Purpose: Positron emission mammography shows promise as a secondary breast screening technique to reduce the number of unnecessary biopsies. To reduce the dose to the patient, current PEM systems use depth of interaction (DOI) enabling detector modules. These detector designs however require a large number of channels per scintillator at high system cost and complexity. We propose a dual-ended readout block detector module (DERBDM) design combining the high encoding ratio of Anger logic with the DOI measuring dual-ended readout detector design to reduce the number of required channels while maintaining spatial resolution on the order of 2-mm.

Methods: A prototype DERBDM was constructed from 2 × 2 pixels with 3.4-mm pitch from two SensL silicon photomultipliers arrays (SPMArray2-A0), two 2-mm thick glass light guides, and a 3 × 3 array of 2-mm × 2-mm × 20-mm scintillators with 2.075-mm pitch. The signal from the DERBDM was digitized using eight channels of a CAEN Systems 16-channel 12-bit 250-MS/s waveform digitizer. The ability to identify crystal index, DOI resolution, and energy resolution were measured.

Results: The DERBDM was found to resolve events in a flood field image and with energy-based corrections clearly identifying the interacting scintillation crystals. After per-crystal corrections were applied, DOI was resolved with 5-mm FHWM resolution. Energy was corrected with crystal index- and DOI- dependant and found to discriminate the energy of events with a resolution of 20%.

Conclusions: This work demonstrates the DERBDM's ability to increase encoding ratio at least 2-fold from that of the dual-ended readout design without sacrificing spatial resolution. It indicates that the DERBDM has the potential to meet the need for an affordable, high resolution, highly specific breast imaging system.