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Automation of Etch Pit Analyses on Solid-State Nuclear Track Detectors with Machine Learning

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Solid-state nuclear track detectors are often used as ion detectors in laser ion acceleration, and considered to be most reliable since they can measure ions one by one [1]. However, the ion pit analyses require tremendous time and efforts on chemical etching and microscope scanning [2, 3]. The purpose of this research is to improve the efficiency and automation of solid-state nuclear track detector analyses. We use two sets of data obtained from calibration experiments with conventional accelerators where ions with known nuclides and energies are generated, and also from actual laser experiments, using solid-state nuclear track detectors. After chemical etching and scanning the ion etch pits with optical microscope, we have used machine learning to distinguish the ion etch pits from the noise. From the results of the calibration experiment, we confirmed that highly accurate etch-pit detection with machine learning is possible. Furthermore, we are also able to detect etch pits with machine learning from the laser-ion acceleration experiment, which is much more noisy than calibration experiments. We have achieved high efficiency and accuracy in solid-state nuclear track detector analyses to detect etch pits by using machine learning.

References

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