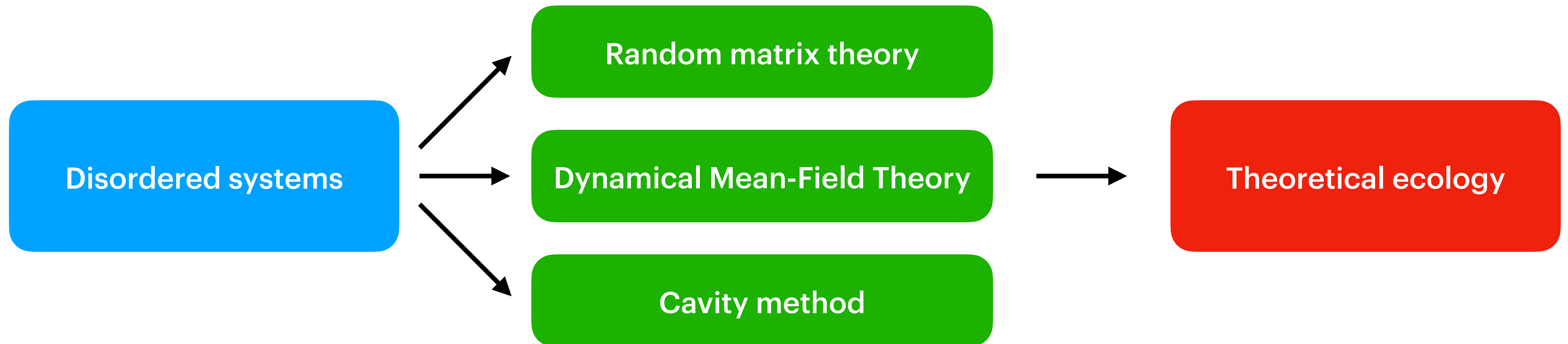


# Advances in the modelling of ecological communities

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# Brief bio

- Theoretical physicist by training
- PhD candidate at University of Padua with Amos Maritan
- Research: disordered system approach to theoretical ecology



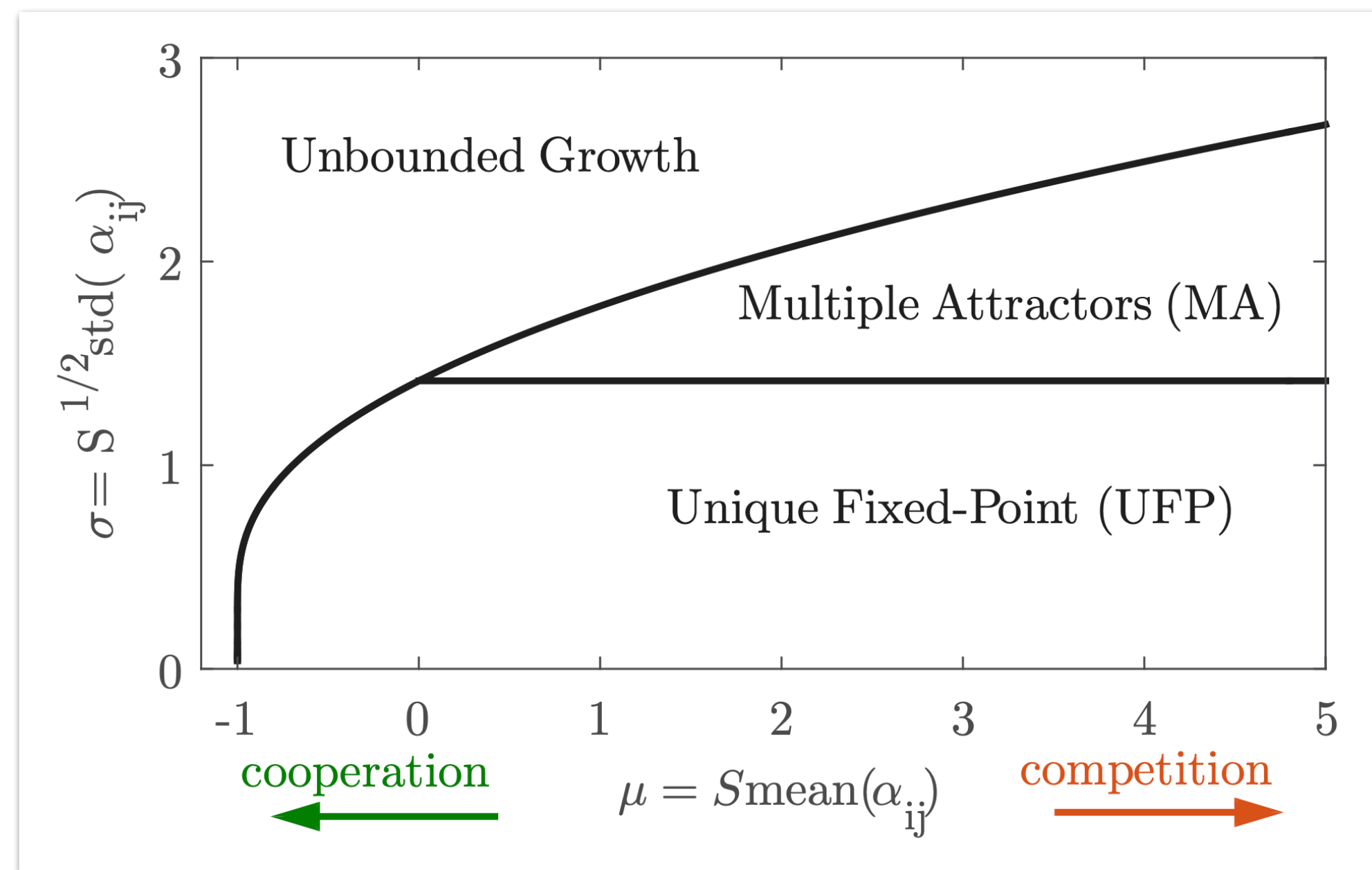
# Modeling ecological communities

- **Disordered** Lotka-Volterra equation

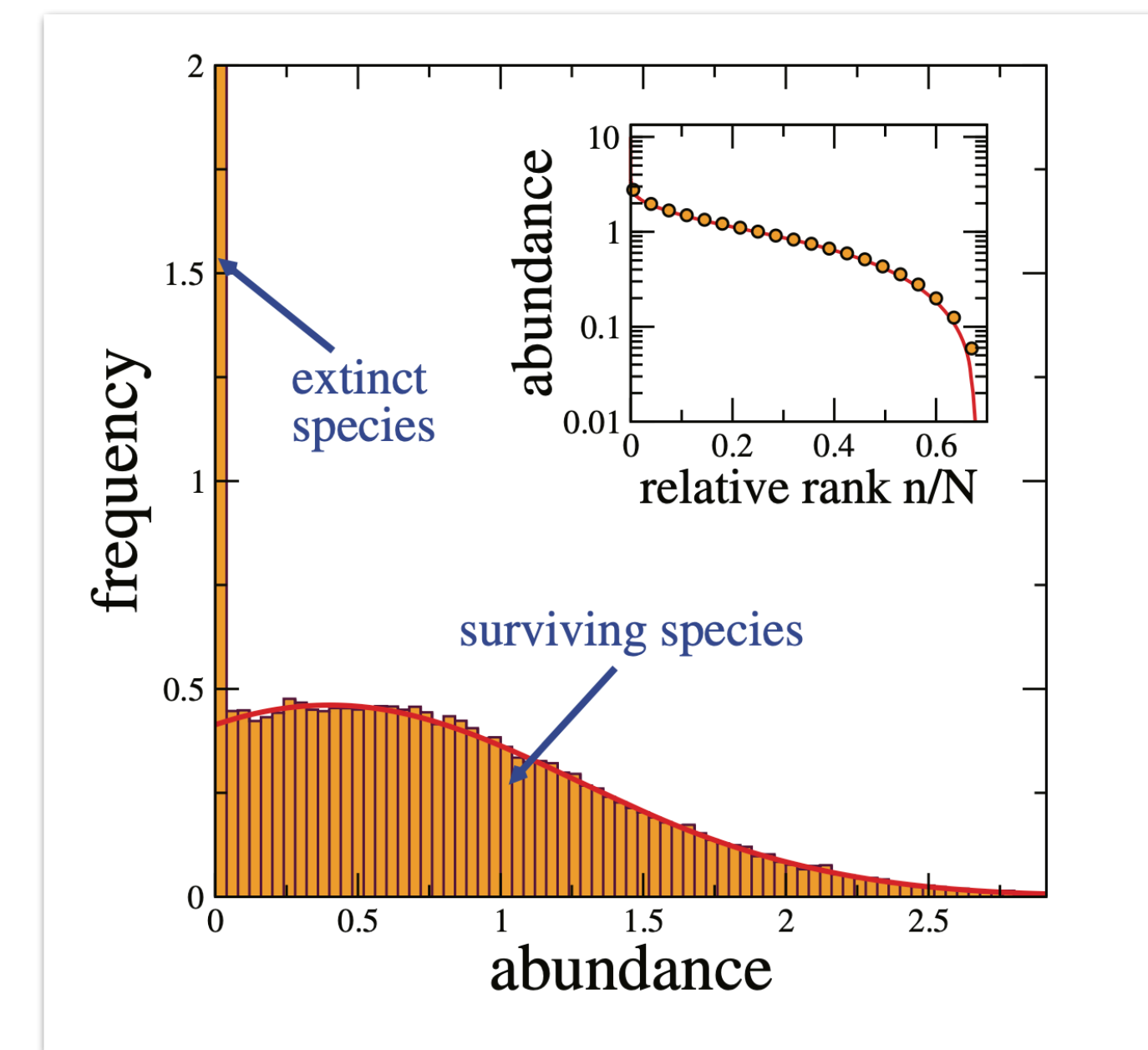
$$\dot{N}_i = N_i \left[ 1 - N_i + \sum_{j \neq i} \alpha_{ij} N_j \right]$$

$$E(\alpha_{ij}) = \mu/S$$

$$\text{Var}(\alpha_{ij}) = \sigma^2/S$$



[Bunin PRE 2017]



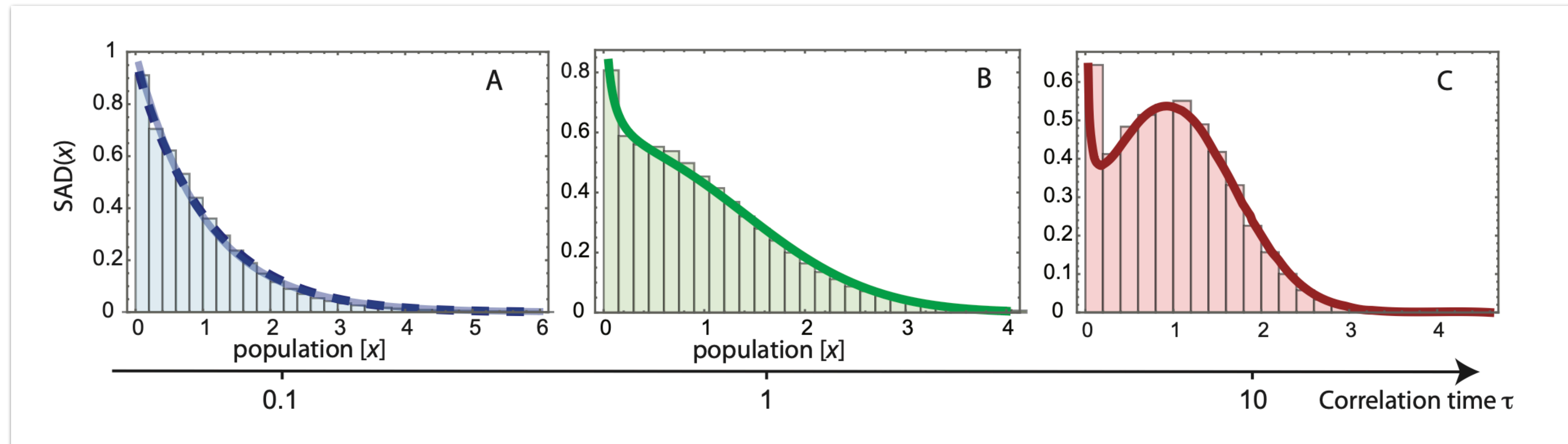
[Galla EPL 2018]

# Time-dependent interactions

- Lotka-Volterra equation with **annealed** disorder

$$\dot{N}_i = N_i \left[ 1 - N_i + \sum_{j \neq i} \alpha_{ij}(t) N_j \right]$$
$$\langle \alpha_{ij}(t) \rangle = \mu/S$$
$$\langle \alpha_{ij}(t) \alpha_{ij}(t') \rangle_c \propto \exp(-|t - t'|/\tau)$$

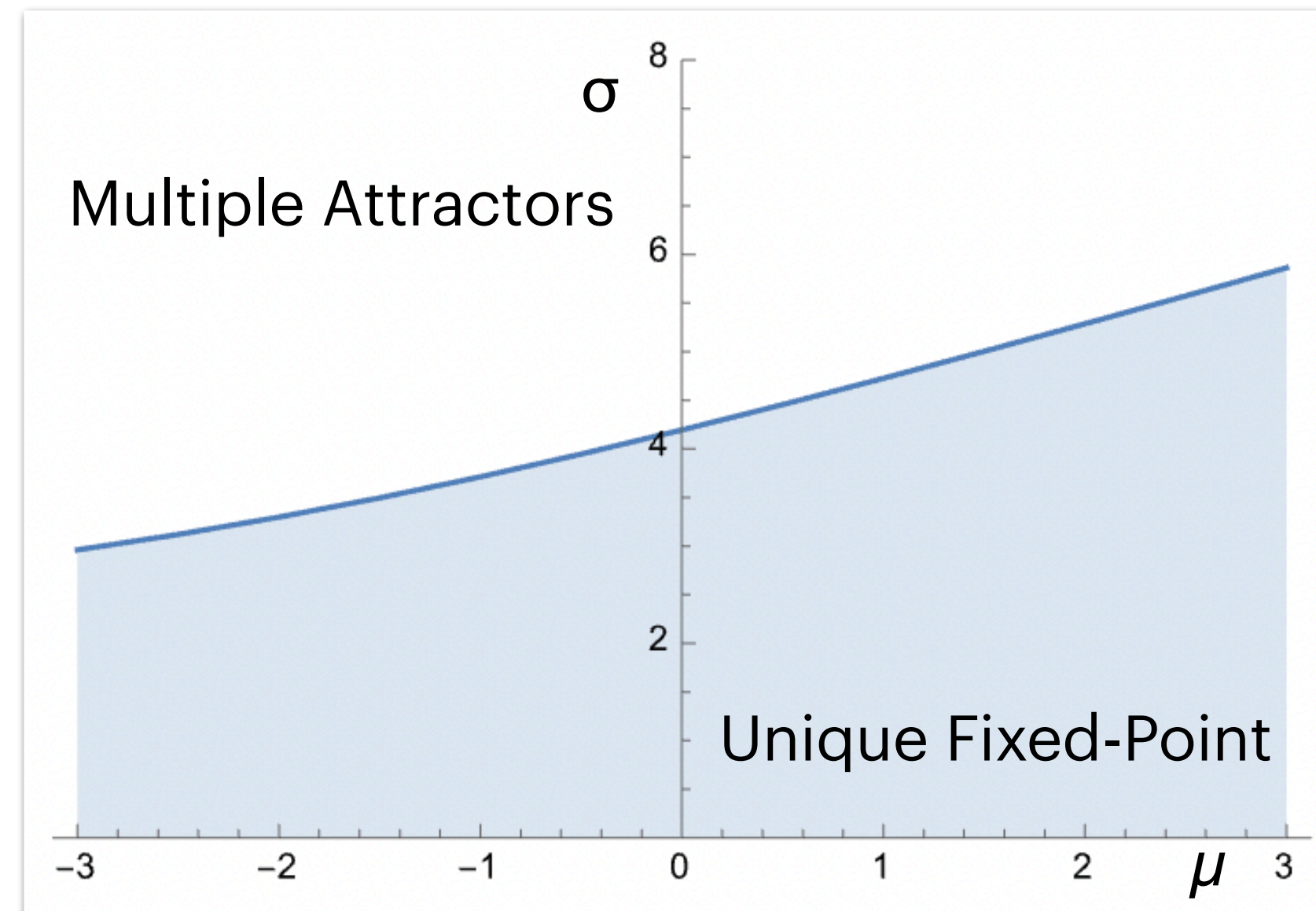
- SAD: interpolation between Gamma function and truncated Gaussian



# Saturation of interactions

$$\dot{N}_i = N_i \left[ 1 - N_i + \sum_{j \neq i} \alpha_{ij} J(N_j) \right] \quad J(N_j) = \frac{N_j}{K + N_j}$$

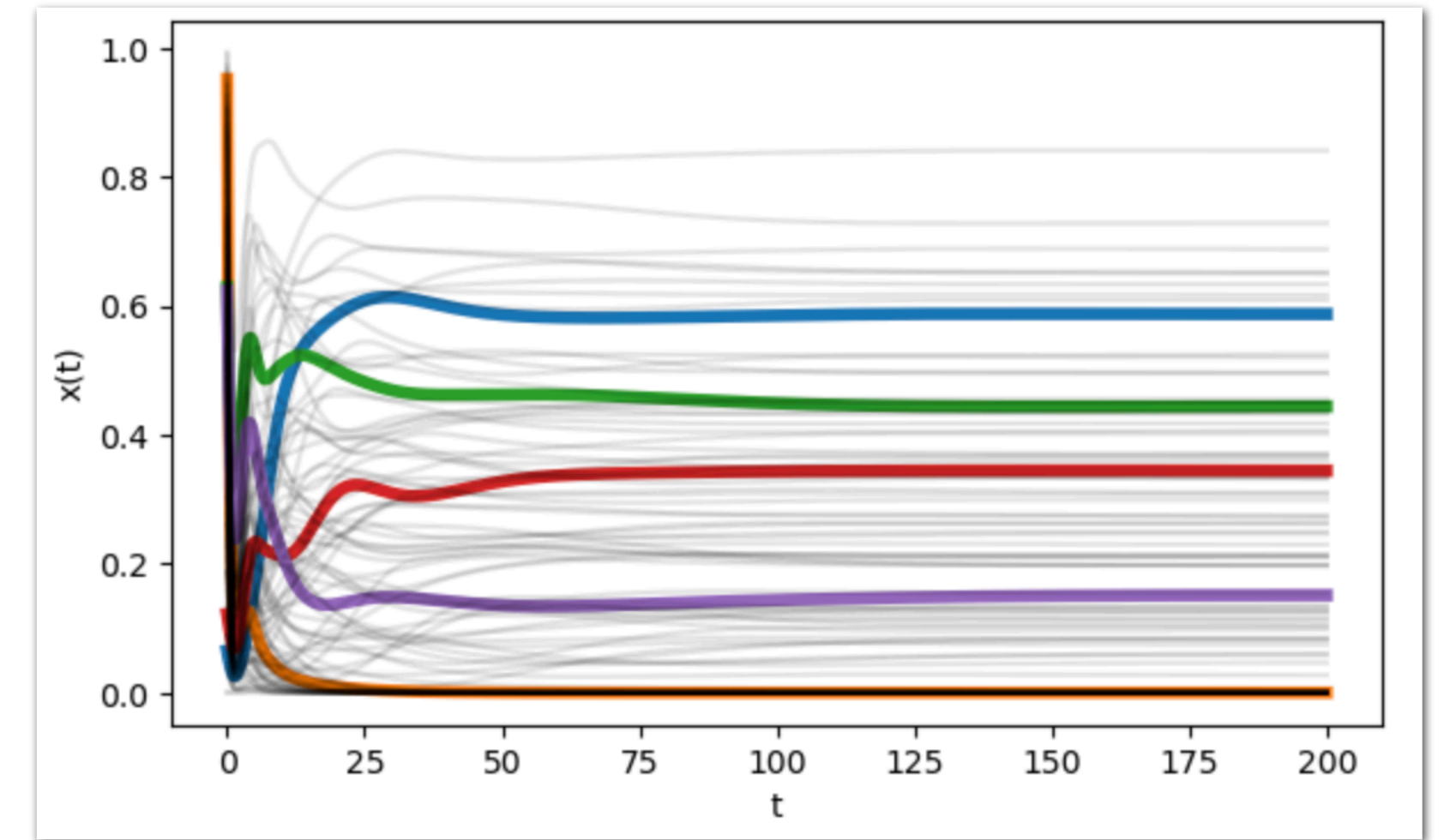
- Absence of phase of unbounded growth



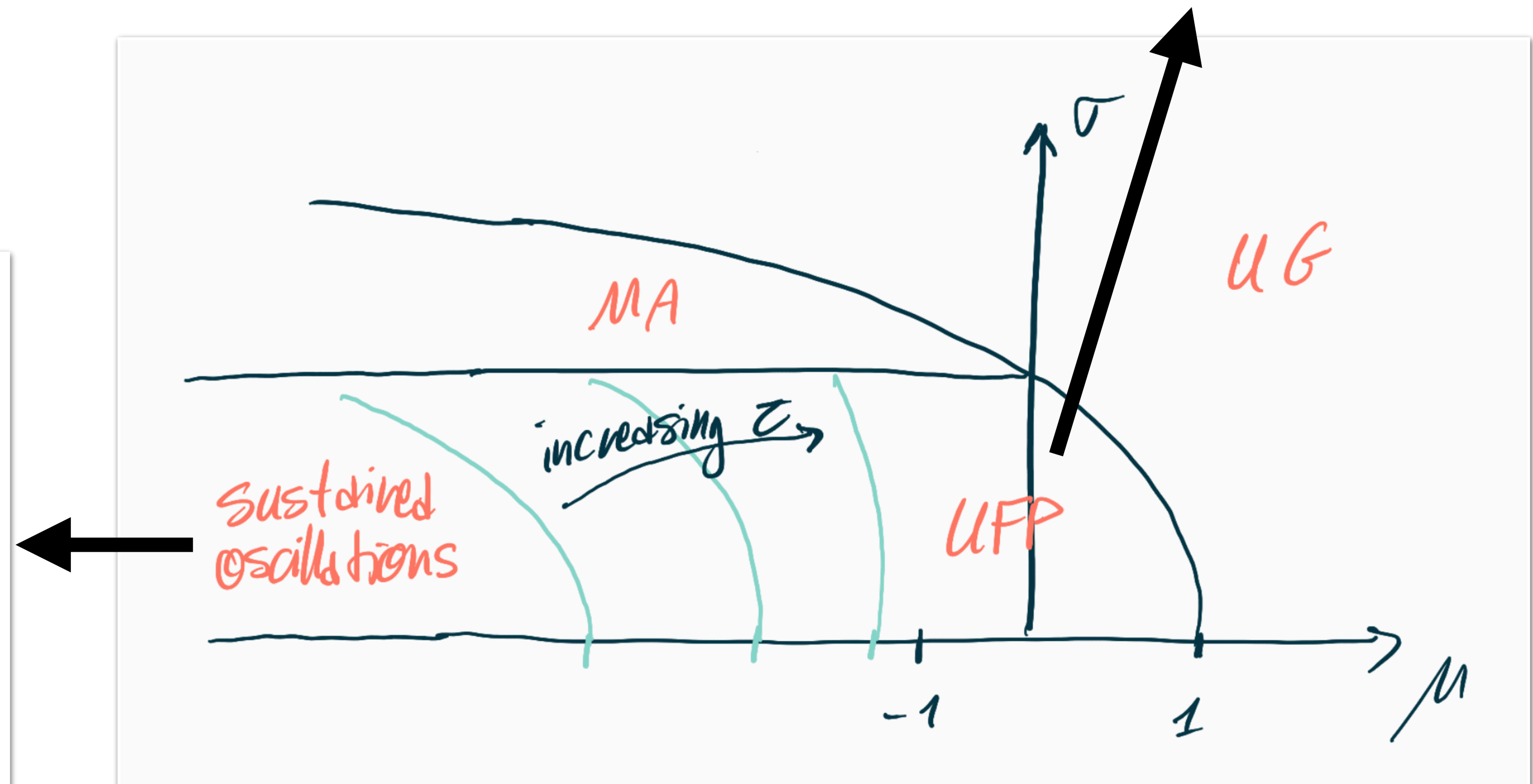
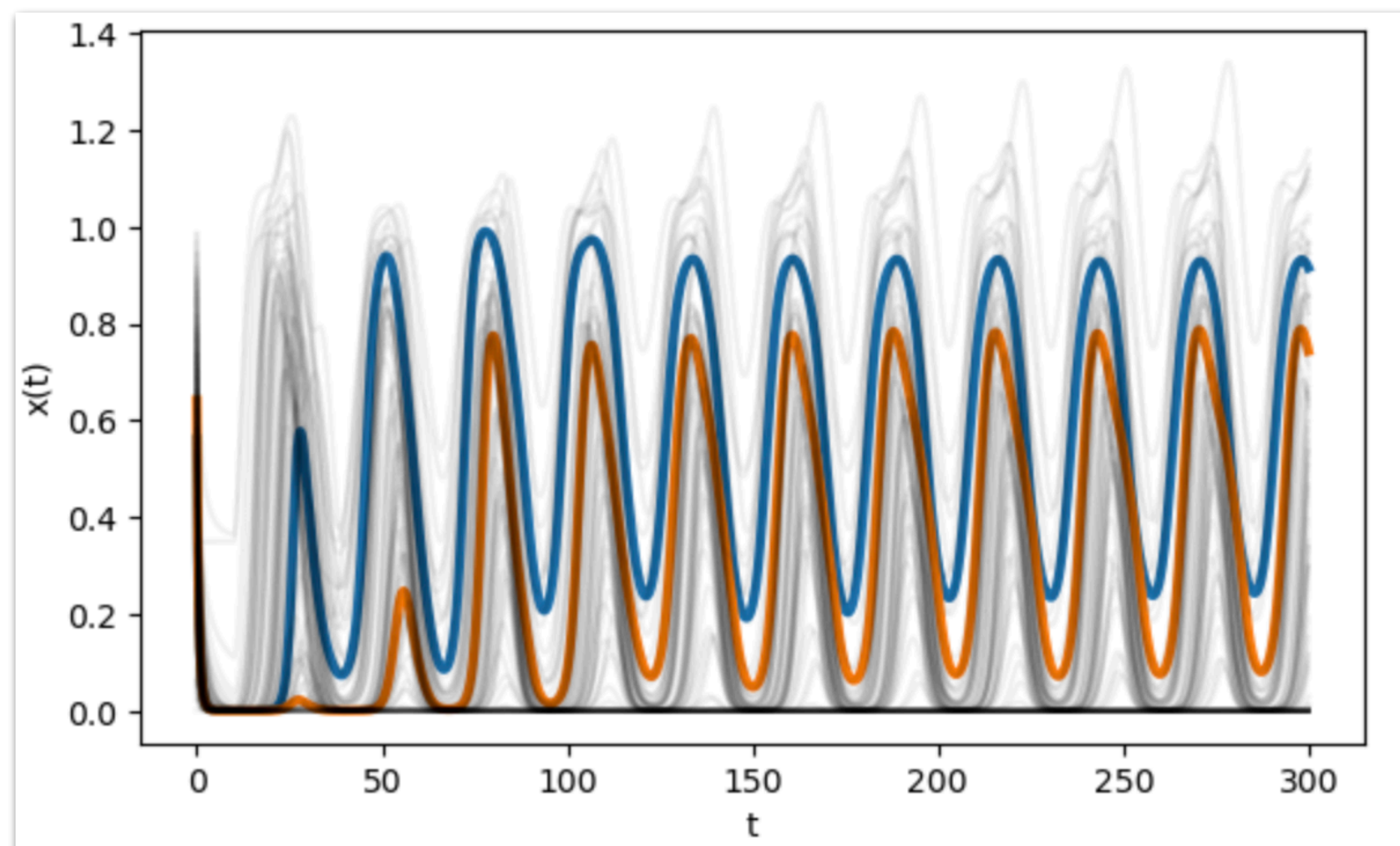
[Ferraro et al. on arxiv soon]

# Delayed interactions

$$\dot{N}_i(t) = N_i(t) \left[ 1 - N_i(t - \tau) + \sum_{j \neq i} \alpha_{ij} N_j(t - \tau) \right]$$



Synchronization of dynamics!



[Ferraro et al. on arxiv soon]