

# Discontinuous Transitions in Stochastic Models of Collective Opinion Dynamics

**Janusz Hołyst<sup>1\*</sup>**

<sup>1</sup> Faculty of Physics, Warsaw University of Technology  
\*[jholyst.fens@gmail.com](mailto:jholyst.fens@gmail.com)

Changes of our opinions can be caused by many reasons and sometimes it is useful to describe a part of them as a stochastic process or an effect of a social temperature. It follows the collective dynamics of social groups depends not only on deterministic interactions between group members but also on a social noise coming for example from communication disturbances or complexity of our beliefs.

The lecture will show that a combination of stochastic and deterministic social interactions can lead to discontinuous transitions in collective group opinions. The effect will be demonstrated with several examples: (i) a social impact model of a strong leader, (ii) a model of interactions between competing social groups, (iii) a temporal bilayer echo-chamber model and (iv) a model of structural balance dynamics. For all these systems critical values of the social noise as calculated from analytical approaches are in a good agreement with agent based numerical simulations.

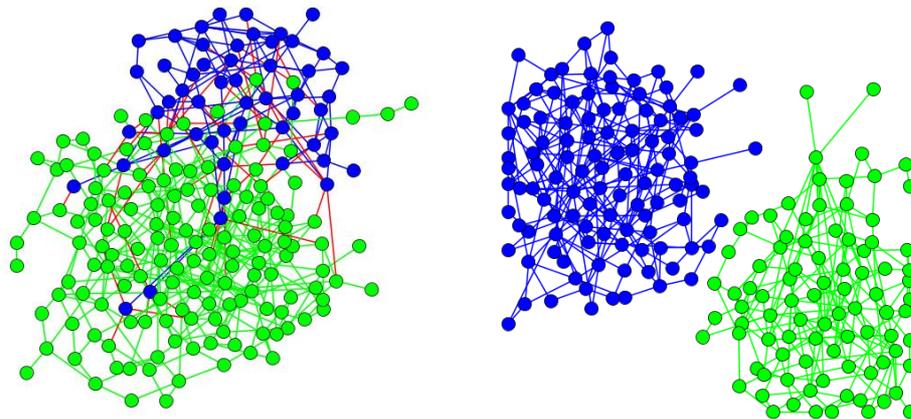


Figure 1: Social structures emerging in the coevolving voter model in which an agent can take the opinion of his neighbour or stick to his own view and seek a connection to an agent of the same state. Left: the case when the probability of social link rewiring is less than a critical value and society is differentiated (green and blue agents) but opposite groups are connected (red links). Right: the probability of social link rewiring is larger than a critical value and society has split into two disjoint subgroups with opposing views. The evolution will be illustrated by on-line computer animations.

## References

- [1] JA Hołyst, K Kacperski, F Schweitzer: *Phase transitions in social impact models of opinion formation*. Physica A: Statistical Mechanics and its Applications **285**,199-210 (2000).
- [2] A Jędrzejewski, J Toruniewska, K Suchecki, O Zaikin, JA Hołyst: *Spontaneous symmetry breaking of active phase in coevolving nonlinear voter model*. Physical Review E **102**, 042313 (2020).
- [3] K Suchecki, JA Hołyst: *Bistable-monostable transition in the Ising model on two connected complex networks*. Physical Review E **80**, 031110 (2009).
- [4] ŁG Gajewski, J Sienkiewicz, JA Hołyst: *Transitions between polarization and radicalization in a temporal bilayer echo-chamber model*. Physical Review E **105**, 024125 (2022).
- [5] PJ Górski, K Bochenina, JA Hołyst, RM D'Souza: *Homophily based on few attributes can impede structural balance*, Physical Review Letters **125**, 078302 (2020).