I will give an overview of the MHD-PIC method, which is developed to study the kinetic physics of cosmic-rays interacting with a background thermal plasma. It treats the cosmic-rays as particles using the conventional PIC approach, while treat background plasma as a fluid described by MHD. This method substantially alleviates the issue of scale separation encountered in conventional PIC approach, and enabled a wide range of plasma astrophysical applications. These include particle acceleration in shocks and reconnection, the microphysics of cosmic-ray transport and feedback, etc., which will all be briefly discussed.

References