The Mechanical and Shielding Design of a Portable Spectrometer and Beam Dump Assembly at BNL's Accelerator Test Facility

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Abstract

A portable assembly containing a vertical-bend dipole magnet has been designed and installed immediately downbeam of the Compton electron-laser interaction cell on beamline 1 of the Accelerator Test Facility (ATF) at Brookhaven National Laboratory (BNL). The water-cooled magnet designed with field strength of up to 0.75 Tesla will be used as a spectrometer in the Thompson scattering and vacuum acceleration experiments, where field-dependent electron scattering and beam focusing will be analyzed. This magnet will deflect the ATF's 70-MeV electron-beam 90° downward, as a vertical beam dump for the Compton scattering experiment. The dipole magnet assembly is portable and can be relocated to other beamlines at ATF or other accelerator facilities to be used as a spectrometer or a beam dump.

The mechanical and shielding calculations are presented in this paper. The structural rigidity and stability of the assembly were studied. A square lead shield surrounding the assembly's Faraday Cup was designed to attenuate the radiation emerging from the 1"-copper beam stop. All photons produced were assumed to be sufficiently energetic to generate photoneutrons. A safety evaluation of groundwater tritium contamination due to the thermal neutron capturing by the deuterium in water was performed, using the updated Monte Carlo neutron-photon coupled transport code (MCNP). High-energy neutron spallation, which is a potential source to directly generate radioactive tritium and sodium-22 in soil, was conservatively assessed in verifying personal and environmental safety.

Keywords: dipole magnet, spectrometer, beam dump, portable magnet, accelerator device

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