

REFERENCES

- Ahsan, N.F., 2021, Analisis Dosis dan Waktu Radiasi untuk Carbon Ion Radiation Therapy (CIRT) pada Non-Small Cell Lung Cancer (NSCL) Menggunakan Program Phits 3.24, *Undergraduate Thesis*, Department of Physics, Universitas Gadjah Mada, Indonesia.
- Armitage, J.O., Kastan, M.B., Dorelaine M. Zeman, Eric C. Schreiber, Joel E. Tepper, oshow, J.H., Tepper, J.E., 2020, Chapter 27 - Basics of Radiation Therapy, *Clinical Oncology*, Sixth Edition, Elsevier, Pages. 431-460.
- Asadi, A., Hosseini, S.A., Akhavanallaf, A., Vosoughi, N., Zaidi, H., 2022, Comparative Assessment of Passive Scattering And Active Scanning Proton Therapy Techniques using Monte Carlo Simulations, *Journal of Instrumentation*, Vol. 17, DOI: 10.1088/1748-0221/17/09/P09008.
- Bailey, D.L., Humm, J.L., Todd-Pokropek, A., Aswegen, A. van, 2014, *Nuclear Medicine Physics. A Handbook for Teachers and Students*, Medical Physics, IAEA, Austria
- Beltran, C.J., Perales, A., Furutani, K.M., 2024, Does the Maximum Initial Beam Energy for Proton Therapy Have to Be 230 MeV?, *Quantum Beam Science*, Vol. 8, Pages. 23, DOI: 10.3390/qubs8030023.
- Brahme, A., 2014, *Comprehensive Biomedical Physics*, First Edition, Comprehensive Biomedical Physics, Elsevier B.V, Amsterdam.
- Bray, F., Laversanne, M., Sung, H., Ferlay, J., Siegel, R.L., Soerjomataram, I., Jemal, A., 2024, Global Cancer Statistics 2022: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries, *CA: A Cancer Journal for Clinicians*, Vol. 74, Pages. 229–263, DOI: 10.3322/caac.21834.
- Brenner, D.J., Elliston, C.D., Hall, E.J., Paganetti, H., 2009, Reduction of The Secondary Neutron Dose In Passively Scattered Proton Radiotherapy, Using An Optimized Pre-Collimator/Collimator, *Physics in Medicine and Biology*, Vol. 54, Pages. 6065–6078, DOI: 10.1088/0031-9155/54/20/003.

- Byun, H.K., Han, M.C., Yang, K., Kim, J.S., Yoo, G.S., Koom, W.S., Kim, Y.B., 2021, Physical and Biological Characteristics of Particle Therapy for Oncologists, *Cancer Research and Treatment*, Vol. 53, Pages. 611–620, DOI: 10.20538/1682-0363-2021-2-113-119.
- Byun, H.K., Kim, C., Seong, J., 2023, Carbon Ion Radiotherapy in The Treatment of Hepa-Tocellular Carcinoma, *Clinical and Molecular Hepatology*, Vol. 29, Pages. 945–957, DOI: 10.3350/cmh.2023.0217.
- Chang, D.S., Lasley, F.D., Das, I.J., Mendonca, M.S., Dynlacht, J.R., 2021, *Basic Radiotherapy Physics and Biology*, Second Edition, Spingers, UK.
- Cherry, S.R., Sorenson, J.A., Phelps, M.E., 2012, *Physics in Nuclear Medicine*, Fourth Edition, Elsevier, Philadelphia.
- Choi, S.H., Park, S.H., Lee, J.J.B., Baek, J.G., Kim, J.S., In Yoon, H., 2019, Combining Deep-Inspiration Breath Hold and Intensity-Modulated Radiotherapy for Gastric Mucosa-Associated Lymphoid Tissue Lymphoma: Dosimetric Evaluation Using Comprehensive Plan Quality Indices, *Radiation Oncology*, DOI: 10.1186/s13014-019-1263-7.
- Chong, I.Y., Chau, I., 2023, Is There Still A Place For Radiotherapy in Gastric Cancer?, *Current Opinion in Pharmacology*, Vol. 68, Pages. 102325, DOI: 10.1016/j.coph.2022.102325.
- Chuong, M., Badiyan, S.N., Yam, M., Li, Z., Langen, K., Regine, W., Morris, C., Snider, J., Mehta, M., Huh, S., Rutenberg, M., Nichols, R.C., 2018, Pencil Beam Scanning Versus Passively Scattered Proton Therapy for Unresectable Pancreatic Cancer, *Journal of Gastrointestinal Oncology*, Vol. 9, Pages. 687–693, DOI: 10.21037/jgo.2018.03.14.
- Coia, L.R., Myerson, R.J., Tepper, J.E., 1995, Late effects of radiation therapy on the gastrointestinal tract, *International Journal of Radiation Oncology*, , Vol. 31, Pages. 1213–1236, DOI: 10.1016/0360-3016(94)00419-L.
- Dedes, G., Parodi, K., 2015, Monte Carlo Simulations of Particle Interactions with Tissue in Carbon Ion Therapy, *International Journal of Particle Therapy*, Vol. 2, Pages. 447–458, DOI: 10.14338/ijpt-15-00021.

- Durante, M., Debus, J., Loeffler, J.S., 2021, Physics and Biomedical Challenges of Cancer Therapy with Accelerated Heavy Ions, *Nature Reviews Physics*, Vol. 3, Pages. 777–790, DOI: 10.1038/s42254-021-00368-5.
- Ganjeh, A.Z., Eslami-Kalantari, M., Ebrahimi Loushab, M., Mowlavi, A.A., 2021, Calculation of Direct DNA Damages by A New Approach for Carbon Ions and Protons Using Geant4-DNA, *Radiation Physics and Chemistry*, Vol. 179, DOI: 10.1016/j.radphyschem.2020.109249.
- Giandola, T., Maino, C., Marrapodi, G., Ratti, M., Ragusi, M., Bigiogra, V., Talei Franzesi, C., Corso, R., Ippolito, D., 2023, Imaging in Gastric Cancer: Current Practice and Future Perspectives, *Diagnostics*, Vol. 13, DOI: 10.3390/diagnostics13071276.
- Gillette, E.L., Alpen, E.L., 1998, *Radiation Biophysics*, First Edition, Academic Press, London.
- Giovannini, G., Böhlen, T., Cabal, G., Bauer, J., Tessonier, T., Frey, K., Debus, J., Mairani, A., Parodi, K., 2016, Variable RBE in Proton Therapy: Comparison of Different Model Predictions and Their Influence on Clinical-Like Scenarios, *Radiation Oncology*, Vol. 11, Pages. 1–16, DOI: 10.1186/s13014-016-0642-6.
- GLOBOCAN, 2022, Cancer in Indonesia, *Global Cancer Observatory Homepage*. <https://gco.iarc.fr/today/en/fact-sheets-populations#countries> (accessed 16-March-2025).
- Guan, W.L., He, Y., Xu, R.H., 2023, Gastric Cancer Treatment: Recent Progress and Future Perspectives, *Journal of Hematology and Oncology*, Vol. 16, Pages. 1–28, DOI: 10.1186/s13045-023-01451-3.
- Health Commission of the PRC, N., 2022, National Guidelines for Diagnosis and Treatment of Esophageal Carcinoma 2022 in China (English version), *Chinese Journal of Cancer Research*, Vol. 34, Pages. 309–334, DOI: 10.21147/j.issn.1000-9604.2022.04.01.
- Hegi, F., Atwood, T., Keall, P., Loo, B.W., 2018, *Technical Requirements for Lung Cancer Radiotherapy*, IASLC Thoracic Oncology. Second Edition, Elsevier, Pages. 318-329.

- Hoegen-Sabmannshausen, P., Naumann, P., Hoffmeister-Wittmann, P., Ben Harrabi, S., Seidensaal, K., Weykamp, F., Mielke, T., Ellerbrock, M., Habermehl, D., Springfield, C., Dill, M.T., Longerich, T., Schirmacher, P., Mehrabi, A., Chang, D.H., Hörner-Rieber, J., Jäkel, O., Haberer, T., Combs, S.E., Debus, J., Herfarth, K., Liermann, J., 2024, Carbon Ion Radiotherapy of Hepatocellular Carcinoma Provides Excellent Local Control: The Prospective Phase I Prometheus trial, *JHEP Reports*, Vol. 6, DOI: 10.1016/j.jhepr.2024.101063.
- ICRP, 2008, ICRP Publication 110: Adult Reference Computational Phantoms, *Annals of the ICRP*.
- ICRU, 1993, ICRU report 50: Prescribing, recording and reporting photon beam therapy (ICRU report 50), *Journal of ICRU*.
- ICRU, 2007, International Commission on Radiation Units and Measurements Report 78: Prescribing, Recording and Reporting Proton-beam Therapy, *Radiation Protection Dosimetry*, Vol. 7, Pages. 213–221, DOI: 10.1093/jicru/ndm041.
- Iwamoto, Y., Sato, T., Hashimoto, S., Ogawa, T., Furuta, T., Abe, S.I., Kai, T., Matsuda, N., Hosoyamada, R., Niita, K., 2017, Benchmark Study of The Recent Version Of The PHITS Code, *Journal of Nuclear Science and Technology*, Vol. 54, Pages. 617–635, DOI: 10.1080/00223131.2017.1297742.
- Karube, M., Mori, S., Tsuji, H., Yamamoto, N., Nakajima, M., Nakagawa, K., Kamada, T., 2016, Carbon-Ion Pencil Beam Scanning for Thoracic Treatment - Initiation Report and Dose Metrics Evaluation, *Journal of Radiation Research*, Vol. 57, Pages. 576–581, DOI: 10.1093/jrr/rrw057.
- Kim, C.H., Yeom, Y.S., Petoussi-Henss, N., Zankl, M., Bolch, W.E., Lee, C., Choi, C., Nguyen, T.T., Eckerman, K., Kim, H.S., Han, M.C., Qiu, R., Chung, B.S., Han, H., Shin, B., 2020, ICRP Publication 145: Adult Mesh-Type Reference Computational, *Annals of the ICRP*, DOI: 10.1177/0146645319893605.

- Kim, J., Park, J.M., Wu, H.-G., 2020, Carbon Ion Therapy: A Review of an Advanced Technology, *Progress in Medical Physics*, Vol. 31, Pages. 71–80, DOI: 10.14316/pmp.2020.31.3.71.
- Kiseleva, V., Gordon, K., Vishnyakova, P., Gantsova, E., Elchaninov, A., Fatkhudinov, T., 2022, Particle Therapy: Clinical Applications and Biological Effects, *life*, Vol. 12, Pages. 1–19, DOI: 10.3390/life12122071.
- Kissell, R.L., 2020, *Algorithmic Trading Methods: Applications Using Advanced Statistics, Optimization, and Machine Learning Techniques*, Second Edition, Academic Press, United States.
- Koosha, F., Ahmadikamalabadi, M., Mohammadi, M., 2024, Review of Recent Improvements in Carbon Ion Radiation Therapy in the Treatment of Glioblastoma, *Advances in Radiation Oncology*, Vol. 9, Pages. 101465, DOI: 10.1016/j.adro.2024.101465.
- Kumar, K., Kumar, S., Datta, K., Fornace, A.J., Suman, S., 2023, High-LET-Radiation-Induced Persistent DNA Damage Response Signaling and Gastrointestinal Cancer Development, *Current Oncology*, Vol. 30, Pages. 5497–5514, DOI: 10.3390/curroncol30060416.
- Lamghari, Y., Lu, H., Bentourkia, M., 2023, DNA Damage By Radiation as A Function Of Electron Energy and Interaction at The Atomic Level with Monte Carlo Simulation, *Zeitschrift fur Medizinische Physik*, Vol. 33, Pages. 489–498, DOI: 10.1016/j.zemedi.2022.07.003.
- Lee, N.Y., Lu, J.J., Yu, Y., 2022, *Target Volume Delineation and Field Setup A Practical Guide for Conformal and Intensity-Modulated Radiation Therapy*, Second Edition, Springer Nature Switzerland AG, Switzerland.
- Liermann, J., Naumann, P., Weykamp, F., Hoegen, P., Debus, J., Herfarth, K., 2021, Effectiveness of Carbon Ion Radiation in Locally Advanced Pancreatic Cancer, *Frontiers in Oncology*, Vol. 11, Pages. 1–9, DOI: 10.3389/fonc.2021.708884.
- Liermann, J., Shinoto, M., Syed, M., Debus, J., Herfarth, K., Naumann, P., 2020, Carbon Ion Radiotherapy in Pancreatic Cancer: A Review of Clinical Data,

- Radiotherapy and Oncology*, Vol. 147, Pages. 145–150, DOI: 10.1016/j.radonc.2020.05.012.
- Maqbool, M., 2017, *An Introduction to Medical Physics*, Springer Nature, Switzerland.
- Marcu, L.G., 2010, Altered Fractionation in Radiotherapy: From Radiobiological Rationale to Therapeutic Gain, *Cancer Treatment Reviews*, Vol. 36, Pages. 606–614, DOI: 10.1016/j.ctrv.2010.04.004.
- Mazonakis, M., Tzanis, E., Lyraraki, E., Damilakis, J., 2022, Automatic Radiobiological Comparison of Radiation Therapy Plans: An Application to Gastric Cancer, *Cancers*, Vol. 14, Pages. 1–14, DOI: 10.3390/cancers14246098.
- Meleshkovskii, I., Van den Brandt, K., Ogawa, T., Datema, C., Mauerhofer, E., 2024, Numerical Intercomparison of PHITS and Geant4 Monte Carlo Codes for Fast Neutron Inelastic Scattering Applications, *European Physical Journal Plus*, Vol. 139, DOI: 10.1140/epjp/s13360-024-05372-z.
- Mohamad, O., Makishima, H., Kamada, T., 2018, Evolution of Carbon Ion Radiotherapy at The National Institute Of Radiological Sciences in Japan, *Cancers*, Vol. 10, DOI: 10.3390/cancers10030066.
- Mutuwong, C., Chaiphaksa, W., Rachniyom, W., Bootjomchai, C., Intachai, N., Cheewasukhanont, W., Tuscharoen, S., Sriwongsa, K., Kothan, S., Kaewkhao, J., 2024, Comparative study of radiation ionizing on The MRCP-AM Phantom Before and After Using The Bi₂O₃-AlF₃-CaO-B₂O₃ Shielding Glass by PHITS Monte Carlo Simulation, *Radiation Physics and Chemistry*, Vol. 223, DOI: 10.1016/j.radphyschem.2024.111881.
- NIH, 2021, Head and Neck Cancers, *National Cancer Institute*. <https://www.cancer.gov/types/head-and-neck/head-neck-fact-sheet> (accessed 16-June-2025).
- Nikjoo, H., Rahmanian, S., Taleei, R., 2024, Modelling DNA Damage-Repair and Beyond, *Progress in Biophysics and Molecular Biology*, Vol. 190, Pages. 1–18, DOI: 10.1016/j.pbiomolbio.2024.05.002.

- Nunes, M. d. Á., 2015, *Protontherapy Versus Carbon Ion Therapy: Advantages, Disadvantages and Similarities*, Springer, Switzerland.
- Nurfatthan, I., 2019, Analisis Dosis dan Waktu Terapi Pada Terapi Kanker Paru-Paru Berbasis Terapi Ion dan Boron Neutron Capture Therapy Menggunakan Program PHITS, *Undergraduate Thesis*, Departement of Physics, Universitas Gadjah Mada, Indonesia.
- Park, H., Paganetti, H., Schuemann, J., Jia, X., Min, C.H., 2021, Monte Carlo Methods For Device Simulations in Radiation Therapy, *Physics in Medicine and Biology*, Vol. 66, Pages. 1–58, DOI: 10.1088/1361-6560/ac1d1f.
- Peach, K., Wilson, P., Jones, B., 2011, Accelerator Science in Medical Physics, *British Journal of Radiology*, Vol. 84, Pages. 4–10, DOI: 10.1259/bjr/16022594.
- Podgorsak, E.B., 2016, *M-Graduate Texts in Physics: Radiation Physics for Medical Physicists*, , Springer Nature, Switzerland.
- Rahman, M., Ashraf, M.R., Gladstone, D.J., Bruza, P., Jarvis, L.A., Schaner, P.E., Cao, X., Pogue, B.W., Hoopes, P.J., Zhang, R., 2022, Treatment Planning System for Electron FLASH Radiation Therapy: Open-Source for Clinical Implementation, *International Journal of Radiation Oncology Biology Physics*, DOI: 10.1016/j.ijrobp.2021.10.148.
- Rezaee, L., 2018, Design of Spread-Out Bragg Peaks in Hadron Therapy with Oxygen Ions, *Reports of Practical Oncology and Radiotherapy*, Vol. 23, Pages. 433–441, DOI: 10.1016/j.rpor.2018.08.004.
- Roberts, A.P., Williams, J., 2008, *Farr's Physics for Medical Imaging*:, Second Edition, Elsevier Limited, London.
- Sato, T., Iwamoto, Y., Hashimoto, S., Ogawa, T., Furuta, T., Abe, S.I., Kai, T., Matsuya, Y., Matsuda, N., Hirata, Y., Sekikawa, T., Yao, L., Tsai, P.E., Ratliff, H.N., Iwase, H., Sakaki, Y., Sugihara, K., Shigyo, N., Sihver, L., Niita, K., 2024, Recent Improvements of The Particle and Heavy Ion Transport Code System–PHITS Version 3.33, *Journal of Nuclear Science and Technology*, Vol. 61, Pages. 127–135, DOI: 10.1080/00223131.2023.2275736.

- Seidensaal, K., Froehlke, A., Lentz-Hommertgen, A., Lehner, B., Geisbuesch, A., Meis, J., Liermann, J., Kudak, A., Stein, K., Uhl, M., Tessonnier, T., Mairani, A., Debus, J., Herfarth, K., 2024, Hypofractionated Proton and Carbon Ion Beam Radiotherapy for Sacrococcygeal Chordoma (ISAC): An Open Label, Randomized, Stratified, Phase II Trial, *Radiotherapy and Oncology*, Vol. 198, Pages. 110418, DOI: 10.1016/j.radonc.2024.110418.
- Song, Y., Zhang, Y., Wang, H., Zhao, M., Guan, F., Li, Z., Yue, J., 2023, Case Report: MR-LINAC-Guided Adaptive Radiotherapy for Gastric Cancer, *Frontiers in Oncology*, Vol. 13, Pages. 1–6, DOI: 10.3389/fonc.2023.1159197.
- Strong, V.E., 2015, *Gastric cancer: principles and practice*, European Surgery, Springer Nature, Switzerland.
- Takeda, K., Sakayauchi, T., Kubozono, M., Katagiri, Y., Umezawa, R., Yamamoto, T., Ishikawa, Y., Takahashi, N., Suzuki, Y., Kishida, K., Jingu, K., 2022, Palliative Radiotherapy For Gastric Cancer Bleeding: A Multi-Institutional Retrospective Study, *BMC Palliative Care*, Vol. 21, Pages. 1–8, DOI: 10.1186/s12904-022-00943-2.
- Tang, X., Yu, H., Shu, D., Gong, C., Geng, C., Ai, Y., Chen, D., 2018, Monte Carlo Study of Dose Distribution Improvement by Skin-Shielding Layer Design in Boron Neutron Capture Therapy for Non-Small-Cell Lung Cancer, *Radioprotection*, Vol. 53, Pages. 207–217, DOI: 10.1051/radiopro/2018024.
- Tey, J., Soon, Y.Y., Koh, W.Y., Leong, C.N., Choo, B.A., Ho, F., Vellayappan, B., Lim, K., Tham, I.W.K., 2017, Palliative Radiotherapy for Gastric Cancer: A Systematic Review and Meta-Analysis, *Oncotarget*, Vol. 8, Pages. 25797–25805, DOI: 10.18632/oncotarget.15554.
- Thwaites, D.I., Prokopovich, D.A., Garrett, R.F., Haworth, A., Rosenfeld, A., Ahern, V., 2024, The Rationale for A Carbon Ion Radiation Therapy Facility in Australia, *Journal of Medical Radiation Sciences*, Vol. 71, Pages. 59–76, DOI: 10.1002/jmrs.744.

- Tripathi, S., 2021, *Accelerator Technology: Applications in Science, Medicine, and Industry (Particle Acceleration and Detection)*, First Edition, Springer Nature, Switzerland.
- Tsuboi, K., Sakae, T., Gerelchuluun, A., 2020, *Proton Beam Radiotherapy: Physics and Biology*, Springer Nature, Singapore.
- Tsujii, H., Kamada, T., Shirai, T., Noda, K., Tsuji, H., Karasawa, K., 2014, *Carbon-ion radiotherapy: Principles, Practices, and Treatment Planning*, Springer, Japan.
- Weng, Z., Chen, B., Lin, J., Xu, M., 2025, Gastric Cancer Radiation Therapy : A Bibliometric Analysis of The Scientific Literature, *Frontiers in Oncology*, Pages. 1–15, DOI: 10.3389/fonc.2025.1513255.
- Yang, Z.Y., Tsai, P.E., Lee, S.C., Liu, Y.C., Chen, C.C., Sato, T., Sheu, R.J., 2017, Inter-comparison of Dose Distributions Calculated by FLUKA, GEANT4, MCNP, and PHITS for Proton Therapy, *EPJ Web of Conferences*, Vol. 153, Pages. 1–8, DOI: 10.1051/epjconf/201715304011.
- Yu, B., Li, K.W., Fan, Y., Pei, X., 2024, Value of Carbon-Ion Radiation Therapy for Breast Cancer, *International Journal of Particle Therapy*, Vol. 14, DOI: 10.1016/j.ijpt.2024.100629.
- Yu, J. Il, 2023, Role of Adjuvant Radiotherapy in Gastric Cancer, *Journal of Gastric Cancer*, Vol. 23, Pages. 194–206, DOI: 10.5230/jgc.2023.23.e1.
- Yu, Z.Y., Gao, D., Tang, Z., Zhou, H.Y., Ou, J., Li, K.Y., Chen, X.Q., Yang, D., Yan, L.L., Li, R., Zhang, X.M., Chen, T.W., 2022, A Quantitative Model Based on Gross Tumor Volume of Gastric Adenocarcinoma Corresponding to N-Stage Measured at Multidetector Computed Tomography for Preoperative Determination of Resectability: A Case Control Study, *Frontiers in Oncology*, Vol. 12, Pages. 1–9, DOI: 10.3389/fonc.2022.1001593.
- Zarepisheh, M., Hong, L., Zhou, Y., Huang, Q., Yang, J., Jhanwar, G., Pham, H.D., Dursun, P., Zhang, P., Hunt, M.A., Mageras, G.S., Yang, J.T., Yamada, Y., Deasy, J.O., 2022, Automated and Clinically Optimal Treatment Planning for

Cancer Radiotherapy, *Interfaces*, Vol. 52, Pages. 69–89, DOI: 10.1287/inte.2021.1095.

Zhang, N., Fei, Q., Gu, J., Yin, L., He, X., 2018, Progress Of Preoperative and Postoperative Radiotherapy in Gastric Cancer, *International Journal of Radiation Oncology Biology Physics*, Vol. 102, Pages. S163–S164, DOI: 10.1016/j.ijrobp.2018.07.020.

Zhang, Q., Kong, L., Liu, R., Wang, X., 2021, Ion therapy guideline (Version 2020): Radiation Oncology Physicians Branch of Chinese Medical Doctor Association, *Precision Radiation Oncology*, Vol. 5, Pages. 73–83, DOI: 10.1002/pro6.1120.

