

Particle beam diagnostics

J. Chang

(Sandia National Laboratories)

Albuquerque, NM 87185 USA, Tel: (505) 844-1018

Particle beam diagnostics have evolved rapidly in the past seven years. Today a wide variety of instruments capable of making electrical, optical, X-ray, and particle measurements are in common use. The recent emphasis in particle beam and matter interactions, has encouraged the development of many new diagnostic methods. Novel X-ray streak photography and large PIN X-ray diode detector arrays were used to measure pinch formation of intense electron beams. Multi-frame holographic systems have been developed to observe material response as well as the formation of plasma channels used for beam propagation. X-ray diodes for detecting soft X-rays have been used to measure emission from the hot plasma formed by particle beam irradiation, and a two-frame flash X-radiography system has been constructed to make high resolution 3 ns exposure images of high density material motion. Particle measurements to determine the mass, charge state, and energy have been made successfully with biased Faraday collectors and a Thompson parabola analyzer. For neutron measurements, heavy shields had to be developed and used to prevent the intense X-ray environment of the particle beam accelerator from driving the scintillation detectors into saturation. The use of these heavy shields has lead to the development of an intense 3 ns calibration neutron source. These diagnostics and their use in various experimental situations will be discussed.

粒子束诊断

J. Chang

(桑迪亚国家实验室)

粒子束诊断在过去的七年间已经迅速发展。今天,可以进行电学、光学、X射线的粒子测量的各种各样的仪器已得到普遍应用。最近由于粒子束和物质相互作用的研究受到重视,从而促进了许多新的诊断方法的发展。新颖的X射线条纹照相术和大型PIN X射线二极管探测器阵列已被用来测量强电子束箍缩的形成。多帧全息照相系统的发展,已经可以观察用于射束传输的等离子体通道的形成以及材料的响应。已经使用探测软X射线的X射线二极管测量由粒子束辐照形成的热等离子体,已制成的双帧闪光X射线照像系统可以拍摄高密度材料运动的高分辨率3毫微秒曝光图像。使用偏置法拉第集电器和汤姆逊抛物线分析器可以成功地进行粒子测量测定质量、电荷态和能量。在中子测量方面,尚需研究和应用强屏蔽以防止粒子束加速器的强X射线环境使闪烁探测器趋于饱和。这种强屏蔽的使用导致3毫微秒强校准中子源的发展。本文将讨论这些诊断技术及其在各种实验条件下的应用。