Bio-Medical and Plant Biology Imaging Tools Derived from Nuclear Physics Detector Development

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Basic nuclear physics research requires continuing advances in detector technology. Often, new detection technology can have applications outside basic nuclear physics research. For over 80 years various sciences have been using radioactive isotopes as tracers for increasing our understanding of biological processes in living systems. New nuclear physics detection technologies using scintillators and photo multipliers have been used to develop imaging tools for radioisotope detection and imaging in bio-medical and plant biology applications. Nuclear imaging techniques such as positron emission tomography (PET) and single photon emission computed tomography (SPECT) benefit greatly from advances in nuclear physics detector technology. Bio-medical research utilizing animals as in pre-clinical research and in clinical applications such as cancer detection and treatment have benefited much from nuclear physics detector advances. New imaging tools are being developed for plant biology research to enhance our understanding of metabolic processes necessary for efficient biofuel production in a changing environment and of best bioassays for environmental remediation. The Radiation Detector and Imaging Group at Thomas Jefferson National Accelerator Facility has been applying detector technology to these applications. The examples of detector systems for medical and plant biology applications as well as scientific motivations driving use of radioisotope tracers in these applications will be presented.
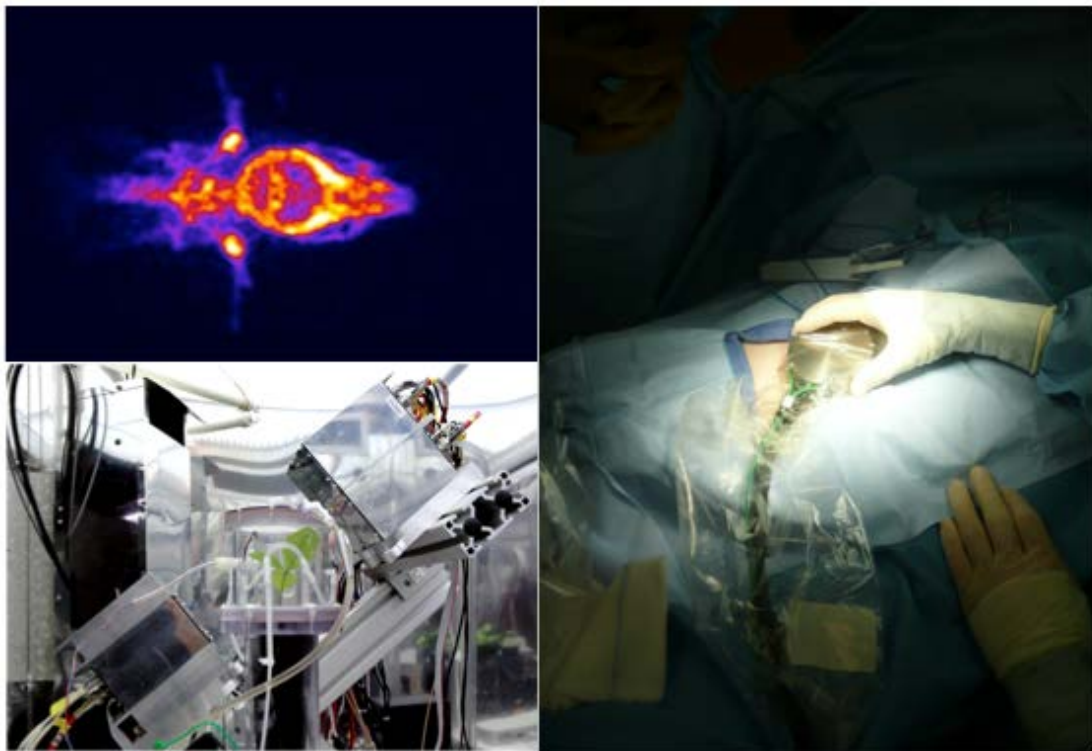
Figure 1: *(Right) Surgeon using a silicon photomultiplier based handheld gamma camera in the operating room. (Left-top) Image of a mouse injected with Tc-99m-methylene diphosphonate obtained with a crystal scintillator based gamma-camera. (Left-bottom) Plant biology PET study using C-11 tagged CO_2 gas.*