Measurement of soft X-rays from neutron radiative decay
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COLLABORATION — In the RDK II experiment, photons with energies between
5 keV and the 782 keV endpoint from neutron radiative decay were detected using
an array of 12 bismuth germanate (BGO) crystals, each coupled to an avalanche
photodiode (APD). Since the experiment was performed in the bore of a supercon-
ducting magnet, APDs were preferable to photomultiplier tubes. Simultaneously
we detected soft X-ray photons in the energy range from 0.3 keV to 20 keV with
three larger APDs. We found that for soft X-ray detection near 77 K the APD must
be oriented with its electric field parallel to the magnetic field, otherwise there is
substantial distortion of the response. Extraction of the soft X-ray radiative decay
spectrum required studies of the response of the APD. We performed measurements
of the APD response for monochromatic X-ray beams between 0.35 keV and 1.5 keV
on the U3C beam line at the NSLS at BNL. The data were used to model the APD
pulse height spectrum as a function of X-ray energy using a profile for the depth-
dependent efficiency for collection of electron-hole pairs. This model was validated
using a continuum spectrum at the NIST SURF III. We will describe the construc-
tion of the detector, discuss the results of the magnetic field, BNL and SURF studies,
and present preliminary results of determination of the radiative decay spectrum in
the soft X-ray range.