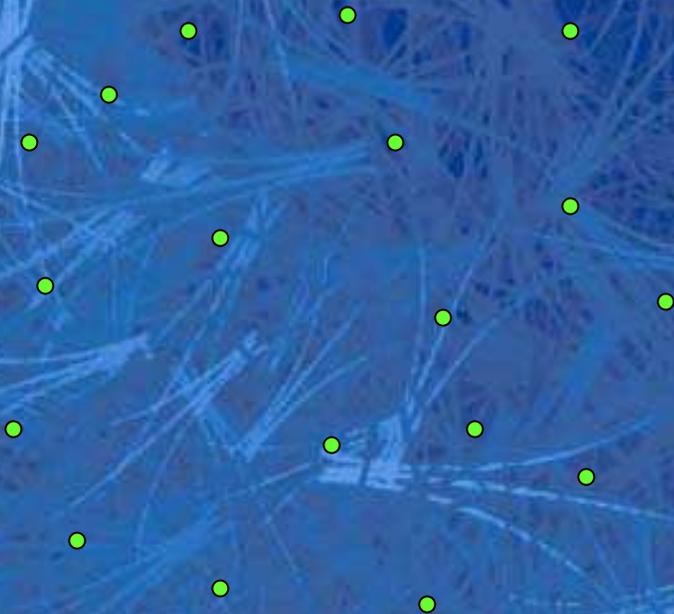




# Polynuclear growth (PNG)

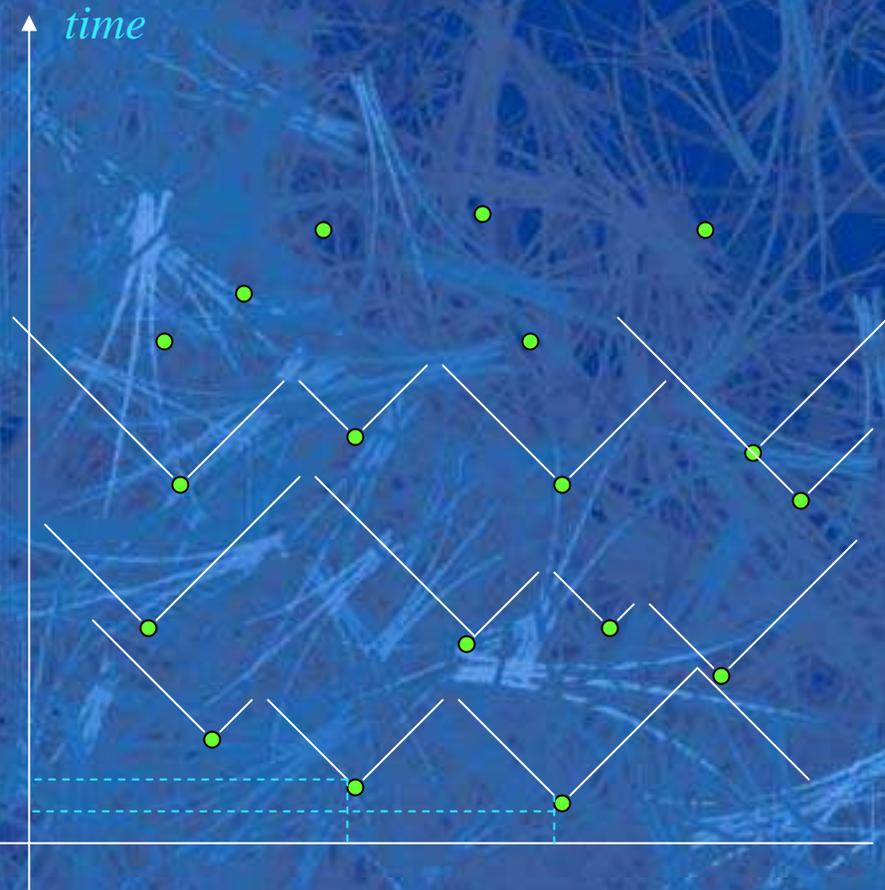
The above growth model is particular case of PNG model with columnar defect at one site. (Ulam's problem)

Poisson<sub>2</sub> (1)



# Polynuclear growth (PNG)

The above growth model is particular case of PNG model with columnar defect at one site. (Ulam's problem)

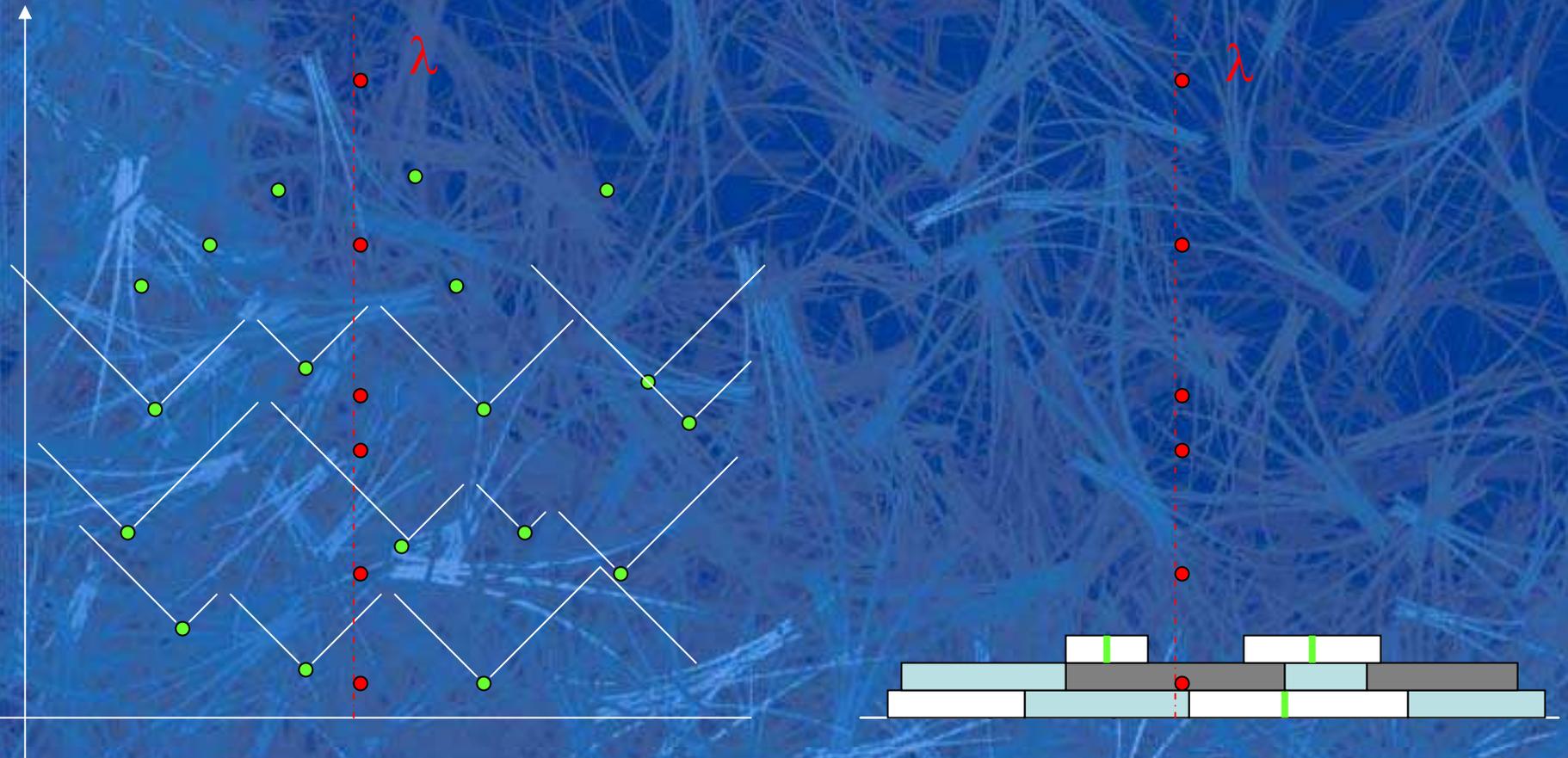


Height of the droplet above given point equals to the number of level lines. [AD]



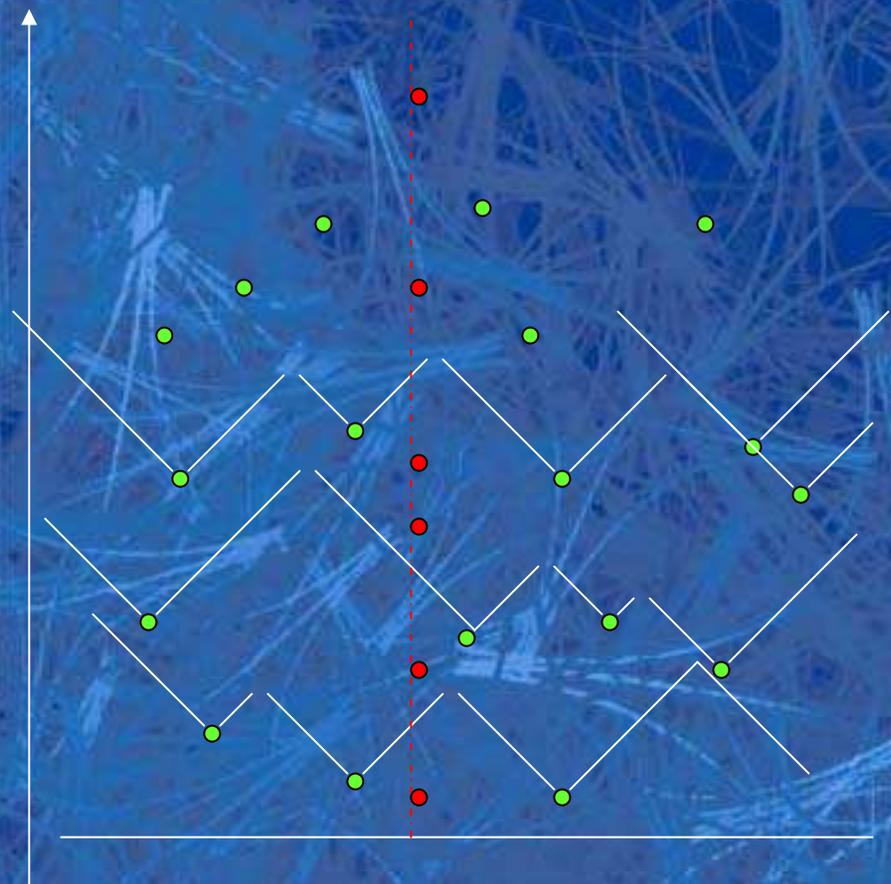
# Polynuclear growth (PNG)

The above growth model is particular case of PNG model with columnar defect at one site. (Ulam's problem)



LLN for level lines.

Theorem (V. Beffara, V.S. 2006) For polynuclear growth model  $\lambda_c = 0$



Proof. Basic ingredients:

“Half-space case” – J. Baik, E.M. Rains (1999) [BDJ]  
T. Sasamoto, T. Imamura (2003)  
 $\lambda_c$  (half) =  $2^{1/2}$ .

From half space to full space:

“Intersection process” is stationary,  
with intensity is  $2^{3/2}$ , (not Poisson).  
[V.S., D. Surgailis, M.E.Vares, 1999]

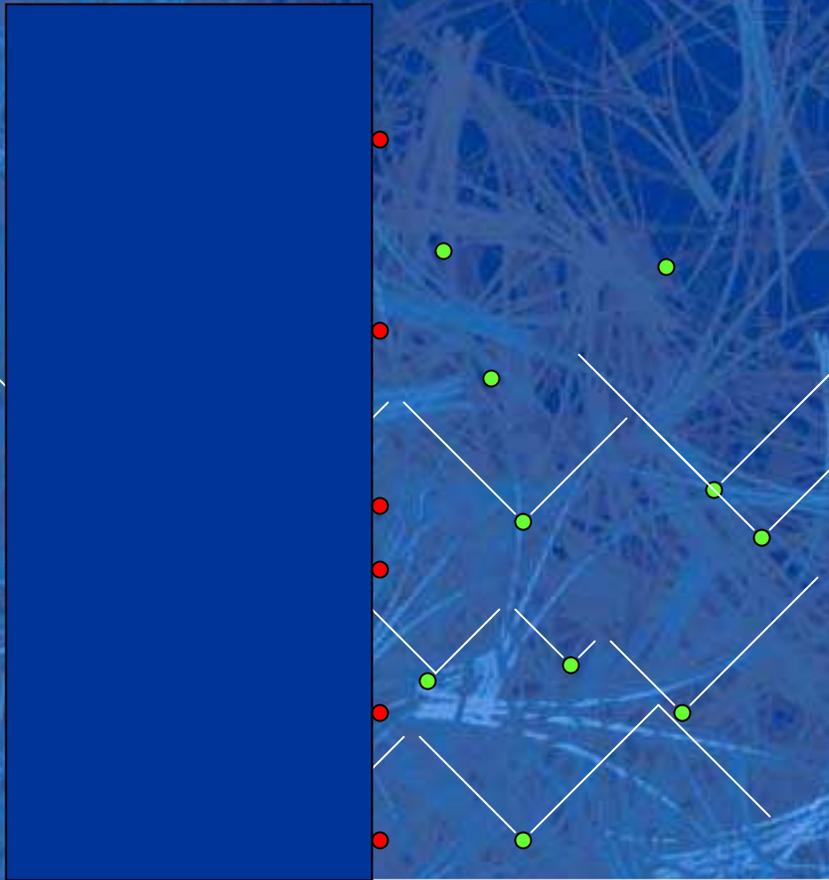
**Coupling I:**

Half-space + Poisson ( $2^{1/2} + \varepsilon$ ) with  
full space process restricted to the  
half plane + Poisson ( $\varepsilon_1$ )  $\Rightarrow$

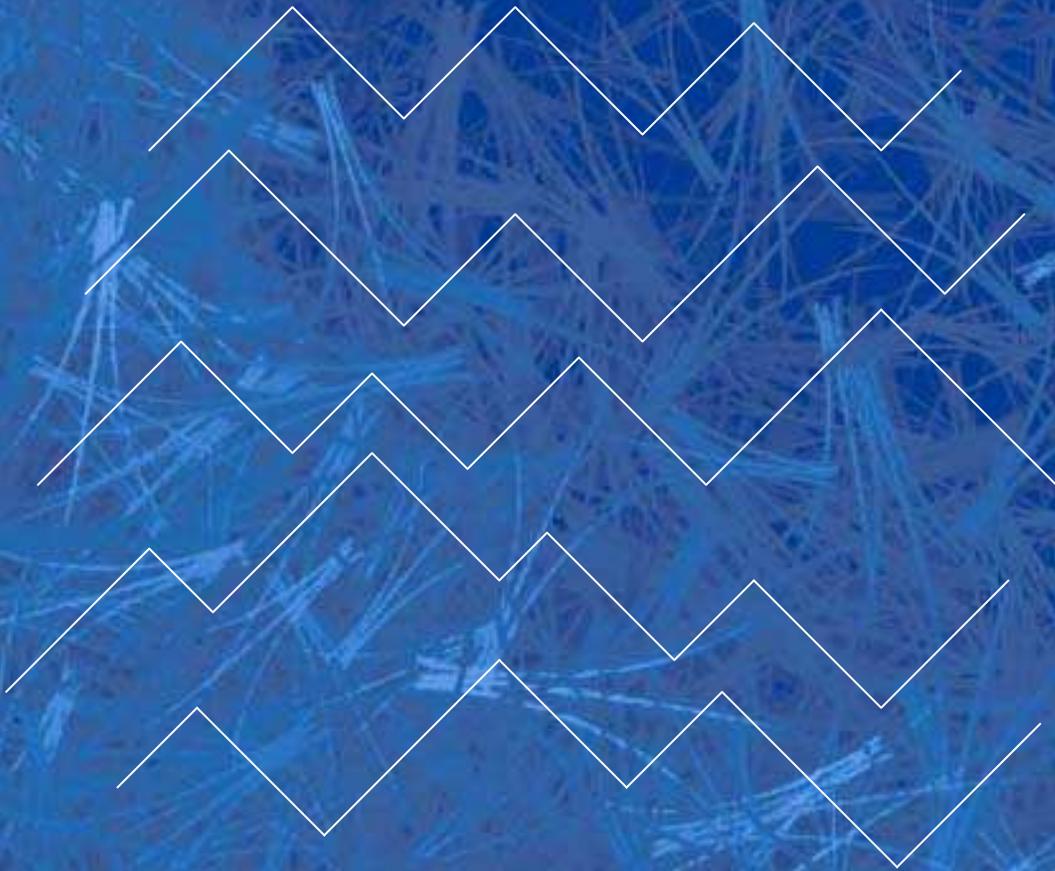
$\lambda_c$  (restricted) = 0

**Coupling II:**

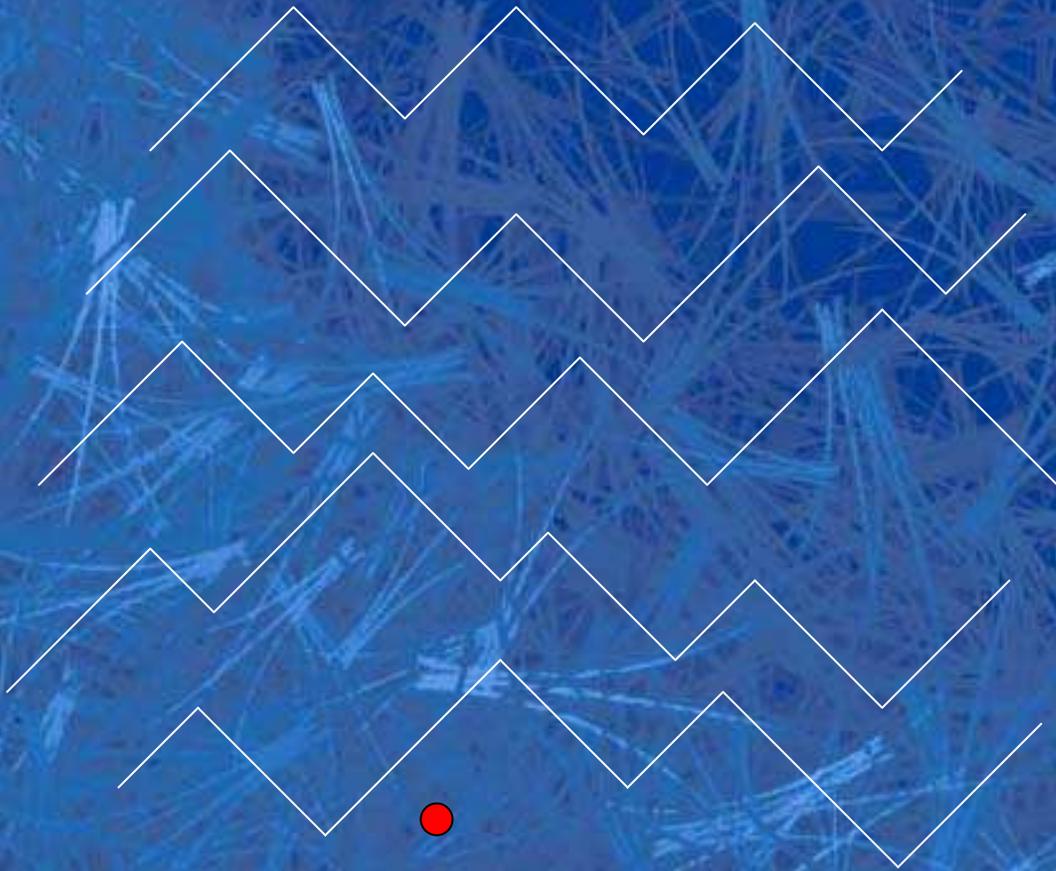
Two restricted processes + Poisson ( $\varepsilon_1$ )  
with full space process + Poisson ( $\varepsilon_2$ )



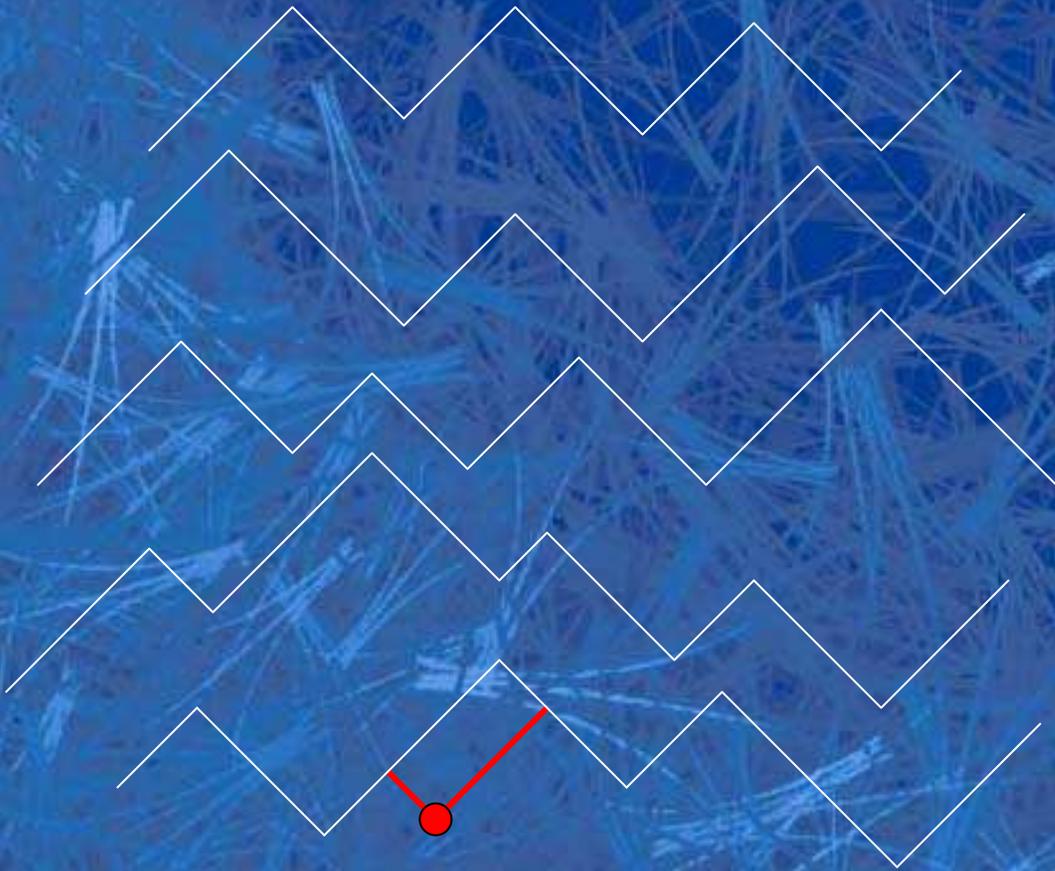
# Percolation of “influence”



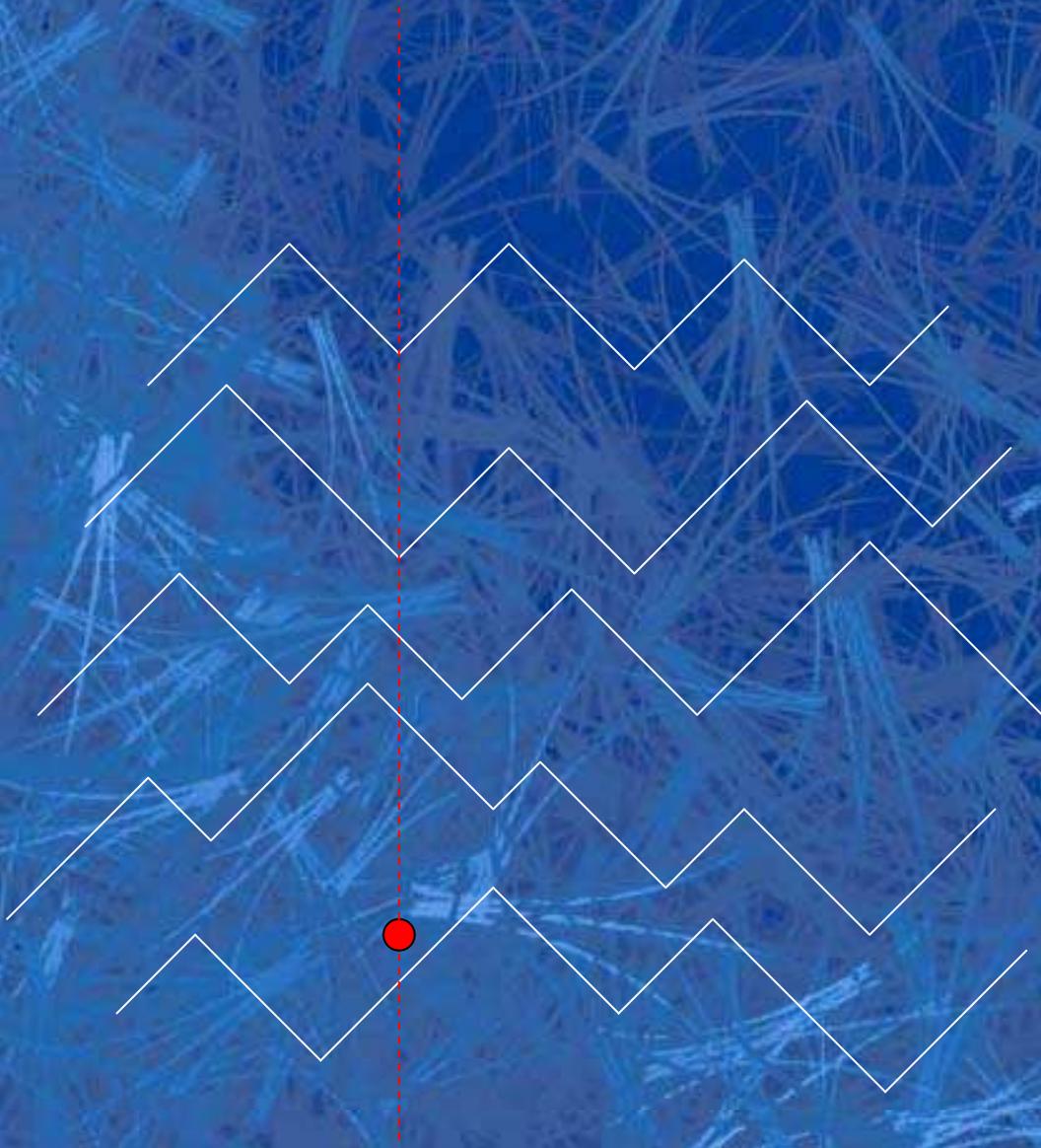
# Percolation of “influence”



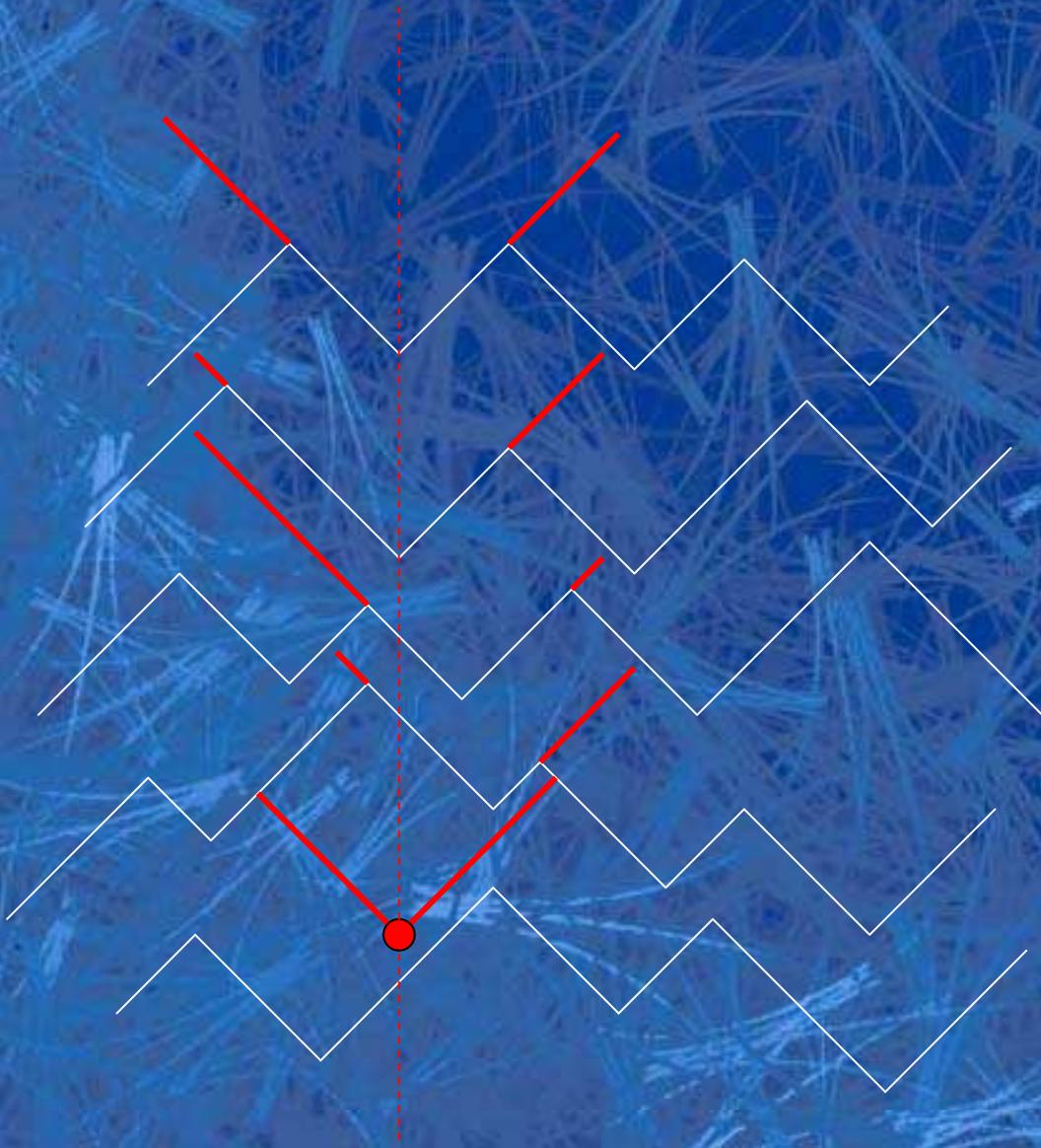
# Percolation of “influence”



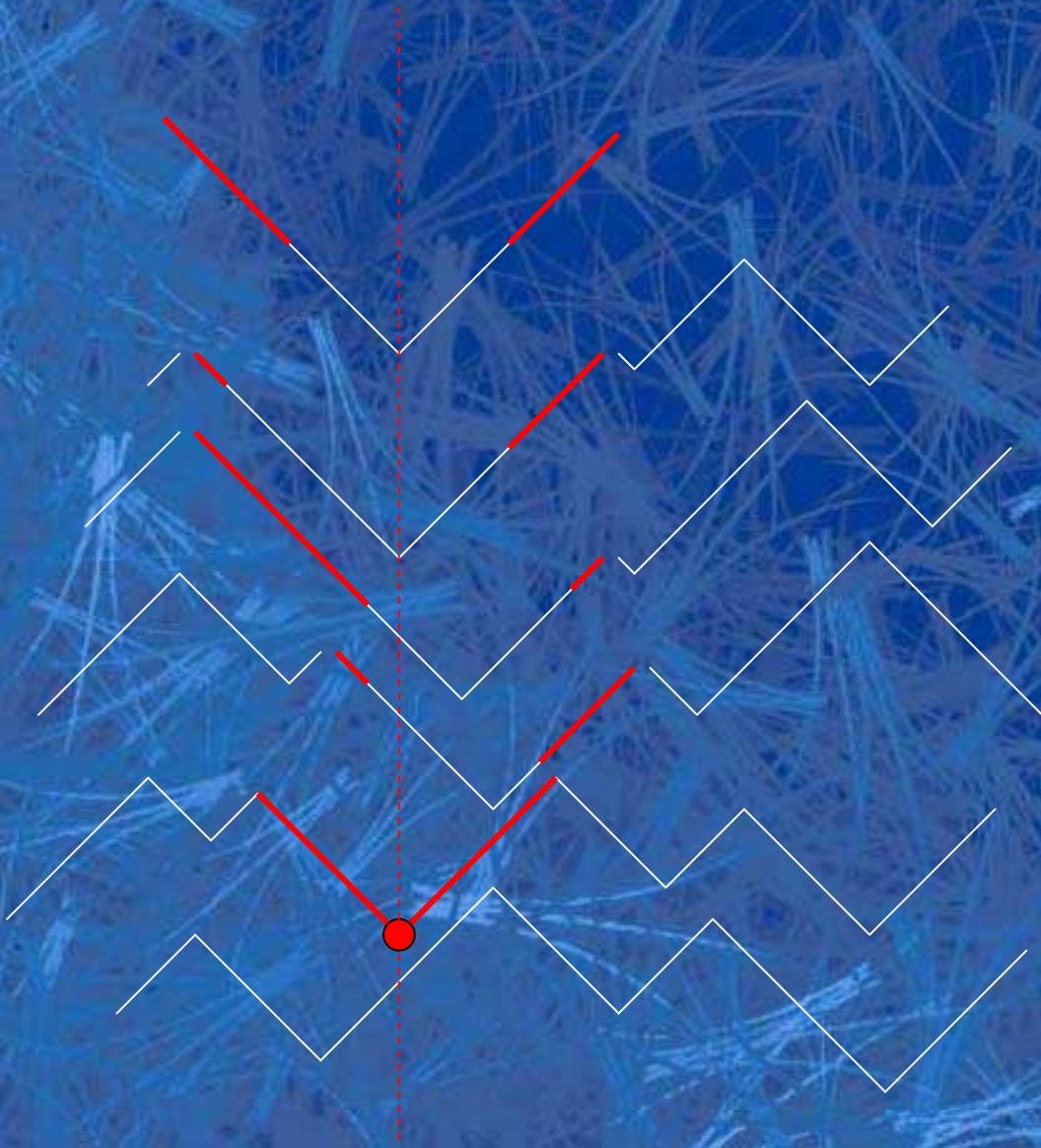
# Percolation of “influence”



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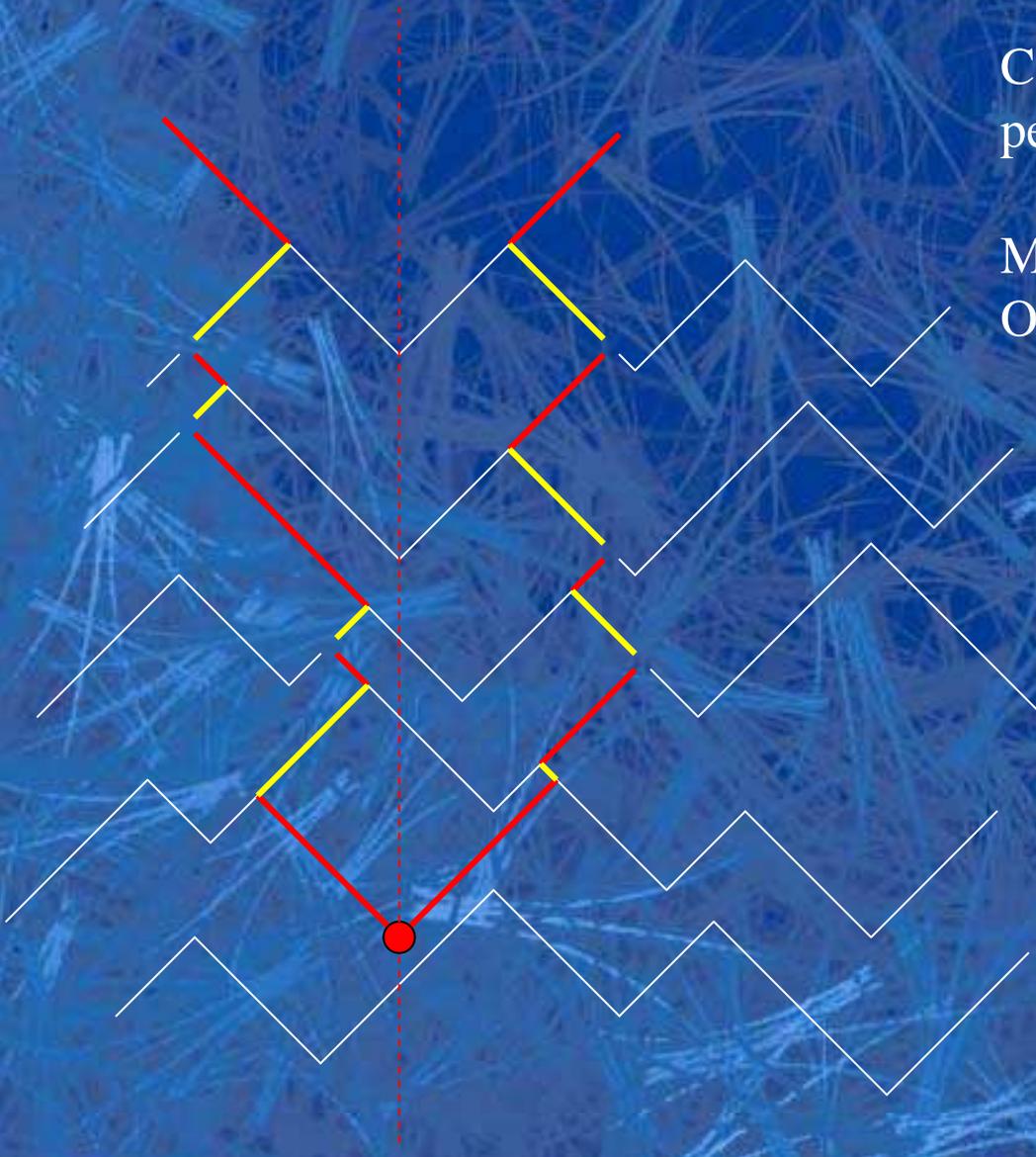
# Percolation of “influence”



# Percolation of “influence”

Class of one dimensional long-range percolation models with heavy tails.

M. Aizenman, C.M. Newman (1986)  
One-sided Cauchy case



# Randomized Polynuclear growth (RPNG)

After nucleation the velocity process of each boundary is a two state Markov which flips at rate  $\zeta > 0$ .

Theorem (V. Beffara, V.S., M.E. Vares, 2006) For randomized polynuclear growth model  $\lambda_c(\zeta) > 0$ , for all  $\zeta > 0$ .

