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Application of recoil-imaging time projection chambers to directional neutron background measurements at SuperKEKB[1] JEFFREY SCHUELER, University of Hawaii — Modern gas time projection chambers (TPCs) with high readout segmentation are capable of reconstructing detailed 3D ionization distributions of nuclear recoils resulting from neutron-nucleus scattering. This provides event-by-event recoil direction and ionization energy, as well as high-quality particle identification; which together enable unique, low-background directional neutron measurements. We report on the first directional measurements of beam-induced neutron backgrounds in the SuperKEKB e^+e^- accelerator tunnel, using a system of six compact gas TPCs with pixel ASIC readout. By rejecting large backgrounds of electron-recoils in these TPCs, we obtain high purity energy spectra and directional distributions of nuclear recoils, which are ultimately used to provide first experimental evidence toward a localized neutron production hotspot near the Belle II detector. This hotspot is predicted to produce the majority of neutrons originating outside of the Belle II detector, making it an important region to monitor and potentially shield in the future. In addition to the applications demonstrated here, recoil-imaging detectors are also of interest for future directional dark matter and neutrino experiments.

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