HEDLA 2022
13th International Conference on High Energy Density Laboratory Astrophysics
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Multidimensional ion radiography with AI individually recognizing multicomponent n-particles on solid state nuclear track detectors

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In laboratory astrophysics, ion radiography is used to measure electric and magnetic fields [1]. In this measurement, however, it is difficult to distinguish between electric and magnetic fields. In this research, we propose a new method to distinguish the fields from multidimensional ion radiography with AI individually recognizing different positions and velocities of many particles detected on solid state nuclear track detectors (SSNTDs)[2]. SSNTDs records the velocity and position as an ion track. Each particle is deflected by different orbital fields with different energies. Therefore, using several kinds of SSNTDs having different ion sensitivities, we identify a number of ion pits (typically $n > 10^5$) with different velocities and species with the aid of machine learning. Furthermore, using the difference in energy dependence of the deflection angles of ions between electric and magnetic fields, it is possible to distinguish electric and magnetic fields from the tracks with different ion energies. The positions and velocities of n-particles, in principle, reconstruct three-dimensional vector electric and magnetic fields with $(n/2)^{1/3}$ of spatial resolution. Under a set of given electric and magnetic field distributions, ion trajectories are computed. With a set of scattering data, we use a neural network to reconstruct electric and magnetic field configurations.

References

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