

# DEPARTMENT OF ELECTRICAL ENGINEERING

Graduate Seminar Guest Speaker

**Dr. A. G. UNIL PERERA**

Department of Physics & Astronomy  
Georgia State University

## “Homo and Heterojunction Multi-band (UV –FIR/THz) Photon Detectors”

Friday, April 7, 2006

11:00 AM

Knox 109

### ABSTRACT

The work describes multiband photon detectors based on semiconductor micro- and nano-structures. The devices considered include quantum dot, homojunction, and heterojunction structures.

A Homojunction or Heterojunction Interfacial Workfunction Internal Photoemission (HIWIP or HEIWIP) infrared detector, formed by a doped emitter layer, and an intrinsic layer acting as the barrier followed by another highly doped contact layer, can detect near infrared (NIR) photons due to interband transitions and mid/far infrared (MIR/FIR) radiation due to intraband transitions. The threshold wavelength of the interband response depends on the band gap of the barrier material, and the MIR/FIR response due to intraband transitions can be tailored by adjusting the band offset between the emitter and the barrier. GaAs/AlGaAs will provide NIR and MIR/FIR dual band response, and with GaN/AlGaN structures the detection capability can be extended into the ultraviolet region.

In the quantum dot structures, transitions are from one state to another, while free carrier absorption and internal photoemission play the dominant role in homo or heterojunction detectors. Quantum Dots-in-a-Well (DWELL) detectors can tailor the response wavelength by varying the size of the well. A tunneling Quantum Dot Infrared Photodetector (T-QDIP) could operate at room temperature by blocking the dark current except in the case of resonance. Photoexcited carriers are selectively collected from InGaAs quantum dots by resonant tunneling, while the dark current is blocked by AlGaAs/InGaAs tunneling barriers placed in the structure. These detectors are useful in numerous applications such as environmental monitoring, medical diagnosis, battlefield-imaging, space astronomy applications, mine detection, and remote-sensing.

### BIOGRAPHY

Dr. Perera obtained his BS from University of Colombo, Sri Lanka with a First Class honors (Physics Special) and went to the University of Pittsburgh for his graduate studies. After his graduation he stayed on at Pittsburgh as a research assistant Professor until 1992. Moving to Georgia State University in September 1992, he initiated the Optoelectronics Laboratory with NSF and GSU support. He has developed wavelength tunable IR detectors resulting in one patent and another patent application. Perera is also working on other type of IR devices, including Multi Quantum Well and pulsing IR detectors and has led a project to “Search for Fractional Charge Impurities in Semiconductors” at the NSLS which was funded by DOE. His work on interfacial IR detectors was featured in “**Laser Focus World**” NewsBreaks in 1992, and the work on fractional charge impurities are recorded in “Reviews of Modern Physics”. His FIR QWIP work was highlighted in the November 2000 issue of **Photonics Spectra**, Technology World Briefs and recent heterojunction FIR detector was featured in the June 2001 issue of **Laser Focus World**” NEWSBREAKS. His three color Qdots in a well detector work was highlighted in the December 2003 issue of **Laser Focus World**” NEWSBREAKS and more recently his dual band detector work is also listed in the Laser Focus NEWSBREAK. He was invited, and has participated in several “advanced research workshop on **QuantumWell Intersubband Physics and Devices**” and has given invited talks at APS, SPIE, ECS and IASTED conferences. He has written 5 book chapters and has contributed to the CRC dictionary of electronics, co-edited a volume on thin film optical devices for a 5 volume handbook. He has served on NSF and NASA review panels and also as a reviewer for numerous research proposals and papers. Dr. Perera has had over 100 refereed journal articles published and a patentee in the Infrared Detector field.