JSMP Medical Physics Summer Seminar 2014

Septmber4-6,2014　KURE-HIROSHIMA

*JSMP医学物理サマーセミナー2014：
会場：グリンピアせとうち
会期：2014年9月4日（木）～6日（土）
受付：9月4日（木）12:30～13:00
開校式：9月4日（木）13:00～13:20
閉講式：9月6日（土）11:50～12:10

*お知らせ

①9月4日：空港及び新幹線広島駅から、ホテル送迎バスを運行します。
1）広島空港：11:40発：1便予定
　集合場所：国内線到着ロビーと国際線到着ロビーの中間付近(お知らせ.pdf)参照
2）新幹線広島駅：11:30発；2便予定
　集合場所：広島駅新幹線口バス駐車場付近.
（お知らせ.pdf）参照。

おしらせ.pdf.（クリック）

②セミナー講義資料ダウンロードについて：
セミナー参加者は，講義資料をダウンロード・印刷し，当日各自で御持参願います。当日の資料配布はありませんのでご注意ください。

https://www.bunken.org/jsmp/documents/jp/login.php

参加受付番号とe-mailアドレスによるログイン

③お知らせpdf(8/29参加者へ配信)

おしらせ.pdf.（クリック）

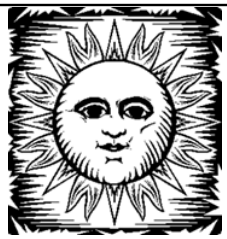
JSMP医学物理サマーセミナー2014 プログラム

September 4-6, 2014 Kre-HIROSHIMA

Day 1: Thursday Sep 4		
13:00	13:20	Welcome, Course overview
13:20	14:40	Radiation Protection and Safety 1 (赤羽恵一)
14:50	16:10	Radiation Protection and Safety 2 (赤羽恵一)
16:20	17:40	Nuclear Medicine/Imaging 1 (吉田英治)
17:50	19:10	Nuclear Medicine/Imaging 2 (吉田英治)
19:30		Banquet
Day 2: Friday Sep 5		
5:30	6:30	Walking
7:00	8:50	Breackfast
9:00	10:20	External Photon Beams: Physical Aspects (小澤修一)
10:30	11:50	Erectron Beams: Physical Aspects (小澤修一)
12:00	13:00	Lunch
13:10	14:30	Magnetic Resonance Imaging 1 (山本　徹)
14:40	16:00	Magnetic Resonance Imaging 2 (山本　徹)
16:00	18:30	Recreation
18:30	19:30	Supper
20:00		Night session & Informal Q&A
Day 3 Saturday Sep 6		
7:00	8:50	Breakfast
9:00	10:20	Cone-Beam CT (芳賀昭弘)
10:30	11:50	Spesial Procedures and Techniques in Radiotherapy (SRS,SRT) (塩見浩也)
12:00		Closing remark, 集合写真撮影

事務局：JSMP教育委員会サマーセミナー実行委員
（担当：小野・有村・小澤・荒木・水野・松本・和田）お問い合わせはe-mailでお願いします。mailto: jsmp2014summer@nirs.go.jp

Syllabus:Medical Physics Summer Seminar 2014 in Kure *'provisional'2014/06/30-07/30*



Ⅰ.Radiation Protection and Radiation Safety
1. Introductions and Historical Perspective
(a) Discovery and early application of ionizing radiation
(b) Observed radiation injury
(c) Suggested radiation protection practices
(d) Pre-regulatory initiatives
2. Interaction Physics as Applied to Radiation Protection
(a) Indirectly and directly ionizing radiation
(b) Bethe-Bloch formalism for coulomb scattering, shell effects, polarization phenomena,
nuclear processes, adiabatic scattering, track structure, target phenomena, radioactive
processes, Anderson-Ziegler parameterization, Janni tabulation, and effects due to
mixtures and compounds
(c) Electromagnetic interaction: photoelectric effect, Compton effect, pair production,
shower cascade phenomena
(d) Neutron interactions: elastic and non-elastic processes
3. Operational Dosimetry
(a) Units
(b) Kerma and absorbed dose
(c) Dose equivalent
ii. Dose/dose equivalent interpretation
iii. TLD energy, dose, dose rate response
(c) Dose equivalent instrumentation
i. Energy dependence
ii. Pulse field response
5. Shielding: Properties and Design
(a) Directly ionizing particles
(b) Indirectly ionizing particles
(c) Build-up parameterization
(d) Stochastic sampling: Monte Carlo
i. Source description and sampling
ii. Interaction sampling
iii. Geometry effects
iv. Scoring
v. Public domain codes
(e) Particle Accelerators
i. Primary particle shielding
ii. Secondary-tertiary particle shielding
iii. Energy and particle type dependence
iv. Interlocks and access control

Ⅱ. Nuclear Medicine/Imaging
1. The Gamma Camera
(a) Camera characteristics
(b) Collimators
(c) Crystals
(d) Photomultiplier tube array
(e) Image formation
(f) Spectrometry
(g) The pulse height analyzer
2. Radionuclide Image Quality
(a) Contrast
(b) Blur and visibility of detail
(c) Image noise
(d) Uniformity
(e) Clinical gamma camera applications
3. Radionuclide Tomographic Imaging
(a) Positron Emission Tomography (PET) and PET-CT
i. Principles of PET imaging, hardware, resolution, acquisition modes
ii. Clinical PET imaging procedures
iii. Quantitative PET imaging
iv. Cine (4D) PET
(b) Single Photon Emission Computed Tomography (SPECT)
i. Principles of SPECT imaging, hardware, resolution
ii. Clinical SPECT imaging procedures
iii. Quantitative SPECT imaging
4. Statistics: Counting Error
5. Patient Exposure and Protection
(a) Internal dosimetry
(b) Clinical dosimetry and typical doses for common imaging procedures
(c) Radionuclide therapy dosimetry
6. Personnel Exposure and Protection
(a) Effective dose equivalents
(b) Exposure limits
(c) Exposure sources
(d) Area shielding
(e) Personnel shielding
(f) Exposure from radioactive sources
7. Radiation Measurement
(a) Ionization chambers
(b) Survey meters
(c) Activity measurement

Ⅳ. Magnetic Resonance Imaging
1. Basic Principles
(a) Intrinsic and extrinsic parameters affecting MR image contrast
(b) Required properties of nuclei that are useful in MR
(c) The static magnetic field (B0) and the equilibrium distribution
(d) The Larmor frequency and the radiofrequency field (B1)
(e) The lab and rotating frames of reference
(f) Relaxation mechanisms (T1, T2, T2*) and effects of common contrast agents
(g) The basic spin-echo sequence
(h) Contrast in spin-echo imaging
(i) Spatial encoding using linear magnetic field gradients (Gx, Gy, Gz)
i. Slice selection
ii. Frequency-encoding
iii. Phase-encoding
iv. 2D vs. 3D acquisitions
(j) Properties of "k-space"
2. Hardware
(a) The static magnetic field subsystem
i. Common field strengths and magnet designs
ii. Siting issues
(b) The radiofrequency (RF) field subsystem
i. Coil designs: volume, surface, phased array
ii. Radiofrequency shielding requirements (siting)
(c) The gradient field subsystem
i. Maximum amplitudes, risetimes, and slew rates
ii. Eddy current effects and compensation techniques
3. Basic Image Quality Issues
(a) Signal-to-noise ratio and contrast-to-noise ratio in MRI
(b) Resolution
(c) Image acquisition time
4. Basic Pulse Sequences
(a) Spin-echo sequence
(b) Gradient-echo sequences
(c) Fast spin-echo sequence
(d) Inversion recovery sequences and applications [STIR, FLAIR (Short Time Inversion Recovery, Fluid-Attenuated Inversion Recovery)]
(e) Common sequence options (spatial and chemical saturation techniques)
(f) Ultrafast imaging sequences (echo planar imaging and

v. Modeling radiation environment
(f) NCRP (National Council on Radiation Protection and Measurements) shielding
recommendations and techniques
6. Statistics
(a) Statistical interpretation of instrument response
(b) Design of experiments
(c) Stochastic and nonstochastic error analysis
(d) Interpreting experimental results
7. Radiation Monitoring of Personnel
(a) Instrumentation and techniques
(b) Integral and active devices
(c) Dynamic range and response sensitivities
(d) Film, TLD, Lexan, and CR-39
(e) Pocket ion chambers and GM counters
(f) Pregnant workers and fetal dose limits
8. Internal Exposure
(a) ICRP 26, ICRP 2A recommendations
(b) Medical internal radiation dose (MIRD) dosimetry
(c) Monitoring and radiation control
(d) Biological assay
(e) Dispersion in a working environment
(f) Allowed limit of intake and derived air (or water) concentrations
9. Environmental Dispersion
(a) Release of radionuclides to the environment
(b) Dosimetric consequences
(c) Environmental Protection Agency (EPA) and U.S. Nuclear Regulatory Commission
(NRC) air and water dispersion models
10. Biological Effects
(a) Basic radiation biology
(b) Nonstochastic and stochastic responses
(c) Biological experimental data base of radiation injury
(d) BEIR (Biological Effects of Ionizing Radiation) and UNSCEAR (United Nations
Scientific Committee on the Effects of Atomic Radiation) Reports
(e) Patient and fetal dose issues
11. Regulations
(a) What is; what is not
(b) 10CFR19-70; 49USDOT300-399, 198; 219SFDA 278; 290SHA; 42USPHS; 40USEPA
(c) States: agreement or not
(d) Relationship to NCRP and ICRP (International Commission on Radiation Protection)
12. High/Low Level Waste Disposal
(a) USNRC/USDOE/USEPA Repository (U.S. Nuclear Regulatory Commission/
Department of Energy/Environmental Protection Agency)
(b) Low level compacts
(c) Future impacts
13. Nonionizing Radiation
(a) Electromagnetic and sound hazards
(b) Device emission requirements
(c) Measurement techniques
(d) Regulatory control

8. Principles of Radiochemistry, Radioimmunoimaging, and the Radiopharmacy
(a) Radiochemistry principles
(b) Radioimmunoimaging and radioimmunotherapy principles
(c) Radiopharmacy techniques
9. Quality Control Issues in Nuclear Medicine

Ⅲ. External Beam Radiation Therapy
1. Clinical Photon Beams: Description
(a) Basic parameters: Field size, source-skin distance, source-axis distance, sourcecollimator
distance
(b) Field size options: Circular, square, rectangular, irregular
(c) Field collimators: Primary, secondary, and tertiary placement of collimators;
rectangular (upper and lower jaws); circular; multileaf collimators
2. Clinical Photon Beams: Point Dose Calculations
(a) Percentage depth dose (PDD)
(b) Peak-scatter factor (PSF)
(c) Tissue-air ratio (TAR)
(d) Tissue-maximum ratio (TMR)
(e) Tissue-phantom ratio (TPR)
(f) Scatter function
(g) Scatter-air ratio (SAR)
(h) Scatter-maximum ratio (SMR)
(i) Collimator factor
(j) Relative dose factor/output factor
(k) Off-axis ratio
3. Clinical Photon Beams: Basic Clinical Dosimetry
(a) Factors affecting the fundamental dosimetry quantities
(b) Relationships between the fundamental dosimetry quantities
(c) Collimator and phantom scatter corrections
(d) Irregular fields and Clarkson's integration method
(e) Tissue heterogeneities and corrections
4. Clinical Electron Beams
(a) Electron treatment head
i. Energy selection
ii. Beam broadening methods: dual scattering foil vs. scanned beam
iii. Collimating methods: trimmers vs. applicators (cones)
(b) Depth-dose distribution
i. Characteristics (Ds,Dx,R100,R90,Rp,R90-10)
ii. Variation with energy and field size
(c) Energy spectrum
i. Characteristics (_E, Ep)
ii. Specification at surface (range-energy relationships) and depth
(d) Dose distribution
i. Beam flatness and symmetry
ii. Penumbra
iii. Isodose plots
(e) Determination of monitor units
i. Method of dose prescription
ii. Output factor formalisms
(f) Effect of air gap on beam dosimetry
(g) Fundamental principles
i. Square-root method
ii. Effective vs. virtual source
iii. Side-scatter equilibrium
5. Special Photon and Electron Beams
(a) Intensity-modulated radiation therapy with photon beams
i. Linacs with multileaf collimators
ii. Tomotherapy
iii. Stereotactic beams and robotic linacs
(b) Intensity-modulated radiation therapy with electron beams

spiral techniques)
(g) MR flow sensitive sequences
i. Flow-related phenoma
ii. Time-of-flight MRA
iii. Phase contrast MRA
iv. Bolus contrast agent-enhanced MRA
v. Perfusion sensitive imaging
vi. Diffusion-weighted and diffusion tensor imaging
(h) Functional MRI neuroimaging techniques
i. Physiological basis
ii. Imaging methods
iii. Experiment design and analysis
(i) MR spectroscopy (MRS) sequences
(j) Parallel imaging techniques
5. Artifacts and Methods for Artifact Rejection/Reduction
(a) Motion
(b) Aliasing or "wrap-around"
(c) Metal objects
(d) Chemical shift
(e) Truncation
(f) System-related
i. Distortions
ii. RF coil problems and RF interference
iii. Ghosting
iv. Receiver/memory/array processor problems
(g) Spatial accuracy limits and optimization
6. Safety and Bioeffects
(a) Static field considerations (projectile, effects on implants, physiological effects)
(b) RF field considerations (tissue heating, specific absorption rate, burn injuries)
(c) Gradient field considerations (peripheral nerve stimulation, sound pressure levels)
(d) Food and Drug Administration (FDA) guidelines
(e) MR and pregnant patients, technologists, and nursing staff
(f) Common MR contrast agents
7. Quality Control
(a) The ACR (American College of Radiology) standards related to MRI
(b) The ACR MR Accreditation Program (MRAP)
(c) The ACR MR Quality Control Manual and its recommended quality control aspects
(d) Other guidelines, including AAPM task group reports and NEMA (National Electrical
Manufacturers Association) reports

Ⅴ-1. Corn Beam CT for IGRT
1.CT image reconstruction (parallel beam)
2 CT image reconstruction (fan beam)
3 CT image reconstruction (cone beam using flatpanel)
4 expand reconstruction field
5 4D cone beam CT
5.1 Edge enhancement
5.2 Signal summation
5.3 Normalized cross correlation
6 Imaging artifacts
7 Scatter, scatter rejection,beam hardening

Ⅴ-2.SRS & SRT
(a) Stereotactic radiosurgery
(b) Stereotactic radiotherapy