6 - 17 Research Progress of High Energy Electron Radiography

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High Energy Density Physics (HEDP) aims to study the properties of matter under extreme states of temperature and pressure. The pressure in a high energy density sample exceeds 1 Mbar (100 GPa), thus the hydrodynamic response of the sample is a high expansion velocity in the range of km/s (μm/ns). Therefore, diagnostics which are capable of high time resolution (< ns) and space resolution (10 μm) are needed. High Energy Electron Radiography (HEER) is a new method suitable for HEDP research that uses a high energy electron beam as a probe for time resolved imaging measurements of high energy density processes in materials. The device uses an electron bunch train with a flexible time structure penetrating a time varying high density target. The electron bunch-lets, each a few ps long and with charges ∼nC is suitable, traverses the HEDP target where the electrons are scattered by the nuclei. The angular distribution depends on the density and thickness of the target. The scattered electrons then travel through the point-to-point imaging lattice with a suitable magnification. A small aperture is used to collimate the scattered electron beam for off axis particles and bremsstrahlung photons, and the target image will be detected by a luminescent screen located after the imaging lattice, as shown in the Fig. 1.

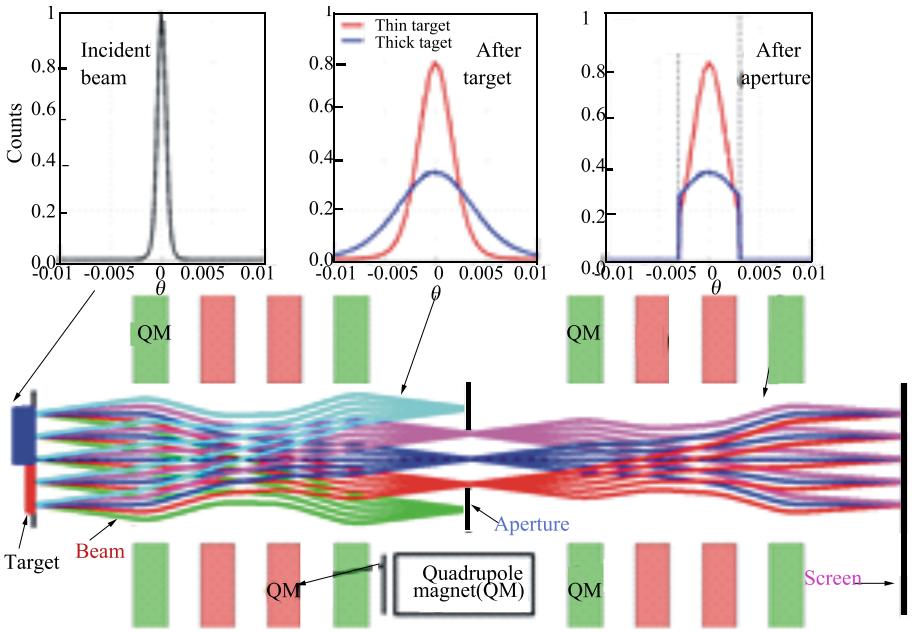

Fig. 1 (color online) Sketch of HEER.

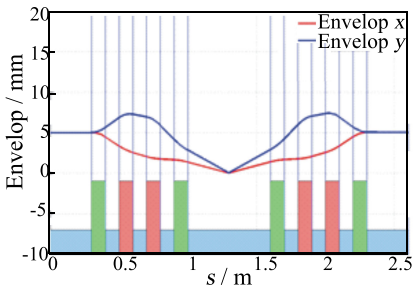

Fig. 2 (color online) Sketch of 1:1 imaging.

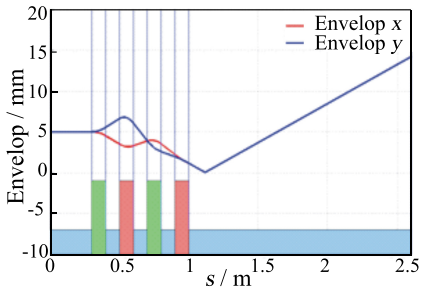

Fig. 3 (color online) Sketch of 1:2.84 imaging.

Fig. 4 (color online) Photo of test beam line for HEER.

A test beam line was designed for experimental research of HEER. We plan to utilize the 40 MeV@1nC electron bunch supply by the Linac in THU/ANL to accomplish the primary experiment of HEER. This beam line use several uniform quadrupoles as imaging lens to form two imaging mode. The first mode could image a 1:1 imaging and chromatic dispersion coefficient is very small, as shown in Fig. 2. And the second mode is a 1:2.84 imaging system use the same lattice with some parameters change of the quadrupoles, as shown in Fig. 3. Now this beam has been assembled in Lanzhou and the vacuum could reach to 6.7×10^{-7} Pa, as shown in Fig. 4.