The non-thermal universe

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The vast majority of all matter outside Earth is found in the plasma state. While much of it can be well described using the model of magnetohydrohdynamics, closer examination reveals that non-thermal particle distributions are quite common and can be important to the overall energy balance or transport properties. This talk will cover how sources of free energy such as kinetic energy in bulk flows or gradients in magnetic can lead to the production of these non-thermal particle distributions. It will cover examples ranging from shocks in the solar wind to magnetic reconnection in AGN disks. Along the way I will discuss which numerical methods have been applied to simulate these inherently kinetic processes and what could be plausible next steps in the development of simulation codes.