EXPERIMENTS ON MADEY THEOREM WITH OPTICAL KLYSTRON FREE-ELECTRON LASER

S. Huang, J. Li, Y.K. Wu, FEL/Duke University, Durham, North Carolina;
S. Huang, PKU/IHIP, Beijing

Abstract

The Madey theorem is a valuable research tool for studying Free-Electron Lasers (FELs). The theorem relates the shape of the on-axis spontaneous radiation spectrum of FEL wigglers to the FEL gain. The theorem predicts that degradation of the spontaneous spectrum, for example as a result of the increase of the electron beam energy spread, provides a direct measure of the reduction of the FEL gain. Extensive experiments have been performed to study the validity of the Madey theorem for a storage ring base optical klystron FEL. The experimental data show that the lasing wavelength of the FEL is very close to the maximum slope of spontaneous spectra as predicted by the Madey theorem with a relative wavelength discrepancy less than 0.2%. Further analysis is underway to understand this wavelength difference. In addition, we have performed direct measurements of the start up gain of the FEL and compared it with the changing slope of the spontaneous spectra. The preliminary results show a good agreement between the measured FEL gain and the prediction by Madey theorem.

CONTRIBUTION NOT RECEIVED