Termine: donnerstags 16-18 Uhr (reservierte Termine und Themen)

~~18.4. / 25.4.~~ / 2.5. / 16.5. / 23.5. / 6.6. / 13.6. / 20.6. / 27.6. / 4.7. / 11.7. / 18.7. / 25.7.

(13 Seminartermine)

Selection of Topics 1-16 (The sub-headings outline the potential content)

1. The era of the discovery of ionizing radiation and subsequent fascination with ionizing radiation

    - discovery of X-rays and natural and artificial radioactivity
    - new insights into atom composition; models of the atom
    - why do some atoms decay?
    - first knowledge of the biological effects of ionizing radiation (Radium girls etc.)

2. Why doesn't one cappuccino kill us but 1 Sv radiation does? Interactions of different types of ionizing radiation with matter; Specific aspects of interactions with biological systems

    - why doesn't one cappuccino kill us but 1 Sv radiation does?
    - Interactions of different types of ionizing radiation with matter
    - Specific aspects of interactions with biological systems

3. New perspectives in radiotherapy: photonic vs. particle radiation, new irradiation techniques and regimens

    - standard photon therapy
    - stereotactic radiosurgery (SRS)
    - proton irradiation
    - heavy-ion irradiation
    - FLASH
    - hyperfractionation
    - hypofractionation
    - brachytherapy
    - boron neutron capture therapy
    - radio-immuno therapy (etc.)

4. Therapeutic possibilities of radioprotection and radiosensitization

    - chemical radioprotectors and radiosensitizers,
    - metal nanoparticles as new nanodrugs in cancer therapy

5. Deterministic vs. stochastic effects of ionizing radiation; carcinogenesis

    - mechanism of deterministic vs. stochastic effects
    - acute vs. late effects
    - high vs. low dose effects
    - acute radiation syndrome (ARS)
    - general principles of radiation carcinogenesis and results from epidemiological studies

6. Current topics in biophysical and radiobiological research, current research methods .

- DNA: analysis of chromosomal aberrations (classic karyotyping, FISH, 3D-FISH, mFISH, mBanding, gene sequencing)
- RNA: qRT-PCR; RNA-CHIP technology, northern blotting
- PROTEINS: Western blotting
- CELL STATUS ANALYSES: clonogenic assay, flow cytometry and other
- methods to analyze cell cycle distribution, apoptosis and cell survival, real-time monitoring of cell proliferation, analysis of cell migration
- SPECIAL METHODS: confocal microscopy of fixed and live cells, nanoscopy (SMLM)
- genome-scale (omics) approaches: profiling of genomes, transcriptomes, proteomes; structuromics
- irradiation of cell cultures with different types of ionizing radiation, etc.

7. Radiation sources contributing to overall human exposure, health risks from radiation in the context of otherwise dangerous lives

    - which sources of ionizing radiation contribute the most to human exposure?
    - natural sources of ionizing radiation - Cosmic radiation, terrestrial radiation, etc.
    - atomic bomb testing
    - nuclear disasters
    - growing radiation exposure and health risks associated with injudicious medical application of ionizing radiation (preventive whole-body CT scans, panorama dentistry scans, mammography in BRCA1-mutated patients, etc.)

8. Nuclear disasters and lessons for the future (2 talks)

    - comparison of causes and consequences of various nuclear disasters
    - Project Manhattan – the most extensive and magnificent project in human history; the largest concentration of scientists in one place; Robert Oppenheimer: “Now I am become Death, the destroyer of worlds“ – Philosophical and ethical aspects of atomic bombing of Hiroshima and Nagasaki
    - Chernobyl - worst radiation disaster ever
    - Fukushima - a mighty force of nature
    - Three Mile Island - when protection in depth is working
    - Majak - when human lives don't matter
    - and other small but surprising radiation accidents
    - basics of radiation protection
    - necessary caution with regard to media reports on "radioactivity"
    - the forgotten heritage of the overground atomic bomb tests

9. Cosmic radiation, health risks to astronauts during inter-planetary flights

    - the spectrum of cosmic radiation (low earth orbit vs. space)
    - the effects of single particles (ions)
    - is there any co-effect cause by micro-gravity

10. Radiation DNA damage and DNA repair at the molecular level

    - types of (radiation) DNA damage
    - DNA double-strand break repair
    - repair of other types of DNA damage

11. Cell nucleus as the main target for ionizing radiation: DNA damage, repair and misrepair in the context of chromatin

    - why is DNA the main target for ionizing radiation?
    - various types of DNA lesions, effects of sparsely and densely ionizing (high-LET) radiation in functionally and structurally distinct chromatin domains
    - DNA repair mechanism and efficiency in the context of chromatin architecture
    - chromosomal aberration formation, biodosimetry
    - epigenetics and epimutations
    - factors influencing DNA repair pathway selection at the pan-nuclear scale and at individual damage sites

12. What makes cells and organisms radiosensitive or radioresistant, examples of extremely radioresistant organisms

    - amplification of genes of the resistance to radiation
    - the contribution of the immune-system (late Chernobyl effects on nature)

13. Differences in the response to radiation of normal and cancer cells

    - hereditary mutations in DNA repair genes
    - cell cycle distribution an cell cycle defect
    - hypoxia
    - chromatin architecture
    - ROS homeostasis
    - defects of apoptosis
    - bystander effects

14. The necessity for a multidisciplinary approach in biophysical research – physical, physico-chemical, chemical, biological and medicinal effects of ionizing radiation

    - linear, non-threshold assumption in radiation protection
    - improving the safety protection rules
    - research results vs. political reasoning

15. Nonsenses about ionizing radiation and its (health) effects in media

    - the differences between French and German salad after the Chernobyl disaster
    - the German “Molkezug” and its travelling through the country
    - statistics and politics about leukemia around atomic power plants

16. Principles and rules of radiation protection

    - distance, time, shielding,
    - dose limits for professionals and normal population
    - The ALARA principle