1. Current status

The value of positron imaging is becoming widely recognized in nuclear medicine. All major suppliers of gamma cameras are offering coincidence circuitry to address this trend toward positron imaging. There are several factors that have encouraged the trend toward positron imaging, including:

- Fluoro-deoxy glucose (FDG) studies being widely recognized as significant in oncology and as the gold standard in cardiac viability,
- Wider availability of FDG distributed in unit doses,
- Higher sensitivity and better image resolution than is possible with other imaging techniques,
- Higher patient throughput.

There are more and more PET (Positron Emission Tomography) isotope-generating cyclotrons in the United States, Europe, and in many other countries. FDG is the only radioisotope distributed at this time, but there exist a large number of other fluorine isotopes that may become important, such as Fluoro-Dopa, Fluoro-Tyrosine, F- and others.

The resolution and sensitivity improvement using positron imaging are well known. A ring tomograph such as the ECAT EXACT HR+ has an image resolution of approximately 4 mm and a sensitivity of 1,000,000 counts/sec/μci/ml. A typical SPECT (Single Photon Emission Tomography) tomograph has a resolution of 10 mm and a sensitivity 20 to 100 times less than a 3D PET tomograph. This ratio also applies to the maximum coincidence count rate, which is typically 600,000 counts/sec for PET and less than 20,000 counts/sec for a SPECT operated in PET mode. In the latter case much longer time is necessary to permit the accumulation of statistically significant images.

2. Detector Materials

Lutetium Oxyorthosilicate (LSO) was discovered in the late 1980s by a group from Schlumberger led by Charles Melcher. The group was looking for an ideal scintillator for use in “down-hole” oil exploration. As the scintillator was developed and better understood, it became evident that its characteristics were almost ideal for nuclear detection in medical applications and not so ideal for the high temperature and more hazardous environment of oil exploration application.

3. Scintillation Detectors: Past and Future

PET detector development has progressed significantly since the first PET tomographs. The number of elements have increased from a few tens of elements in the first tomograph at St. Louis to more than 100,000 in the new High Resolution Research Tomograph (HRRT) that was delivered to MPI, Koln in February of 1999. The HRRT is the first commercial LSO tomograph and it represents a major change in the technology used in detectors for PET. The ECAT HR+ is presently the highest resolution commercial PET tomograph and it uses BGO for the detector material. The commercial tomograph with the same detector as the ECAT HR+ but having six rows of detectors rather than four was the ECAT HR++ delivered to the MRC Hammersmith Hospital in London in 1997.