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The promise of next generation hydrodynamic cosmological simulations

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Cosmological hydrodynamical simulations are an indispensable and uniquely powerful tool to link fundamental parameters of cosmological theories with small scale astrophysics, thereby allowing predictions of numerous observables far into the non-linear regime. In the future we seek to build up on successful recent calculations such as IllustrisTNG by expanding the physical faithfulness of the numerical treatments of star formation and black hole growth as well as their associated energetic feedback processes, and in addition, we enlarge the size and statistical power of the leading cosmological models as this is required to take full advantage of upcoming new survey data. In my talk, I will review the methodologies we currently pursue to obtain future multi-physics, multi-scale simulations that realize more reliable and thus more predictive calculations. The road towards such a next generation of galaxy formation simulations is rich with technical challenges and scientific opportunities, especially for the arriving exascale supercomputers.

Primary author: SPRINGEL, Volker (Max Planck Institute for Astrophysics)

Presenter: SPRINGEL, Volker (Max Planck Institute for Astrophysics)

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