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Experience with small-gap undulators

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Small-gap undulators offer enhanced performance as synchrotron radiation sources, by providing extended tuning range and the possibility of higher photon energies via short-period, small-gap devices. Challenges associated with the operation of small-gap undulators arise from their requirement for small beam apertures and the resulting possibility of lifetime degradation, beam instabilities, and radiation hazards. To investigate these fundamental limitations, we have constructed an R&D small-gap undulator for the X13 straight section of the NSLS 2.584 GeV X-ray Ring and have tested it during studies shifts and normal user shifts during the last year. This device, the NSLS Prototype Small Gap Undulator (PSGU), consists of a variable-aperture vacuum chamber and a 16 mm period pure-permanent-magnet undulator, both mounted to a common elevator base stage. The design output spectrum of 2.5 keV in the fundamental (and 7.5 keV in the 3rd harmonic) was obtained with a magnet gap of 5.6 mm and an electron beam aperture of 2.5 mm. The partial lifetime contribution at these parameters was observed to be about 40 hr. Details of the synchrotron radiation output spectrum, lifetime dependence on aperture, and bremsstrahlung radiation production will be presented.