Contribution ID: 87 Type: 口头报告

High-Efficiency Attosecond-Resolution Terahertz Streaking of Relativistic Electron Beams

摘要

太赫兹偏转是诊断相对论电子束纵向结构的有力工具，这是因为由光学整流方法产生的太赫兹脉冲与加速器的驱动激光是内禀同源的，而且太赫兹波的波长与电子束自身相空间的尺寸高度匹配。然而，受限于可用的太赫兹脉冲能量以及太赫兹-电子相互作用的效率，目前的太赫兹偏转方法的测量精度仅能达到飞秒量级。在本次报告中，我们将介绍一种新型的高效率太赫兹偏转方案以及在清华大学 FORTRESS（超高时空分辨相对论电子源与散射装置）束线上开展的相关实验。利用能量仅几微焦的单周期太赫兹脉冲，束团长度和到达时间的测量精度分别达到了 100 阿秒和 10 阿秒量级。这些结果展示了太赫兹偏转测量可作为一种实用的阿秒级诊断工具及其在下一代超快电子束装置中的应用潜力。

关键词

阿秒时间分辨；相对论电子束；太赫兹偏转

Abstract

Terahertz (THz) streaking is a powerful technique for ultrafast longitudinal diagnosis of relativistic electron beams, as THz pulses generated via optical rectification are intrinsically synchronized to the driving laser and exhibit wavelengths well matched to the characteristic phase-space dimensions of relativistic electron bunches. However, the temporal resolution of THz streaking is often constrained to the femtosecond-level by the available THz pulse energy and the efficiency of the THz-electron interaction. In this talk, we introduce a high-efficiency THz streaking scheme and the corresponding experiments conducted at the FORTRESS (Facility Of Relativistic Time-Resolved Electron Source and Scattering) beamline of Tsinghua University. Using single-cycle THz pulses with only a few microjoules of energy, the measurement precisions of 100 as level for bunch length and 10 as level for arrival time have been achieved. These results demonstrate the potential of THz streaking as a practical attosecond-level diagnosis tool for the next-generation ultrafast electron beam facilities.

Keywords

Attosecond timing resolution; Relativistic electron beams; Terahertz streaking

Authors: Mr 鹏, 吕 (清华大学); Prof. 任恺, 李 (清华大学)

Co-authors: Mr 志远, 王 (清华大学); Mr 一宁, 杨 (清华大学); Mr 卓轩, 刘 (清华大学); Mr 柏廷, 宋 (清华大学)

Presenter: Mr 鹏, 吕 (清华大学)

Session Classification: 核技术及应用、医学物理与工程

Track Classification: 口头报告: 核技术及应用、医学物理与工程