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Computer simulations and large-scale structure formation

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Scientific models and computer simulations are indispensable to scientific practice. Through their use, physicists are able to learn about how the world works, and to discover new information. However, there is a challenge in understanding how physicists can generate knowledge from their use, stemming from the fact that simulations are necessarily incomplete representations and partial descriptions of their target systems. In order to construct a simulation, one must make idealizations, approximations, and abstractions. In this talk, I focus on the role of idealization and representation in large-scale structure formation simulations. This case provides the opportunity to study the precise ways that idealization and representational trade-offs enter into the construction of simulations, and how they may determine values for simulation parameters. I argue that the use of simulation code that is flexible enough to de-idealize representations plays a specific role in reasoning about results in the context of astrophysics. This is particularly salient when the simulations aim to connect a vast array of independent astronomical observations/phenomena to cosmologists' more global arguments.