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## A high-resolution PET demonstrator using a silicon "magnifying glass"

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To assist our ongoing investigations of the limits of the tradeoff between spatial resolution and noise in PET imaging, several PET instruments based on silicon-pad detectors have been developed. The latest is a segment of a dual-ring device to demonstrate that excellent reconstructed image resolution can be achieved with a scanner that uses high-resolution detectors placed close to the object of interest or surrounding a small field-of-view in combination with detectors having modest resolution at larger radius. The outer ring of our demonstrator comprises conventional BGO block detectors scavenged from a clinical PET scanner and located at a 500mm radius around a 44mm diameter field-of-view. The inner detector—in contrast to the high-Z scintillator typically used in PET—is based on silicon-pad detectors located at 70mm nominal radius. Each silicon detector has 512 1.4mm x 1.4mm x 1mm detector elements in a 16 x 32 array and is read out using VATA GP7 ASICs (Gamma Medica-Ideas, Northridge, CA). Even though virtually all interactions of 511 keV annihilation photons in silicon are Compton-scatter, both high spatial resolution and reasonable sensitivity appears possible. The system has demonstrated resolution of  $\sim 0.7$ mm FWHM with Na-22 for coincidences having the highest intrinsic resolution (silicon-silicon) and 6–7mm FWHM for the lowest resolution BGO-BGO coincidences. Spatial resolution for images reconstructed from the mixed silicon-BGO coincidences is  $\sim 1.5$ mm FWHM demonstrating the "magnifying-glass" concept. In the next months, the system will be upgraded to silicon detectors having 1mm x 1mm pads.

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