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Critical behavior for configuration model with power-law degrees

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We discuss some recent developments on the critical behavior of percolation on finite random networks. In a seminal paper Aldous (1997) identified the scaling limit for the component sizes in the critical window of phase transition for the Erdos-Renyi random graph (ERRG). Subsequently, there has been a surge in the literature, revealing several interesting scaling limits of these critical components viz., the diameter, or the component itself when viewed as a metric space. Fascinatingly, when the third moment of the asymptotic degree distribution is finite, many random graph models has been shown to exhibit a universality phenomenon in the sense that their scaling exponents and limit laws are the same as the ERRG. In contrast, when the asymptotic degree distribution is heavy-tailed (having an infinite third moment), the limit law turns out to be fundamentally different from the ERRG case and in particular, becomes sensitive to the precise asymptotics of the highest degree vertices.

In this talk, we will focus on uniformly chosen graphs with a prescribed degree sequence. We start by reviewing recent scaling limit results, and explore the universality classes that arise from heavy-tailed networks. Of particular interest is a new universality class that arises when the asymptotic degree distribution has an infinite second moment. Not only it gives rise to a completely new universality class, it also exhibits several surprising features that have never been observed in any other universality class so far. We end the talk with some open questions.

The talk is based on joint works with Shankar Bhamidi, Remco van der Hofstad, Johan van Leeuwaarden, and Sanchayan Sen.

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