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A hybrid Monte Carlo Generator for Ultra High Energy Cosmic Rays from their Sources to the Observer

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To understand in detail cosmic magnetic fields and sources of Ultra High Energy Cosmic Rays (UHECRs) we have developed a Monte Carlo simulation for galactic and extragalactic propagation.
In our approach we identify three different propagation regimes for UHECRs, the Milky Way, the local universe out to 110 Mpc, and the distant universe.
For deflections caused by the Galactic magnetic field a lensing technique based on matrices is applied which are created from backtracking of antiparticles through Galactic field models.
Propagation in the local universe uses forward tracking through structured magnetic fields extracted from simulations of the large scale structure of the universe.
UHECRs from distant sources are simulated using parameterized models.
Interactions with backround photons are taken into account per simulation step or as continuous energy loss.
In this contribution we present the combination of all three simulation techniques by means of propability maps.
The combined propability maps are used to generate UHECRs for large scale mass production, and to create distributions with realistic arrival directions and energies.
Comparisons with physics analyses of UHECR measurements enables the development of new analysis techniques and constrain parameters of the underlying physics models like the source density and magnetic field strength.

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