

BazookaSPECT: A Low-Cost Approach to High-Resolution, Single-Photon Imaging Using Columnar Scintillators and Image Intensifiers

We recently developed the BazookaSPECT gamma camera, a low-cost, single-photon counting gamma-ray detector based on an image intensifier optically coupled to a low-cost CCD. Typically, a columnar CsI(Tl) slab or a radiography screen such as Lanex/Min-R serves as the scintillator. The detector has an intrinsic spatial resolution of $69\ \mu\text{m}$ when operated at 1:1 magnification. BazookaSPECT has a 25-mm diameter active imaging area when operated at 8:1 magnification, and the imaging area can be increased to a diameter of 50 mm via a 2:1 fiber-optic taper coupling the scintillator to the input face of the image intensifier. BazookaSPECT employs a second-generation image intensifier which amplifies scintillation light prior to the lens-coupling system, thereby negating light loss in the optical system and allowing for a customizable imaging system. Operating in photon-counting mode, individual gamma-ray interactions are seen as clusters of signal, and significant improvement in spatial resolution is obtained by estimating the interaction position of individual gamma rays via Anger (centroid) estimation or maximum-likelihood techniques.

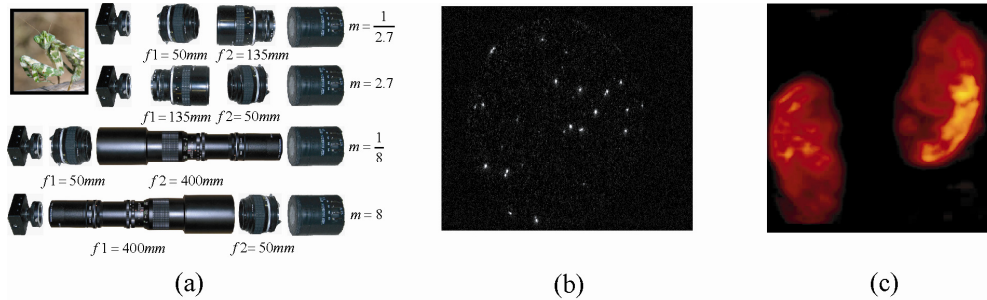


Figure 1. (a) Various macroconfigurations for BazookaSPECT, (b) BazookaSPECT flood illuminated with $^{99\text{m}}\text{Tc}$ gamma rays, and (c) BazookaSPECT mouse kidney SPECT using $^{99\text{m}}\text{Tc}$ gluconate.

In addition to functioning as SPECT detector, we have configured BazookaSPECT to function as a gamma-ray microscope by employing a microcoded aperture. With hundreds of sub- $100\ \mu\text{m}$ diameter pinholes, the microcoded aperture is able to image objects containing only tens of nanocuries (nCi).

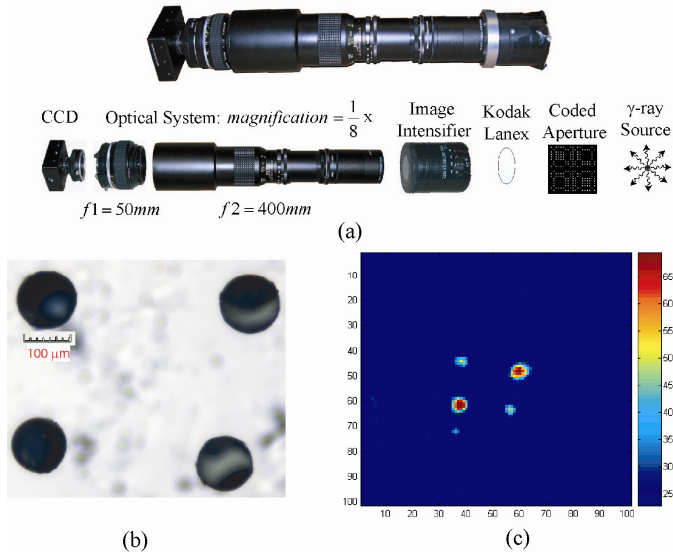


Figure 2. (a) BazookaSPECT detector functioning as a gamma-ray microscope, (b) white-light microscope image of four ^{111}In oxine source beads, (c) coded aperture reconstruction of bead phantom

1. B. W. Miller, H. B. Barber, H. H. Barrett, D. W. Wilson, and L. Chen, A low-cost approach to high-resolution, single-photon imaging using columnar scintillators and image intensifiers, Presented at the IEEE 2006 NSS/MIC, October 29-November 4, 2006.

2. B. W. Miller, H. H. Barrett, L. R. Furenlid, H. B. Barber, and R. J. Hunter, Recent advances in BazookaSPECT: Real-time data processing and the development of a gamma-ray microscope, 591,1,272-275, Nucl. Instrum. Meth. A., 2008.