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Chapter 1

Introduction

One of the unique opportunities presented by a CEBAF upgrade to energies of 12 GeV and beyond is the possibility of generating high-intensity continuous photon beams for high-energy photoproduction experiments. In this regime, photon beams represent an interesting extension to the meson spectroscopy program that has been actively pursued using beams of pseudoscalar mesons at hadron accelerator laboratories: with high energy photons one has essentially a beam of *vector* mesons. It is difficult, in fact, to conceive of any other way to obtain such a vector beam.

A key component of the 12 GeV Jefferson Lab upgrade is the GlueX experiment, devoted to the search for mesons with gluonic excitations. The experiment requires a photon beam with energies in the range 8-9 GeV and linear polarization. The preferred method for producing such a beam is coherent bremsstrahlung in an oriented crystal. Electrons of 12 GeV from the accelerator pass through a thin diamond radiator, generating an intense beam of high-energy photons with a continuous energy spectrum that is dominated by a single peak. A significant fraction of the total power in the beam is concentrated inside this peak, which has a width of less than 5% f.w.h.m. At a fixed electron beam energy E_0, the peak energy of the photon beam can be varied anywhere up to 90% E_0 simply by rotating the crystal. The photon spectrum inside the intensity peak has a large degree of linear polarization. The precise energy of an individual photon inside the peak is determined ("tagged") from the momentum of the recoil electron measured in a dedicated tagging spectrometer.

This report begins with a survey of the techniques for producing high-energy photons that were considered in the development of this design, and the reasons for the choice of coherent bremsstrahlung. The coherent bremsstrahlung source is then described in greater detail, followed by a discussion of the requirements that the design places on the electron beam properties at the source. The tagging spectrometer design is described next, followed by the photon beam collimation and shielding design. The report concludes with a description of the pair spectrometer and methods for monitoring the properties of the beam.

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