



**Title of Project : Interdisciplinary research on quantum imaging opened with 3D semiconductor detector**

Yasuo Arai  
( High Energy Accelerator Research Organization (KEK),  
Institute of Particle and Nuclear Studies, Professor )

**【Purpose of the Research Project】**

Radiations such as X-ray, infra-red light, charged particles, have a characteristic of a quantum particle in addition to that of wave. The purpose of this new scientific research area is to open such quantum particle detection with 3D fine structure semiconductor sensors.

In this research, both semiconductor engineers and scientific researchers such as astrophysics, elementary particles, and material sciences will cooperate (Fig. 1) with the help of industry technology.

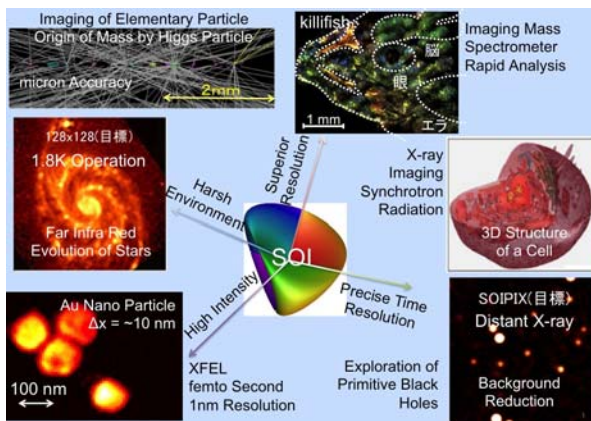


Fig. 1 Aim of this new scientific research area.

**【Content of the Research Project】**

Based on a Silicon-On-Insulator (SOI) technology, we will develop new detectors that combine high sensitive sensors and integrated circuits in a 3D structure.

Both the sensor structure and the readout circuit can be optimized independently, and the detector is produced in a fine semiconductor process. By using two Si active layers, measurements such as very low noise quantum detection, which is difficult in existing devices, become possible.

Furthermore, the SOI devices can be operated in very low temperature. Thus far-infrared light detection and superconducting sensors, which require low-temperature operation, also become possible.

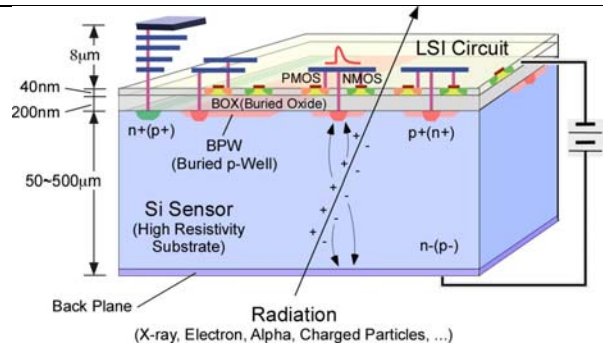


Fig. 2 Structure of SOI imaging sensor.

**【Expected Research Achievements and Scientific Significance】**

For a big leap of science, a new detector often plays an essential role. Many of the detectors are so far original in foreign countries, but in this project researchers can realize their idea in the SOI detector developments by their own.

With these kinds of detector developments for pioneering measurements, we can lead the world in various scientific fields.

The SOI detectors are also useful in existing fields to improve the quality utilizing its small pixels and high performance.

**【Key Words】**

Silicon-On-Insulator: The technology developed for low-power and high-performance integrated circuits. It bonds two Si wafers interleaved by an insulator layer. We are using the bottom thick silicon as a radiation sensor matrix.

**【Term of Project】** FY2013-2017

**【Budget Allocation】** 1,063,200 Thousand Yen

**【Homepage Address and Other Contact Information】**

<http://rd.kek.jp/project/soi/shingaku>  
yasuo.arai@kek.jp