AbstractID: 4681 Title: Development of a high resolution imaging system for nuclear medicine

Purpose: To construct a diagnostic imaging system for nuclear medicine that can generate images with spatial resolutions of 1-2 mm and hence improve the image quality in diagnostic nuclear medicine.

Method and Materials: Tumors of 1-2 mm can be detected using photon diffraction to focus the gamma rays emitted by the radiopharmaceutical in the tumor region onto a detector, much like using a magnifying glass to focus sunlight on a small area. The gamma rays from the tumor volume are focused by an array of lenses, each comprised of small copper crystals arranged in concentric rings of increasing diameter. Specific crystalline plane orientations can be used for each ring so that the diffracted gamma rays converge on a small area on a detector's sensitive region. No collimation is needed since each lens in the system will focus one gamma-ray energy at one time.

Results: Preliminary data collected with a prototype lens using Co-57 and Tc-99m not only show that photon diffraction is a viable approach to focusing gamma rays, but yielded a spatial resolution of 3 mm. Sensitivity estimates based on these data indicate that a 9-lens array could detect a 1 μCi spherical source of 0.01cc in volume with a signal-to-noise ratio of 6-to-1.

Conclusion: The use of photon diffraction in diagnostic imaging in nuclear medicine is a strong and innovative technique that only this imaging system possesses. Photon diffraction eliminates the need for external collimation, which is the cause of limited sensitivity in gamma and SPECT cameras, because the crystal elements in a lens prevent photons with energies other than the specified energy from reaching a detector. Finally, detection of a tumor site at its inception can allow for earlier initiation of treatment and wider treatment options which can potentially improve the chances of a cure.