Department of Mathematics and Statistics &
Department of Physics and Engineering Physics

Seminar Announcement

Tuesday
October 25 2016

Physics Building
Room 103 @ 3:30 PM

Gamma Knife Radiosurgery Basics: a Physicist's Prospective

Guest Speaker: **Valeriy V. Kostyuchenko,** Medical Physicist
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Abstract: In this talk we will start from some aspects of radiation physics, discuss interaction of radiation with matter, the means of generating radiation, and how all this allows us to deliver large doses of radiation deep inside the matter. Then we will discuss radiobiological questions, that is, how radiation influences biological tissues – the DNA damage, chromosome aberrations, and the role of oxygen. Mathematical models, such as Linear-Quadratic Model (LQM) of cell damage, allow us to make some calculations of biological effects and define a fractionation scheme using the Biological Effective Dose (BED) concept. Fractionation is commonly used in the conventional radiation therapy (RT), due to the fact that tumors and normal tissues respond to the radiation differently. In particular, there is a so-called therapeutic gap between the probability curves of tumor control (TCP) and complications in normal tissues (NTCP). But a modern technique which began with Radiosurgery (RS) introduced by Lars Leksell in 1951 and was realized in the Gamma Knife since 1967, and later also in other units, suggests another possibility – conformal/stereotactic irradiation. First introduced for brain treatments (Stereotactic RS - SRS), and intended for functional disorders, it quickly became common for tumor and AVM treatment, and has now expanded to the spine and other localizations through the Image Guided Technology (IGRT), respiratory synchronization, and so on. This field is called Stereotactic Body RT (SBRT) or Stereotactic Ablative RT (SAbR). This direction has a different, "surgical", perhaps a simpler view on the problem, compared to radio oncology (with less importance of fractionation but necessity to account for systemic effects – blood supply, immune reaction, etc.). This approach, more practically efficient due to high dose technique, becomes increasingly popular, partly moving towards RT, and partly superseding it through the hypo fractionation methods.

Due to their knowledge of fundamental science and versatility, medical physicists are key specialists in the applied principally interdisciplinary RT field. In a clinical setting, a medical physicist routinely executes dosimetry testing and treatment planning, but also in many cases defines the future of RT. First RT devices were developed by clinical engineers themselves, and only later became manufactured by large companies like Philips, Varian, Elekta, etc. Later, the same path, from a "physics art" to industry, was traced by computer treatment planning. What is the present state and the future of the "physics art" in this area? We will try to address this question.

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