



# Indian Institute of Technology Hyderabad

Ordinance Factory Campus  
Yeddumailaram 502205, AP

## Hitachi Expert Lecture Series @ IIT Hyderabad

### Superconductive Electronics

**Venue: Lecture Hall-2, IITH**

**Date: March 9, 2011**

**Time: 3 – 5 PM**

**Speaker: Kazuo Saitoh, PH. D.**

**Affiliation: Laboratory Manager, Advanced Research Lab., Hitachi Ltd.**

#### ***Abstract***

The year of 2011 is a centennial anniversary of Superconductivity. That is, Prof. Kamerlingh Onnes at Leiden University found out that peculiar property of metal (Hg); resistance vanishes at very low temperature. It was done in 1911 and due to the virtue of the technology of refrigeration. In fact, he was succeeded in liquefied gas of Helium before his outstanding discovery. We should notice the temperature of liquid Helium is 4.2K.

The objective of the lecture is to enjoy some introductory knowledge of superconductivity and its application for Electronics. Firstly, some historical stories will be given with the view of superconductive material, which includes Copper Oxide Superconductors as well as some classical materials. Then, basic properties of Superconductivity may briefly be reviewed. The most important point is that the Superconductivity is an example of Macroscopic Quantum Effect. As a result, in addition to (a) ZERO-Resistance at low temperature, following distinctive phenomena were discovered: (b) Meissner Effect, (c) Flux Quantization, (d) Josephson Effect.

In this lecture, we mainly focus on the DIGITAL Application of Superconductivity, though the technology has not been practical yet, it is quite challenging issue. The circuitry named Single Flux Quantum (SFQ) circuit will be discussed. The principle of the SFQ circuit is based on the (c) Flux Quantization, (d) Josephson Effect. The basic idea of the circuit is employing the single flux in the superconductive device as a digital signal. The feature of the circuitry is ultra-fast operation (several tenth giga-hertz) and very low power consumption (micro watt per gate). Finally, results of our research will be shown.

#### ***Panel Discussion***

#### **Topic: Superconductive Electronics**

Kazuo Saitoh, PH. D., Laboratory Manager, Hitachi Ltd  
Dr. Saket Asthana, Asst. Professor, IIT Hyderabad  
Dr. Shiv Govind Singh, Asst. Professor, IIT Hyderabad