

## **Supercomputer insights into the messy physics of galaxy formation**

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Hydrodynamical simulations of galaxy formation have now reached sufficient physical fidelity to allow detailed predictions for their formation and evolution over cosmic time. I will review the foundations of this methodology and describe results from recent efforts to construct a new generation of cosmic structure formation models. These numerical simulations need to tackle a complex multi-scale, multi-physics problem. They now succeed in making accurate predictions for matter clustering on cosmologically relevant scales, while at the same time being able to compute detailed galaxy morphologies, the enrichment of diffuse gas with heavy elements, or the amplification of magnetic fields during structure growth. They also support the notion that supermassive black holes are crucial for setting the final life stages of galaxies.