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THE STORAGE RING AS RADIATION SOURCE

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ABSTRACT

These notes derive from my part of a course on using storage rings as synchrotron light sources, given with Sol Gruner, spring term 2000. Sol emphasized the "downstream" view, especially detection apparatus. My part gave an "upstream" view of the storage ring as radiation source. There is a large degree of overlap of these notes with the famous storage ring report by Sands. The main difference is the emphasis on using the ring as source of photons rather than as colliding beam facility.

By now there is a considerable body of material describing this topic, and detailed "handbook" formulas are available for the important quantities. I refer to this material occasionally, but my intention is more to emphasize the intuitive content of the subject, even when this yields formulas having only a semi-quantitative validity. My rationale is that it is harder to grasp the essentials of the subject than to find and understand exact formulations once one has the general idea. To promote this approach I pretend that all storage ring development has been motivated by their use as sources of synchrotron light, even though early generation radiation sources were entirely parasitic, and early ring designs were driven by particle physics considerations.

In the first chapter I promote the view that the evolution of internal/electron and external/photon beams are "essentially" equivalent, and are subject to the same formulas. To exploit this "economy" it is necessary to apply to beams of photons terms that are familiar mainly to accelerator physicists. Unfortunately this (not very deep) synthesis is sufficiently novel that I am unaware of any helpful references.

The major deficiency of these notes, at this time, is that, though imaginary, futuristic, undulators are discussed at length, currently employed magnetic wigglers and undulators are not—in the original course syllabus wigglers were regarded as being downstream. The essential ideas are covered, however. Another deficiency is that, though the main ingredients of FEL theory are described, they are not stitched together coherently. Also, though supposedly sophisticated statistical methods (such as Fokker-Planck) are explained, no examples are included (at this time.)