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Cosmological Simulations of Dark Matter

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Dark matter is supposed to be the backbone of structure formation in the universe. It dominates the energy content of the universe together with dark energy. Modern computer simulation allow the detailed prediction of the distribution of dark matter on very large and small scales. The main inputs for these simulations are the initial conditions observed through the cosmic microwave background and gravity as the main force behind structure formation. I will present in my talk recent advances in cosmological simulations and how state-of-the-art simulations lead to virtual universes which agree remarkably well with observations of the real universe. Despite this success the small-scale structure predicted by these simulations does not agree perfectly with observations. I will discuss possible solutions to these problems that might also point to new theories of dark matter.