5 - 7 Test of Transparent Target for the Pellet Tracking System

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The pellet tracking system is very important to Pellet target test station (PTS) which is being constructed at IMP[1]. We have performed several tests for this system. The pellet being tracked is a small transparent sphere. We have done two kinds of tests to make sure the transparent sphere could be detected by the camera.

Firstly, we used a plastic rod (3.43 mm) as a target and took photos for them. Fig. 1 shows that the diameter of the rod estimated on the photos is 3.41 mm, and the error is only 0.6%. This result suggests that the camera can be detected the target perfectly.

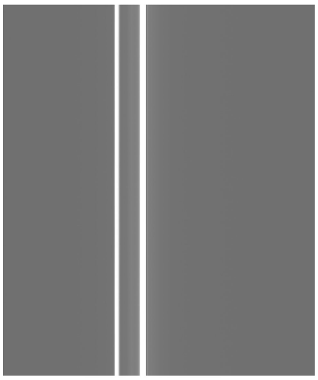

Fig. 1 An image of a plastic rod.

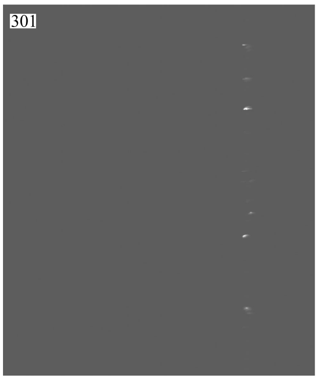

Fig. 2 Pixel image of water droplets with 45 ° between laser and camera.

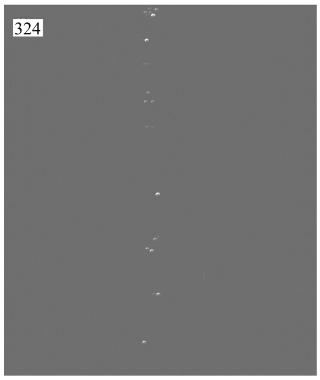

Fig. 3 Pixel image of droplets with 135 ° between laser and camera.

Secondly, we took photos for the water droplets with two different angles between the laser and camera, 45 ° and 135 ° . Figs. 2 and 3 show that in both configurations the droplets can be clearly taken. But the photo with 135 ° between laser and camera is much better than the photo with 45 ° . That is because the large angle of dispersed droplets can reflect more light, and the camera can get more droplets from reflected light in this way. And this configuration of the system will be used in the future.

Reference

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5 - 8 Study of Non-ionizing Energy Loss in Silicon Detectors

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Many studies have demonstrated that the degradation of silicon detector properties in a radiation field is linearly correlated to the displacement damage energy[1] induced by the non-ionizing energy loss (NIEL). It has been pointed outthat NIEL can be incorporated into Monte Carlo transport codes to estimate the displacement damage effects[2].

Fig. 1 shows the results of a SRIM simulation for 10 MeV protons injected on a double-sided silicon micro-strip detector. It can be clearly seen that more than 95% of the energy loss can be ascribed to ionizing energy loss, which provides energy to excite or ionize extra nuclear electrons to generate electron-hole pairs when incident particles traverse the detector and collide with lattice atoms. Less than 5% of energy loss is non-ionizing energy loss which induces lattice atom displacement damage or transforms into phonons to participate in the crystal lattice vibration.

It's show that the proton-induced NIEL increases with the decreasing of incident proton energy as shown in Fig. 2. When protons traverse into a silicon micro-strip detector, they are affected by atomic Coulomb interactions,

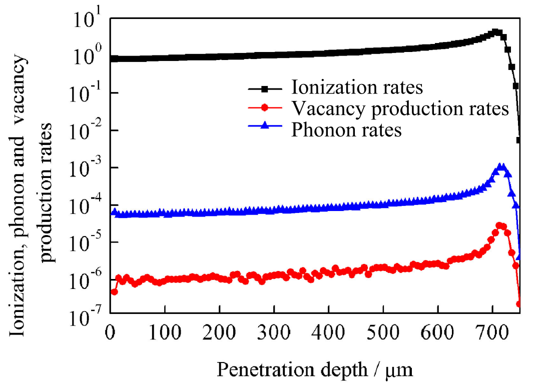

Fig. 1 (color online) The ionization, phonon and vacancy production rates of the incident proton.

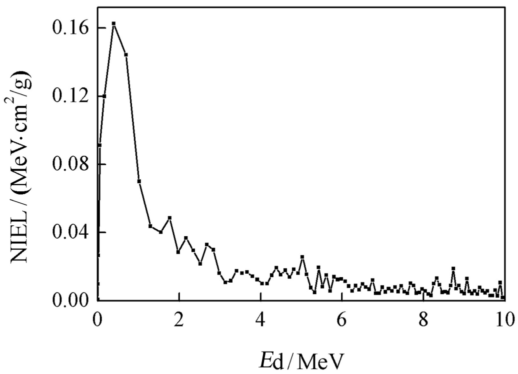

Fig. 2 Proton NIEL as a function of incident proton energy.

and nuclear elastic/inelastic scattering. At low energies, Coulomb interactions induce the production of displaced atoms from their lattice sites. At high energies, nuclear reactions are mostly responsible for displacements.

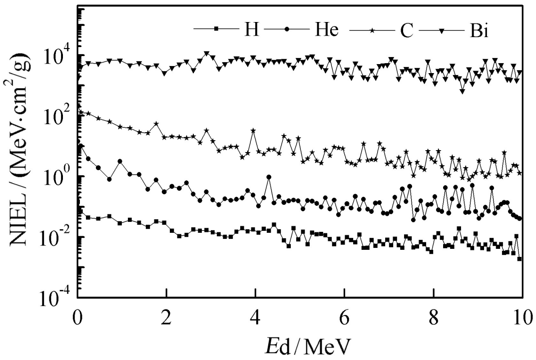

Fig. 3 NIEL for different particles as a function of incident particle energy.

According to Ref. [3], the incident particle NIEL is proportional to the equivalent irradiation fluence (Φ) that the detector has received. Experimentally the maximum proton equivalent irradiation fluence of such a double-sided silicon strip detector is 2×10^{14} cm^{-2}[4]. Compared with the experimental data from Ref.[4], the maximum equivalent irradiation fluences for α particles, carbon and bismuth ions are roughly estimated as $\Phi_\alpha \approx 2\times10^{13}$ cm^{-2}, $\Phi_C \approx 5\times10^{11}$ cm^{-2}, $\Phi_{Bi} \approx 2\times10^{8}$ cm^{-2} respectively, and the corresponding NIELs are shown in Fig. 3. The energies for all incident particles (proton, α, carbon and bismuth) are 10 MeV.

References

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