Introduction to the Special Issue on Free-Electron Lasers

THIS issue of the IEEE JOURNAL OF QUANTUM ELECTRONICS presents a collection of articles on many aspects of free-electron lasers (FEL's) and similar devices. It reflects well the surge of interest in these topics over the last few years. Previous collections of articles, presented at conferences in Telluride, appeared in two books [1], [2]; another collection, summarizing a conference in Erice, will appear soon [3].

This issue can be conveniently divided into wavelength regions. Starting from the millimeter wavelengths, we have papers on gyrotrons, orotrons, and Raman-type FEL's. Some of these devices, especially gyrotrons, have shown high efficiency and high power. The articles reflect the relative maturity of these topics.

In the shorter wavelength region, the Stanford free-electron laser is still the only operating device. Accordingly, a large portion of this issue reviews the theory of this type of FEL carried to a great deal of sophistication, including some time-dependent effects, particle in cell calculations, and noise performance.

There is hope that lasers of unprecedented power and efficiency may be constructed in the future, using "efficiency enhancement" techniques. This issue contains the fundamental work of Kroll, Morton, and Rosenbluth on variable parameter wigglers (a special invited paper), their work on transverse gradient wigglers in collaboration with Eckstein and Madey, as well as the first buds of forthcoming experimental efforts.

As an Editor, I wish to thank the many contributors to this issue. I view it as a community effort, and I am proud of the scope of the work. FEL's have brought together accelerator physicists with laser physicists broadening the perspectives of both. Experimentalists now have the tough job of demonstrating lasers that work, and theoreticians have the equally hard job of understanding all the details and providing guidance as well as analysis. As an interested observer, I predict a bright future to free-electron lasers or, at the very least, a few fascinating years ahead.

REFERENCES

[1] *Physics of Quantum Electronics, Vol. 5, Novel Sources of Coherent Radiation*, S. F. Jacobs, M. Sargent, and M. O. Scully, Eds. Reading, MA: Addison-Wesley, 1978.

[2] *Physics of Quantum Electronics, Vol. 7., Free-Electron Generators of Coherent Radiation*, S. F. Jacobs, H. S. Pilloff, M. Sargent, M. O. Scully, and R. Spitzer, Eds. Reading, MA: Addison-Wesley, 1980.

[3] *Physics and Technology of the Free Electron Laser*, A. N. Chester, S. Martelucci, and A. Renieri, Eds. Erice: to be published.

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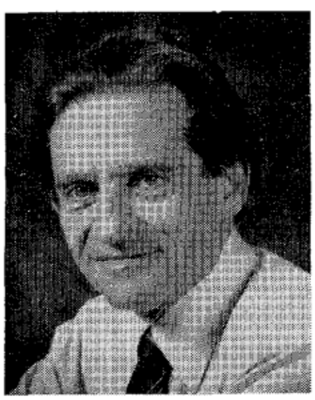
Guest Editor



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