

Bi-layer temporal model of echo chambers and polarisation

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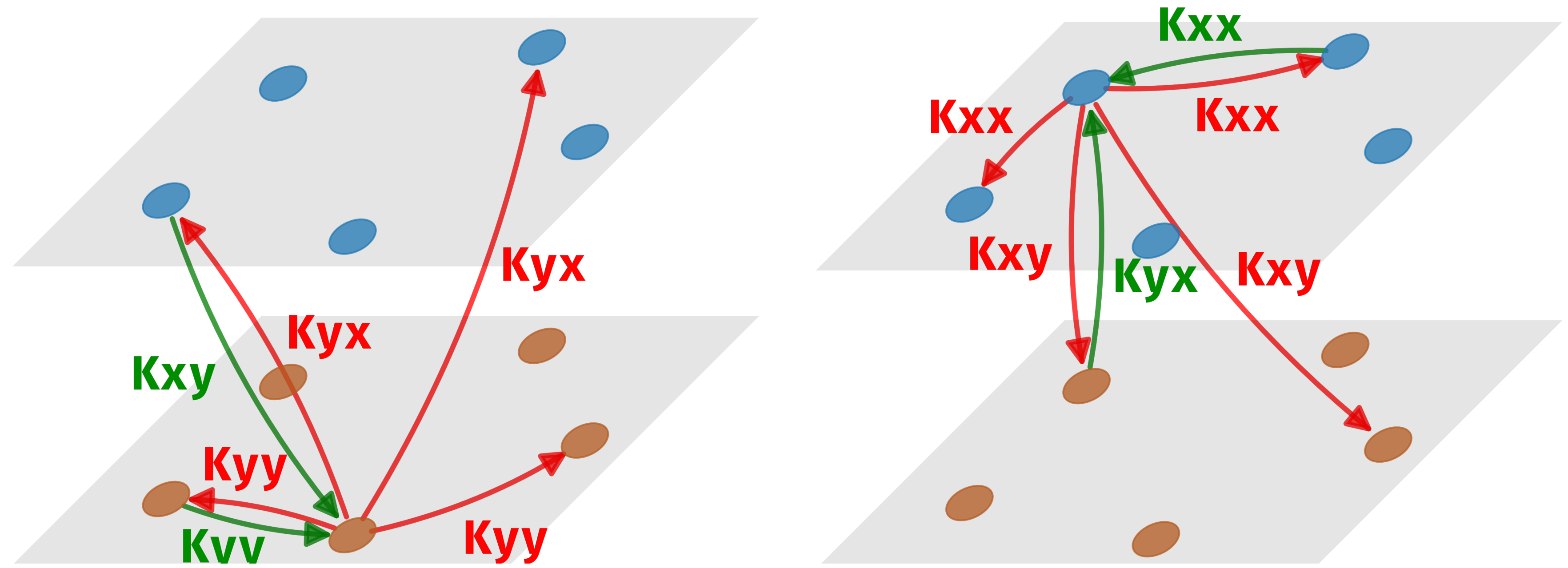
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Echo chambers and polarisation dynamics are as of late a very prominent topic in scientific communities around the world. As these phenomena directly affect our lives, and seemingly more and more as our societies and communication channels evolve, it becomes ever so important to understand the intricacies of novel opinion dynamics in the modern era. We build upon an existing echo chambers and polarisation model and extend it onto a bi-layer topology allowing us to indicate the possible consequences of two interacting groups. We develop both agent-based simulations and mean field solutions showing that there are conditions in which the system can reach states of a neutral or polarised consensus, a polarised opposition, and even opinion oscillations.

$$\dot{x}_i = -x_i + K \sum_{j=1}^N A_{ij}(t) \tanh(\alpha x_j),$$

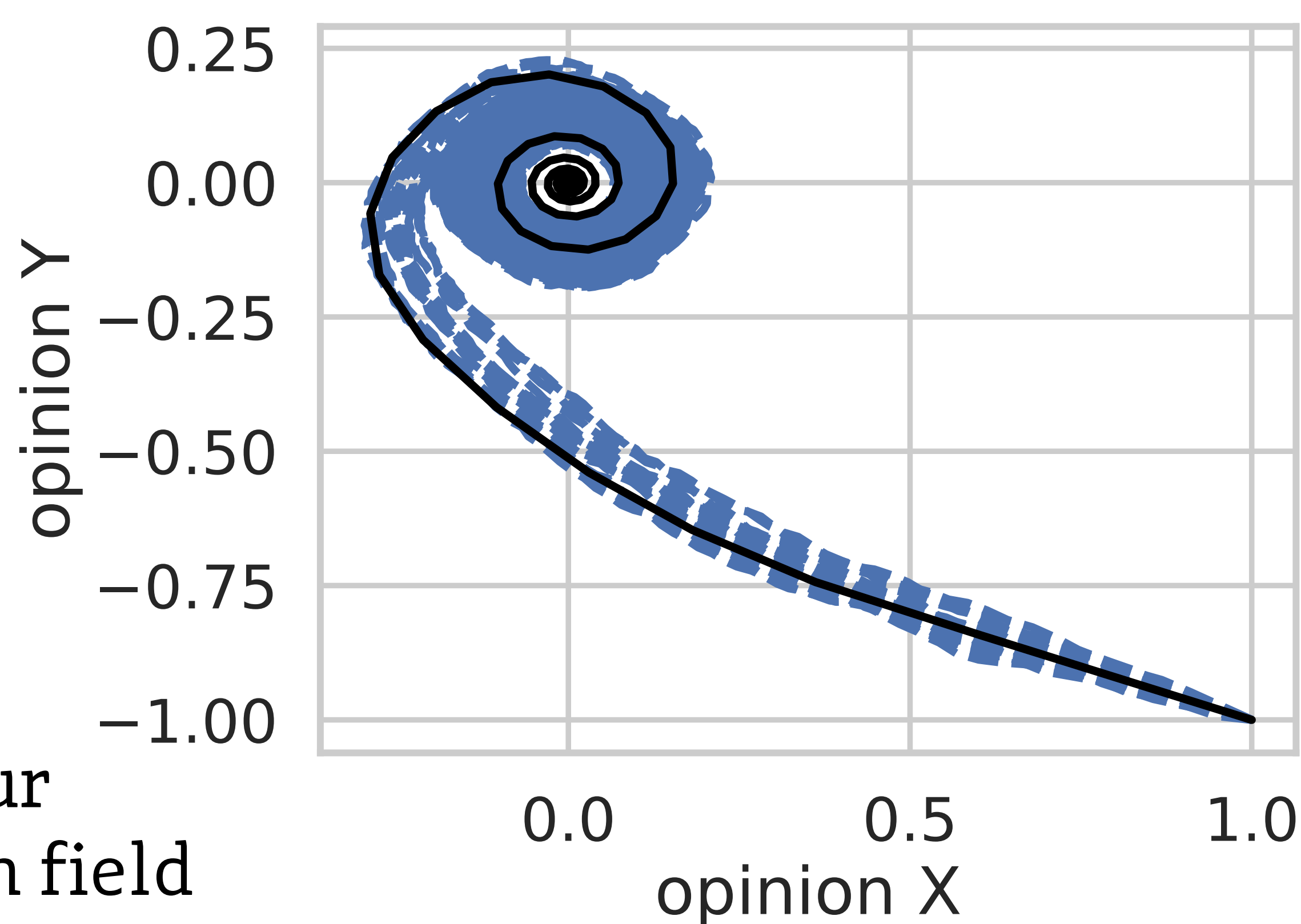
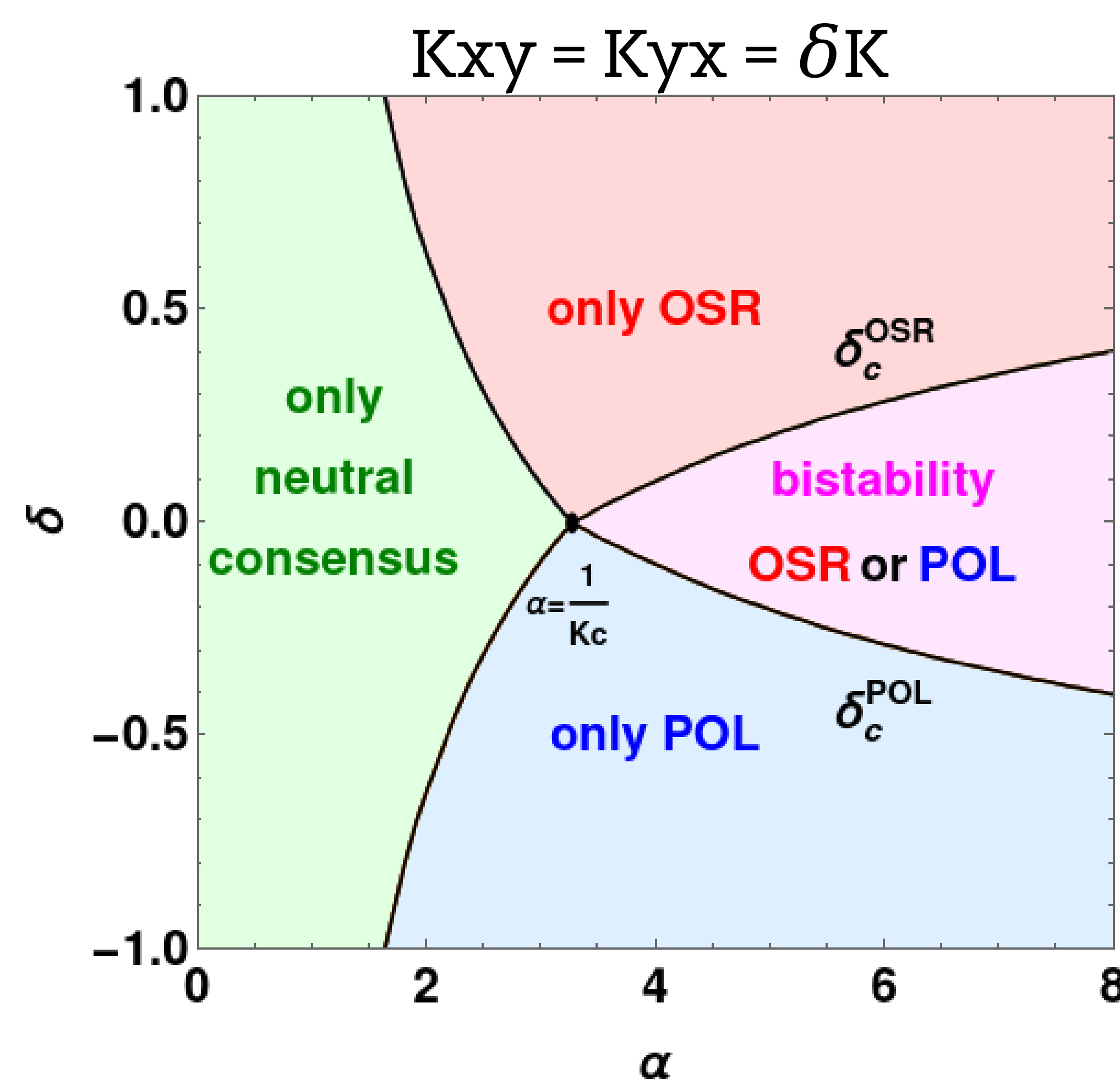
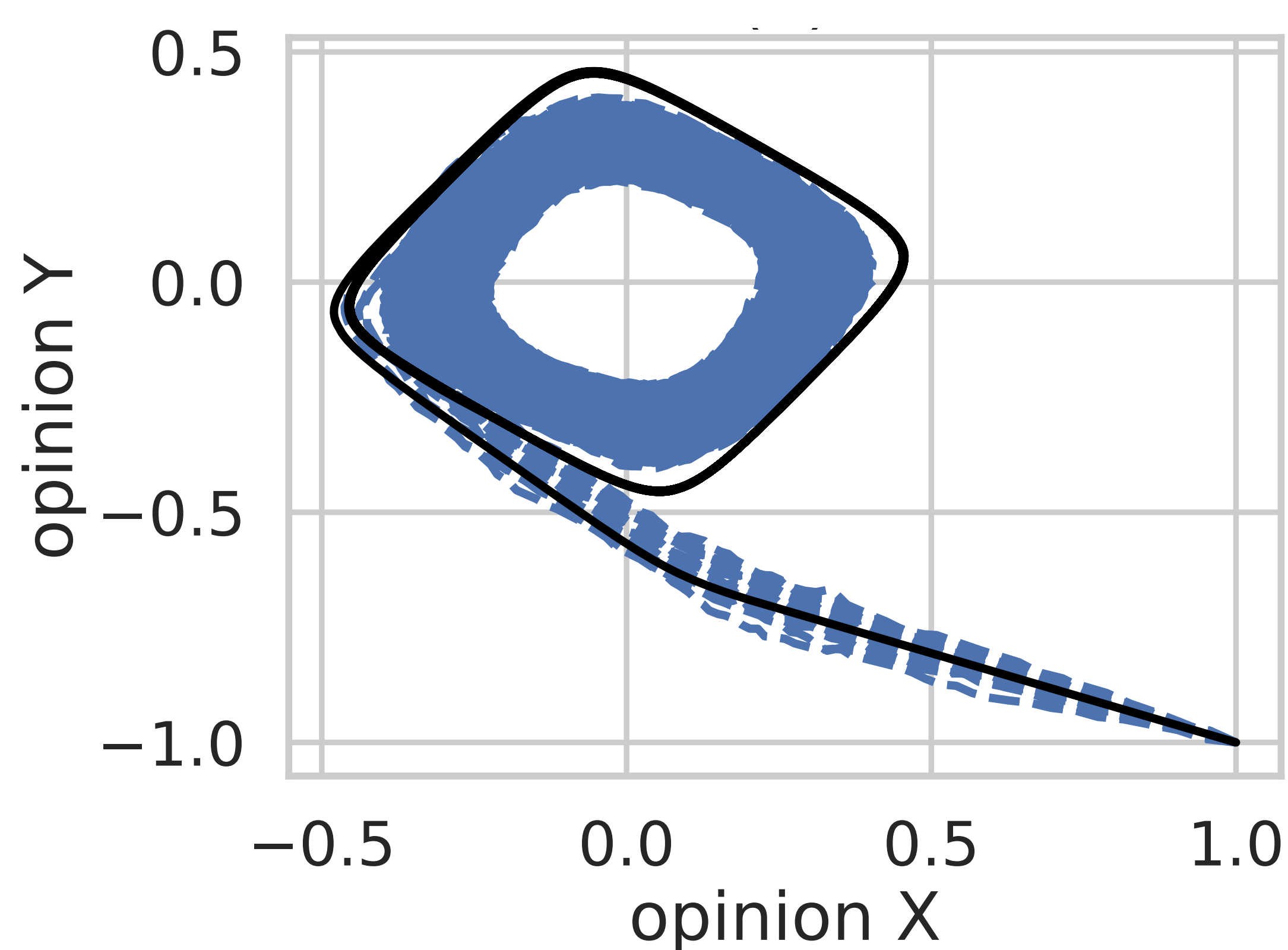
Echo chambers and polarisation model on an activity driven network with homophily → Baumann et al. [1]

- Remove explicit homophily
- Add a second layer
→ Gajewski et al. [2]



$$\begin{cases} \dot{x}_i = -x_i + K_{xx} \sum_j^{N_X} A_{ij}^{xx}(t) \tanh(\alpha_{xx} x_j) + K_{xy} \sum_j^{N_Y} A_{ij}^{xy}(t) \tanh(\alpha_{xy} y_j) \\ \dot{y}_i = -y_i + K_{yy} \sum_j^{N_Y} A_{ij}^{yy}(t) \tanh(\alpha_{yy} y_j) + K_{yx} \sum_j^{N_X} A_{ij}^{yx}(t) \tanh(\alpha_{yx} x_j), \end{cases}$$

Three distinct steady states emerge: a neutral consensus, one sided radicalisation, and polarisation, similarly to the results in [1] but the mechanism is different (no explicit homophily!) and it also gives rise to opinion oscillations absent in the single layer model.



Solid black is our analytical mean field solution and dashed blue are the agent-based simulations.

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- [1] Baumann, F., Lorenz-Spreen, P., Sokolov, I. M., & Starnini, M. (2020). Modeling echo chambers and polarization dynamics in social networks. *Physical Review Letters*, *124*(4), 048301
[2] Gajewski, Ł. G., Sienkiewicz, J., & Hołyst, J. A. (2021). Bifurcations and catastrophes in temporal bi-layer model of echo chambers and polarisation. arXiv preprint [arXiv:2101.03430](https://arxiv.org/abs/2101.03430).



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