

On the beam

Alan Phelps

Undulators and Free Electron Lasers. By P. Luchini and H. Motz. *Oxford University Press: 1990. Pp.322. £40.*

HANS Motz invented the undulator in 1951 and was therefore uniquely well qualified to write a book on the subject. Although Motz died in 1987 this book represents his collaborative writing with Paolo Luchini in the immediately preceding years. Luchini completed the book after Motz's death.

An undulator is a device that presents a spatially periodic magnetic field to an

Doppler upshift and intentionally operated in the microwave region.

Luchini and Motz have concentrated on the short wavelength FEL in contrast to the microwave FEL which has been given more space in the book *Free Electron Lasers* by T. C. Marshall. Marshall's book is aimed at a less mathematical readership than the book of Luchini and Motz, which retains mathematical rigour when the results justify it. The authors have successfully written a book suitable as a learning tool for scientists or graduate students wishing to enter the field and also suitable as a reference text for those already actively working on FELs. To cater for those readers not familiar with some of the elements of hamiltonian relativistic mechanics and classical electromagnetic

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Star Wars research — high-power laser beams form part of the US Strategic Defense Initiative.

electron beam and thereby generates a beam of electromagnetic radiation. Effectively it concentrates the electron synchrotron radiation into a narrow cone and into a narrow frequency interval. Although the radiation is incoherent it can be made coherent by placing the undulator in a cavity and providing feedback of the electromagnetic radiation field to bunch the electrons into short packets with linear size comparable with the electromagnetic radiation wavelength. The term 'free electron laser' (FEL) was introduced by John M. J. Madey in 1971 and the first self-oscillation of an FEL was achieved in 1977 by Deacon, Elias, Madey, Schwettman and Smith at Stanford. Since that date several FELs have operated successfully. The use of highly relativistic electron beams allows the emitted electromagnetic radiation to be Doppler upshifted from the centimetric dimensions of the undulator to the visible spectral region. The first chapter provides a general overview of the subject through a description of the arguments and results obtained in some of the early papers. This chapter also includes a brief discussion of the Ubitron which was built in several versions by R. M. Phillips in the period 1958–65. This device did not have a large

radiation theory, a brief introduction to both has been provided.

After treating the motion of an electron in an undulating field and considering the properties of undulator radiation, this book devotes chapters to the small-gain FEL, large-gain FEL and saturation. Luchini and Motz then discuss tapered undulators, which have become increasingly important for operation of FELs at maximum efficiency. The authors also point out that the undulator does not only have the FEL as an application, but also allows the operation of the inverse FEL. The latter device may also be regarded as a laser-driven particle accelerator. The last chapters are usefully directed towards the practical subjects of undulator operation, magnet design and experiments and applications.

One has the feeling, when reading this book, that it is destined to become a physics textbook classic. It is likely that all libraries in institutions that specialize in laser research and more specifically free electron laser research will want to acquire a copy of this important text. □

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Variety club

C. D. Pigott

Ecology of Plant Communities. By J. O. Rieley and S. E. Page. *Longman: 1990. Pp.178. £25.*

MOST British plant ecologists have resisted the production of a comprehensive classification of British vegetation by the methods of plant sociology. They have claimed either that the methods are subjective and theoretically flawed, or that classification freezes an essentially dynamic system and diverts attention from the real understanding of the ecology of plants.

But for practical purposes the lack of a comprehensive and generally accepted classification of British vegetation has been a serious obstacle both to the development of experimental ecology and to the application of ecology to a wide variety of problems. Ecology cannot, by definition, be the study of plants in isolation, but must include the study of their responses within the vegetation of which they are a part. This has clear practical application in nature conservation, where it has become increasingly apparent that it is the variety of types of vegetation which has to be conserved. Then, to a large extent, the variety of species of both plants and animals, including those which are rare, will look after themselves.

It might be supposed, therefore, that the appearance of a textbook, which provides a treatment of the methods of plant sociology and a phytosociological account of British vegetation, would be more than welcome: particularly a book which is so well presented and attractively illustrated. Unfortunately, it seems to have been written by authors who are either unaware of events in recent years, or who have chosen to ignore them.



Plant classification — an obstacle to a real understanding of plant ecology.