and mechanical system simulation, in order to achieve the ultimate goal of the CiADS digital twin system.

References

[1] S. H. Liu, Z. J. Wang, Y. Tao, et al., International Journal of Modern Physics, A. Particles and Fields, Gravitation, Cosmology, 34(2019)29.
[2] Y. Chen, F. Brinker, W. Decking, et al., Journal of Physics: Conference Series, 2420(2023)012026.

8 - 14 Experimental Research of Extremely High Spatial-resolution Cascaded High Energy Electron Radiography at HERPL

Ran Zhaohui, Li Jia, Zhou Youwei, Cao Shuchun and Zhang Zimin

To study the structure and characteristics of nuclear materials, many diagnostic tools has been proposedt. With the main features of the strong penetrating power, high space-time resolution, and large area density diagnostic range High Energy Electron Radiography (HEER) has been proposed as a new diagnostic technology for nuclear materials. Therefore, High Energy Electron Radiography experimental platform(HERPL) dedicated to HEER experiment research had been established. A common electromagnetic lenses composed point to point imaging beamline with a magnification of 10.18 has been designed and built, and the imaging spatial resolution of 0.8 μm was obtained that demonstrates the imaging capability of HEER for material imaging diagnosis. In this paper, the HEER experiment with a cascaded quadrupole based imaging system has been proposed and designed to further improve the spatial resolution of image and expand its scope of application. The microcracks inside the nuclear material can be diagnosed with improved the imaging spatial resolution, and the dynamic imaging study of the formation process of the internal pores of the nuclear material can be carried out with combining the ultra-high temporal resolution of HEER.

According to the principle of HEER, the imaging resolution will be improved as the magnification increases. Therefore, an cascade imaging lens with a magnification of 16.6 was designed to improve the imaging spatial resolution. Figure 1 shows the electron trajectories in the cascade HEER imaging lens system.

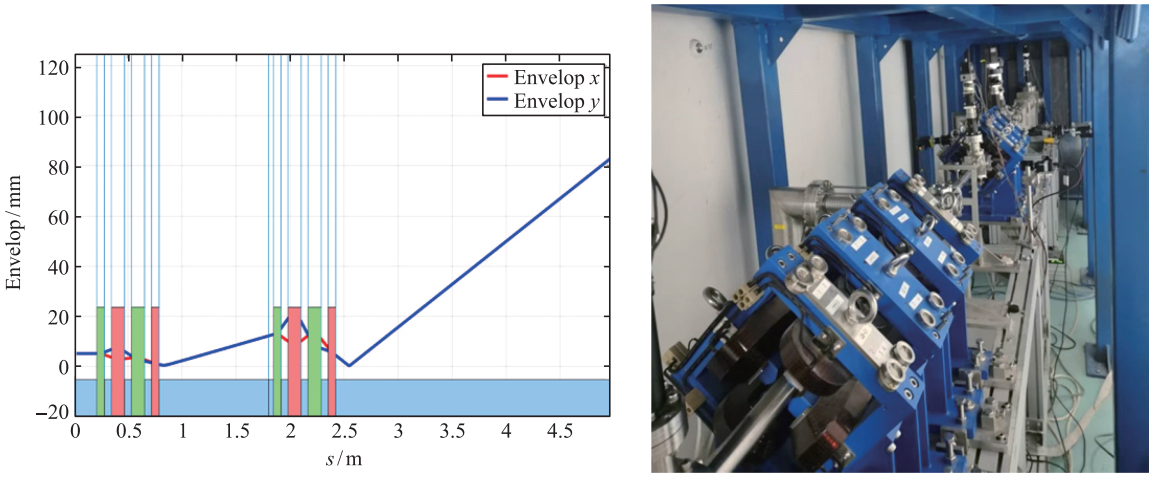

Fig. 1 (color online) HEER cascade imaging lens layout and electron trajectories.

The relevant simulations of the cascade imaging experiment have been completed. A standard 100 mesh molybdenum TEM grid with a hole width of 200 μm, a bar width of 50 μm and the thickness of 25 μm was used in the experiment, and the experimental results with a spatial resolution of 0.6 μm was obtained in the experiments. Figure 2 shows the HEER experimental result of the TEM grid.

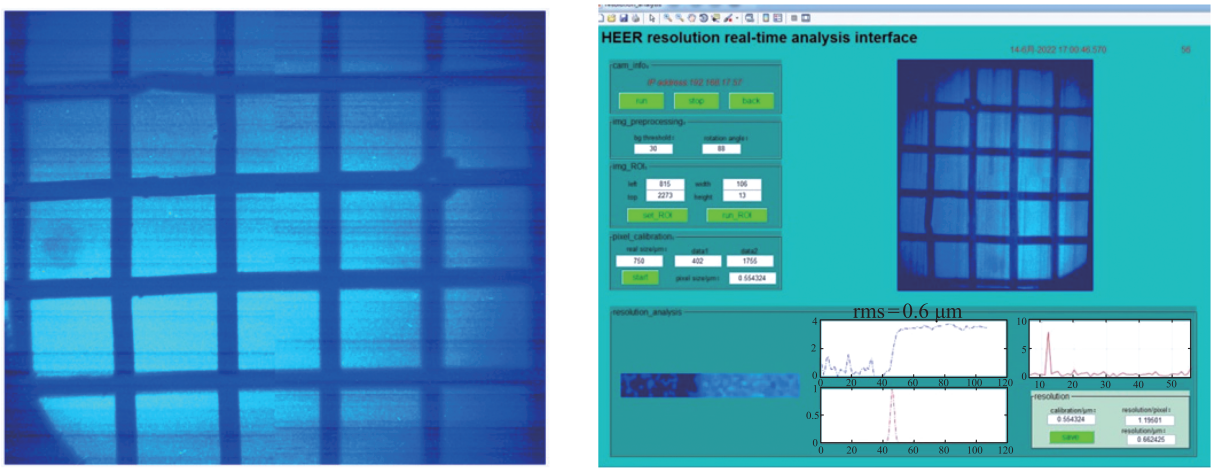

Fig. 2 (color online) HEER cascade image with TEM grid.

References

[1] Z. H. Ran, Z. P. Li, Q. T. Zhao, et al., Nuclear Instrum. Meth, A, (2021)1015,
[2] J. Li, Q. T. Zhao, Y. Zong, et al., Nuclear Instrum. Meth, A, (2021)1020.

8 - 15 Beam Parameters Measurement Using BPM with IMP Electron Linear Accelerator

Li Jia, Ran Zhaohui, Zhao Quantang, Cao Shuchun, Yuan Xiaoxiao, Yan Wenbin, Shen Xiaokang and Zhang Zimin

The IMP electron linear accelerator has now entered the stable operation stage. In order to improve the efficiency of beam operation and enhance the understanding of beam parameters for researchers, the BPM-based beam collimation method and the emittance measurement method have been developed. BPMs are arranged at the entrance and exit of the alpha magnet and the entrance and exit of the traveling wave accelerating tube. It is a strip structure, and the signal processing electronics used is Libera Spark EL[1].

The beam collimation experiment based on BPM was carried out at the beamline from the exit of the alpha magnet to the entrance of the accelerator tube. In order to achieve online correction, beam based alignment using on the PSO algorithm (PSO-BBA) was developed. The key variable is the strength of the steering magnet, and the fitness value is the transverse position of the beam after passing through the steering magnet, which is reflected as the reading of the BPM of the subsequent beamline in the experiment. The beam collimation results obtained by using PSO-BBA are shown in Fig. 1. As the number of iterations increases and the objective function decreases, the strength value of the correction magnet gradually converges to a certain area, the final collimation results can meet the needs of accelerator experiments.

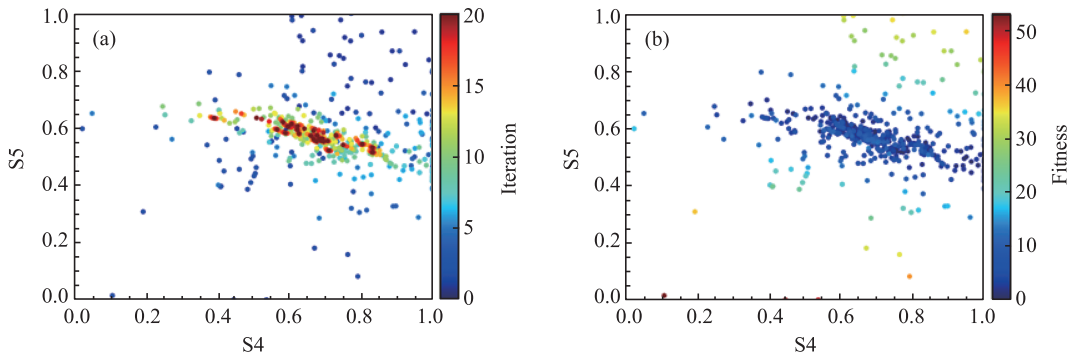

Fig. 1 (color online) Online PSO-BBA correction results, (a) steering magnet strength varies with iterations, (b) steering magnet strength varies with fitness.