# Research on the Physics of Ultra-High Brightness, Ultra-Relativistic Electron Beams

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**Abstract:**
It is noteworthy that this research has led both to record breaking experimental demonstrations of the accelerator technology required for high power, short wavelength FEL operation and also the critical theoretical description and analysis of a number of novel low cost approaches to the production of high power XUV, X-ray and gamma-ray radiation.
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Introduction:

The research supported by this contract has focused on the concepts and technologies relevant to the production and utilization of high brightness, high current electron beams for generation of high power infrared, visible, ultraviolet, x-ray and gamma ray radiation.

The period reviewed in this report was unusually productive as documented by the titles and texts of the 19 publications generated during this period with AFOSR support.

It is noteworthy that this research has led both to record breaking experimental demonstrations of the accelerator technology required for high power, short wavelength FEL operation (V. N. Litvinenko, Y. Wu, B. Burnham, J. M. J. Madey and S. H. Park, to be published in the proceedings of the 1995 Particle Accelerator Conference), and also the critical theoretical description and analysis of a number of novel low cost approaches to the production of high power XUV, X-ray and gamma-ray radiation.

Special recognition for this record of accomplishment should be accorded to the faculty of the FEL Laboratory, in particular, to Professors Vladimir Litvinenko, Patrick O’Shea, and K. David Straub and to their students.

Summary of Research Performed:

The research performed during this period is summarized in the following publications. Copies of these publications are attached as an appendix to this report:


Future Research:

The principal thrusts of the research supported by this grant will continue the directions established in the first two years of this program. In particular, it is anticipated that the OK-4 FEL system will be brought into operation prior to the end of the next contract year. This system will test not only the analytical predictions of performance for this high performance FEL system in the ultraviolet region, but also provide an important experimental test of the theory for gamma ray production through the inverse-Compton scattering mechanism described in the appendices (V. N. Litvinenko and J. M. J. Madey, SPIE ‘95, Vol. 2522, page 49).