at which glucose is metabolized in different regions of the brain. Some remarkable findings have resulted from such studies:

1. Kuhl and colleagues at UCLA have scanned the brains of epilepsy patients, including some during seizures. The PET scans show that the brain cells that trigger a seizure are metabolically active during an attack. What surprised epilepsy specialists is that these same brain cells are less metabolically active between seizures than they are in normal people. The significance of this finding is as yet unknown.

   The UCLA doctors also have used PET to locate precisely the trigger site of seizures in patients where it could not be determined by other means. This has led to successful surgery in some previously inoperable cases.

2. NIH researchers have confirmed a theory that rare but deadly brain cancers called *gliomas* increase their metabolism when the speed of their growth increases. Doctors may delay operating on such tumors in their early stages because the surgery itself can do serious damage to the brain. The problem is that no good way now exists to determine the growth rate of the cancers. PET could be the answer.

Instrument Standardization Two standard instrumentation systems, the NIM and the CAMAC systems, were developed and coordinated as a result of efforts to improve the effectiveness and efficiency of scientific instrumentation.

The NIM system provides mechanical and electrical power supply interchangeability of scientific instruments and encourages a considerable degree of electrical signal compatibility. Mechanical interchangeability means that any NIM module (e.g., an amplifier) will fit mechanically into any NIM bin (a frame for holding modules). Electrical power supply interchangeability means that any NIM module, when inserted into any NIM bin, will be connected to the correct power supply. CAMAC includes these features plus the compatibility of digital signals and signal transfer processing, system interconnections, interfacing to computers and other processors, and associated software.

NIM and CAMAC are now the principal instrumentation systems used throughout the world in nuclear and radiation physics, nuclear chemistry, and nuclear medicine. Their use has also spread into other areas, including general laboratory and industrial research and industrial applications in process control and automated testing.

The CAMAC specifications are now industrial standards worldwide, having been promulgated by the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE), as well as by the International Electrotechnical Commission (IEC).

Approximately 80 firms supply NIM instruments and equipment. Over 50 firms manufacture CAMAC equipment. Major manufacturers of NIM and CAMAC instruments estimated United States sales for 1982 to be $23 million for NIM and $17 million for CAMAC. The United States market for NIM accounts for about 50 percent of the worldwide market, and the United States market for CAMAC accounts for about 60 percent of the worldwide market.

History Prior to the development of NIM and CAMAC, the users of solid-state nuclear instrumentation were severely limited in their ability to use the best available instrumentation. Instruments from different manufacturers often were neither electrically nor mechanically compatible. Consequently, the nuclear instrument user often had to choose to bypass the most appropriate instrument, to incur excessive costs by replacing all modules to obtain one new capability, or to design expensive ad hoc interface instruments.

In December 1963 the National Bureau of Standards, under contract to AEC's Division of Biology and Medicine (now OHER), urged that the National Laboratories develop a module that could become standard in all of those laboratories. Representatives of the National Laboratories met on February 26, 1964, to establish the NIM Committee and assign responsibility for developing a standard module system. Prototype bins and modules were produced by ORNL, LBL, and LLNL. The specifications for the NIM system were published in July 1964.

As automated and computer-linked nuclear instrumentation systems came into use, however, new compatibility problems arose. In late 1964 the Harwell Laboratory in England took the initiative to organize the development of CAMAC. In 1967 responsibility for the system development passed to the European Standards or Nuclear Electronics (ESONE) Committee of European Laboratories, which initiated close collaboration with the United States NIM Committee (still under OHER sponsorship). The ESONE NIM collaboration continues.

Benefits The benefits identified with the NIM and CAMAC standards include:

1. Flexibility and interchangeability,
2. Optimization of systems,
3. Ease of restructuring,
4. Deferred obsolescence,
5. Reduction of interfaces,
6. Ready interchange between installations,
7. Reduction of inventories,
8. Increased utilization of instruments,
9. Ease of serviceability,
10. Reduction of design costs, and
11. Savings in software costs.

These advantages can be translated into producer surplus or cost savings resulting from the use of NIM and CAMAC equipment. Annual benefits for 1982 were estimated to be $40 million. The present value of past and present cost savings associated with NIM and CAMAC between 1964 and 1982 totals $1.9 billion. Major factors contributing to these benefits are: