



Australian Institute of Physics NSW Branch (June Public Talk)

**“From the Gas to Solid State Micro-and Nano-
Dosimetry: Radiation Medicine & Space Applications”**

Professor Anatoly B. Rozenfeld

Centre for Medical Radiation Physics, University of Wollongong

Tuesday 24th June 2008 @ 6.00PM

At the

Slade Lecture Theatre, School of Physics, University of Sydney

Public talk arranged by: The Australian Institute of Physics (NSW Branch)

Entrance is FREE

Summary of talk:

Prediction of biological effect of ionizing radiation is an important issue for radiation medicine and terrestrial, avionics and space radiation protection. It is well known that radiation absorbed dose is a surrogate for prediction of radiation effects and applicable for low linear energy transfer (LET) radiation only. The concept of *dose equivalent* was introduced to better compare radiobiological efficiency (RBE) by different ionizing radiations. This concept is based on measurements of pattern of stochastic deposited energies by charged particles on a cellular level in tissue represented by a sphere of 2-5 microns diameter. This approach is called *microdosimetry*. Traditional instrumentation for microdosimetry is a tissue equivalent gas proportional counter (TEPC) utilizing low pressure of TE gas and has quite large order of centimetre in size. A new generation of microdosimeters which substituted TEPC by micron size array of silicon sensitive volumes has been originated and developed at the Centre for Medical Radiation Physics (CMRP) University of Wollongong. Silicon on Insulator (SOI) technology has advantage for microdosimetry detectors allowing fixed micron size well defined sensitive volumes (SV) for charge collection deposited by ionizing event. SOI microdosimeters were produced and investigated in a broad range of radiation fields: fast neutron, proton and heavy ions fields including hadron therapeutic oncology modalities and NASA radiation laboratory for deep space radiation effect modelling. Recently further improvement in SOI microdosimetry was possible by development of array of 3D cylindrical SVs of 1-2 micron size with well defined charge collections in partnership with semiconductor nanofabrication facility (SNF) at UNSW and ANSTO, where heavy ion microprobe has been proved as an ideal tool for investigation of microdosimeter's response on ions with wide range of LET. The next step in SOI microdosimetry, which is currently under development at CMRP with our partners, is a monolithic chip with array of SVs with micron and submicron size and with built in readout electronics on the same SOI chip. Fabrication will be done in collaboration with microelectronic industry utilizing 0.18 microns and 90 nm technology. Such radiation detectors will be capable in detection of charged particle radiation track features that will expand radiobiological functionality of microdosimeter. Application of developed silicon microdosimetry in charged particles therapy for RBE measurements and in radiation protection for space and avionics will be presented. The next stage of our R&D is a solid state real time nanodosimetry. Nanodosimetry is defined as quantification of ionizations or energy deposited by ionizing radiation within sensitive volumes of nanometer dimensions. For applications in biomedicine the relevant sensitive volume should match the dimensions of a short segment of DNA and the surrounding medium. We are investigating different approaches by utilization of quantum dots and silica microspheres in conjunction with new silicon Geiger mode photomultipliers (SiPM). Instrumentation for prediction of DNA damage will be new step in radiation protection and charged particles radiotherapy.





Brief Biography of the Speaker:

Anatoly Rozenfeld is a Professor at the University of Wollongong, School of Engineering Physics. He was born in Kiev and has moved to Australia at the end of 1992. He has joined University of Wollongong in 1993 as a lecturer aiming to work on development of medical radiation physics research and educational program. His scientific interest is in the development of innovative radiation semiconductor detectors and instrumentation based on them for radiation dosimetry, microdosimetry and nanodosimetry for radiation therapy including proton, heavy ions and synchrotron therapies, space applications and medical imaging and HEP. His major contribution in a field is in the development of mini-silicon detectors for real time dosimetry in radiotherapy and imaging. They are MOSFET detectors, silicon neutron sensors, nuclear spectroscopy based in vivo dosimetry, radiation damage monitoring dosimetry for nuclear reactors and HEP and others. Anatoly originated and contributing strongly to silicon microdosimetry direction and leading international collaboration in this field. Currently he is working with his team on semiconductor nanodosimetry.

Anatoly is a founder and Director of the Centre for Medical Radiation Physics (CMRP) which is the research strength of the University of Wollongong and a major provider of education and multidisciplinary research in medical radiation physics in Australasia. He has originated proton therapy research in Australia and currently CMRP is leading proton therapy education and research in Australia with strong collaboration with USA partners and RPAH. He was selected and is serving on many international committees: IEEE Radiation Instrumentation Steering Committee (RISC), Solid State Dosimetry Scientific Advisory Committee, AFOMP research committee and International Advisory Board on Microdosimetry (MICROS 2005). He is a member of the Editorial Board of Journal of Instrumentation (JINT) and Physica Medica (European Journal of Medical Physics). He actively collaborates with ANSTO and contributed strongly to the creation of a radiation detection group there which is closely working with CMRP, he served as University of Wollongong councillor and member of the specialist committee at Australian Institute of Nuclear Science and Technology (AINSE). Anatoly was elected to be Chairman of the Asian-Pacific Program at IEEE NSS MIC 2007 and Chair of Hadron Therapy Innovation Technology Workshop (2005-2008) at this premier radiation detection science meeting. Also he was recently elected to be the Chairman of Solid State Dosimetry conference in 2010 (SSD 16), which will be held in Sydney. Anatoly was awarded with his MSc (with Distinction) in semiconductor physics and PhD in a field of radiation physics from Leningrad Polytechnic Institute (USSR) and Institute for Nuclear Research (Ukraine) respectively. He has published more than 150 peer reviewed publications and hold 12 patents in a field of radiation detectors.

Detailed Schedule for Tuesday, 24th June 2008:

- **6:00-6.30 pm REFRESHMENTS, Slade Lecture Theatre.**
- **6.35-7.30 pm LECTURE by Professor Anatoly B. Rozenfeld.**
- **8.00 pm DINNER with the Speaker at Buon Gusto (Italian), 368 Abercrombie Street, Chippendale.**
E-mail Dr Fred Osman (fred_osman@exemail.com.au) if you will be able to join us for dinner.

Travel Directions:

- Train to Redfern station and walk to the **School of Physics**.
- Buses 422, 423, 426, 428, 448, and 450 from Circular Quay to City Road / King, or 412, 435, 438, 470, 483 etc. along Parramatta Road from Circular Quay.
- Drive and park in various parking lots. You will need to pay for parking (**\$6 flat-rate after 4 pm**) and display the ticket in your car. You may also find parking places on public roads outside the Uni.

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