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THEORY OF ELEMENTARY PARTICLES STUDIES IN WEAK INTERACTION AND GRAND UNIFICATION AND STUDIES IN ACCELERATOR DESIGN.

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DISCLAIMER

REPORT OF ACTIVITIES

During the past year the investigation of micropole undulators continued. These devices were proposed[1] as a means of extending the range of useful photon energies emerging from high energy electron storage rings, as well as devices capable of reducing the size, expense and circulating electron energy required to generate radiated photons of a given wavelength. Various applications of these devices were studied, and the conditions under which alternative types of micropole devices can be employed in storage rings of given characteristics, were explored.[2],[3] During the year covered by this report of activities a patent on micropole undulators was obtained[4].

It was clear to us that of the large variety of insertion devices which are technologically feasible at this time, only a few have been investigated in detail. Our success with micropole undulators encouraged us to undertake a systematic study of insertion devices for storage rings as well as linear machines. In the course of this investigation we evolved a novel undulator design particularly well suited to high energy electron rings. we refer to this device as a "cusp field" undulator.[5] This device can be constructed in a manner which is wholly non invasive, and can, therefore, be installed without interruption of normal operations on the given electron ring. The entire magnet structure is to be located outside the vacuum system. Furthermore, the undulator can be operated in such a manner as to have no noticeable effect on the

circulating electron beam, that is, it can be operated entirely in a parasitic mode (except under extreme conditions). When installed on the PEP ring at Stanford, the generated photons can be chosen to lie in the range of interest to pump a Li soft x-ray laser, and also to cover the most interesting wavelength ranges for biological imaging. In addition, the coherent content of this beam would exceed any other photon beam either now in existence, under construction, or planned.

The capabilities offered by dynamical optics were further studied in connection with the generation of transversely coherent photon beams and the generation of short photon pulses.[6],[7],[8] We also investigated the relationship[9] between the minimum length to which a photon pulse can be compressed by dynamical optics and the speed with which an element of the optics is moving (uptill now this relationship has been established only for one particular class of geometries).

Although the properties of radiation emitted by insertion devices is well understood mathematically, the expressions are often sufficiently involved to obscure the essential features. Nevertheless, in certain important special cases one can find simple formulae which will reproduce the correct results to a high degree of accuracy.[10]

As a result of our investigation of nontraditional particle acceleration mechanisms we performed calculations on (and submitted

a patent disclosure for) a novel type of device, based on acceleration by electromagnetic radiation.

References

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2. "Micropole Undulators, Novel Insertion Devices for Synchrotron Sources" (with A. Toor and R.O. Tatchyn), Rev. of Sci. Instruments, 60 (7), 1439 (1989).

3. "Perspectives on Micropole Undulators in Synchrotron Radiation Technology" (with R.O. Tatchyn and A. Toor) Rev. of Sci. Instruments, 60, 1796 (1989).

4. "Micropole Undulator", (with R.O. Tatchyn), U.S. Patent No. 4, 800, 353 (1988).

5. "A Novel Cusp Field Undulator for High Energy Storage Rings" (with R.O. Tatchyn and T. Cremer).

6. "Properties and Applications of Fast Rotors in Dynamical Optics, to be published.

7. "Equitemporal X-ray Optics: A Method to Generate Subpicosecond X-ray Pulses", Proceedings of the Third international Conference on Synchrotron Radiation Instrumentation, Tsukuba, Japan, 1988.

8. "Coherence Saturation for Energetic Photons", to be published.

9. "General Limits for Equitemporal Optics Devices" to be published.

10. "Properties of photon spectra radiated by isertion devices in the limit of high and low K values" (with H. Watanabe), to be published.