Title of Project: **Image quality measures from GaAs-Medipix3**

Project Number: **273**

University Project Leaders/Departments: Professor Phil Butler; Physics and Astronomy

Brief outline of project

Aim:
To evaluate CT image quality obtained using physic's recently acquired Gallium Arsenide Medipix3 detectors. Specifically the student will use this camera in a MARS-CT scanner to measure:

- Modulation Transfer Function (spatial resolution)
- CT number homogeneity
- Energy resolution
- Contrast Resolution
- Image Quality

The results will be compared to Silicon-Medipix2 and Silicon-Medipix3. Accurate calibration of spectral response, geometrical alignment and image quality is essential for quantitative and repeatable experiments. The results of these QA tests will be used to validate and improve camera performance so that more subtle differences can be identified.

Project Significance and Outline:
Medipix[1] is a photon counting X-ray detector that can simultaneously collect and discriminate photons of different energies giving unique and new radiographic information. The detector is mounted in the MARS (Medipix All Resolution Scanner) CT scanner which has been developed by a collaboration of Christchurch School of Medicine (CSM), University of Canterbury and Christchurch Hospital staff.

Recently the MARS team has obtained two "single" Medpix3 detectors with GaAs sensor layers bonded to them. These are being characterized by a Physics and Astronomy PhD student, Raja Amir, to look at 2D image quality. In this proposal the summer student will look at the image quality obtained when these detectors are used in a CT experiment.

GaAs-Medipix3 enables the use of higher energy x-ray beams, and therefore high atomic number radiography contrast agents. These contrast agents are an important area of radiological imaging. In clinical radiology, iodine and gadolinium are routine used. In pre-clinical development functional labels for macrophages and important enzymes have been developed (e.g. Angiotensin converting enzyme).

While the project is well circumscribed and standalone, the outcome of this project will directly impact the current MARS projects using high atomic number radiographic contrast agents; 1) functional imaging nano-particles and 2) functional cartilage imaging. It will also lay the foundation for future projects using this class of agents. In addition, the results will enable comparison with other students studying CdTe-Medipix3 and GaAs-Medipix3.

Expected Outcomes:

The student will review the phantoms and methods developed thus far along with a literature review of similar micro-CT QA methods[2,3]. Issues such as dark field mapping will be considered and compensated as necessary. The image quality factors described above will be documented, protocols developed and baseline data established. Image quality will be compared to existing silicon-Medipix measures as well as CdTe-Medipix image quality measures.

1. http://medipix.web.cern.ch/MEDIPIX/Medipix3/homeMP3.htm
2. Comparative Evaluation: Acceptance testing and constancy testing for micro-CT scanners, Biomedizinische Technik, 50, Supp 1, Part 2, 2005
3. Micro-CT, Marc Kachelriess pp23-52, W. Semmler and M. Schwaiger (eds.), *Molecular Imaging I.* 23 Handbook of Experimental Pharmacology 185/I, 2008

Specific student requirements:

Please indicate below any specific academic requirements you have for the summer scholarship student (e.g., specific level; specific courses, or equivalents, completed)

Student is to have completed 300 level study in technical sciences such as maths, physics, computing or engineering. A good working knowledge of Python or Matlab will also be helpful.

Special condition:

n/a