Dr. Niklas Wahl

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Education & Experience

since 9/2019 — **Research Scientist & Group Leader "Radiotherapy Optimization"**, *Division of Medical Physics in Radiation Oncology, German Cancer Research Center – DKFZ*, Heidelberg,
leading a research team focusing on the development and implementation of physical, biological and numerical models in the context of radiotherapy treatment planning and maintaining the open source dose calculation and treatment planning toolkit "matRad"

8/2018 – 8/2019 — **Postdoctoral Researcher & Project Coordinator**, *Division of Medical Physics in Radiation Oncology, German Cancer Research Center – DKFZ*, Heidelberg,
research in uncertainty quantification and probabilistic/robust treatment planning for particle therapy, maintenance of the open source toolkit "matRad", and coordination of the Chilean-German Consortium for Medical Physics in Radiation Oncology (CGCoMPRO)

1/2015 – 7/2018 — **Doctoral Studies**, *Division of Medical Physics in Radiation Oncology, German Cancer Research Center – DKFZ & University of Heidelberg*, in Physics, including **two three-month research stays** at the Max Planck Institute for Intelligent Systems, Tübingen,
awarded the degree of Dr. rer. nat. graded *summa cum laude* for the thesis titled "Analytical models for Probabilistic Inverse Treatment Planning in Intensity-modulated Proton Therapy"

7/2014 – 9/2014 — **Research assistant**, *German Cancer Research Center – DKFZ*, Heidelberg

2012 – 2017 — **Freelancer**
Metadata Annotation, Web-Programming, Research consulting.

10/2011 – 3/2014 — **Master Studies**, *University of Heidelberg*, in Physics,
graduated M. Sc. with overall grading *very good*, master thesis: "Automated Voxel-based Penalty Adaption for ultra-fast Treatment Planning in Intensity-modulated Radiation Therapy"

2010 – 2014 — **Student teaching assistant** for practical physics courses on a regular basis, *Department of Physics & Astronomy at the University of Heidelberg*

4/2008 – 10/2011 — **IT Assistant**, *HierEDV*, Heidelberg

10/2007 – 5/2011 — **Bachelor Studies**, *University of Heidelberg*, in Physics,
graduated B. Sc. with overall grading *good*, bachelor thesis: "Performance of the local on-line Tracking and of a Track-based Jet Trigger Algorithm for the ALICE TRD on the Basis of Monte-Carlo Simulations"

10/1999 – 6/2007 — **Abitur**, *Dietrich-Bonhoeffer-Gymnasium*, Weinheim,
higher education entrance qualification with overall grading of 1.4

Community & Outreach

since 2021 — Associate Editor "Medical Physics"

2021 — Organization of the first HITRIplus Heavy Ion Therapy Masterclass School

since 2019 — Organization of a weekly Medical Physics Seminar with invited (international) speakers for the Research Program "Imaging and Radiooncology" at DKFZ

since 2019 — Establishing a "Particle Therapy Master Class" for school children (in cooperation with CERN, GSI & the Heidelberg Life Science Lab) with the first successful pilot in March 2019

since 2019 — Member of the Deutsche Gesellschaft für Radioonkologie (DEGRO)

since 2019 — Member of the Deutsche Gesellschaft für Medizinische Physik (DGMP)

2018 – 2020	Project coordinator within the Chilean-German Consortium for Medical Physics in Radiation Oncology (CGCoMPRO) sponsored by the German Federal Minstry of Education and Research, organizing multiple workshops in Santiago de Chile
since 2018	Occasional reviews for Medical Physics, Physica Medica: European Journal of Medical Physics, Physics in Medicine and Biology, International Journal of Radiation Oncology*Biology*Physics, and Strahlentherapie & Onkologie
since 2017	Member of the European Society for Radiotherapy & Oncology (ESTRO)
2016	Referee for "Jugend forscht", Europe's biggest youth science & technology competition
since 2015	Co-hosting a YouTube channel (Physiktutorium) with instructional physics videos for students
since 2015	Continuous contribution to the open source radiation therapy treatment planning toolkit matRad (http://www.matrad.org)
2015	Participating in & supporting the organization of the Machine Learning Summer School (MLSS), Tübingen
2009 – 2017	Helper in the International Summer School for German Language and Culture at the University of Heidelberg
2008 – 2018	Assisting at "Explore Science", a yearly educational scientific event at the behest of the Klaus Tschira Foundation
since 2007	Member of the German Physical Society (DPG)
2003	Participation in a one-month school exchange with Hunterdon Central Regional High School, NJ, USA, within the German American Partnership Program (GAPP)

Third-party Funding & Projects

2022 – 2027 CI	**NIH Award R01CA266467**, *Ionization Detail – Biologically based treatment planning for particle therapy beyond LET-RBE*, $308 650 awarded to DKFZ, Principal Investigator: Prof. Jäkel, other Co-Investigator: Prof. Karger
2022 PI	**Mathworks Community Toolbox Development Support**, *Development sparse linear algebra and DICOM plugins for matRad*, $20 500, Principal Investigator
2021 – 2024 PI	**DFG project support grant WA 4707/1-1**, *Sustainable development of the open source radiotherapy dose calculation and optimization toolkit matRad*, 315 000 €, Principal Investigator
2021 – 2024 PI	**DFG New Instrumentation for Research grant WA 4707/3-1**, *HELIOS – Developing a HELium Imaging Oncology Scanner for Range Guided Radiotherapy (RGRT) for Non-Small Cell Lung Carcinoma (NSCLC)*, 187 000 € (of total project funds: 950 000 €), Principal Investigator (Other PIs: Prof. Joao Seco, Prof. Oliver Jäkel)
2021 – 2024 CI	**HIDSS4Health Project**, *Inverse Radiotherapy Treatment Planning using Machine Learning Outcome Prediction Models*, 1 fully-funded PhD position, Co-Investigator (PIs: Prof. Martin Frank, Prof. Oliver Jäkel)

Awards, Honors, Appointments & Positions

Position	Associate Editor "Medical Physics", since 2021
Honor	"Distinguished Reviewer" for the Medical Physics journal, 2021
Position	Considered for an independent research group leader position at the University of Tübingen (no exact ranking communicated), 2020
Dissertation Award	DEGRO Dissertation Award, 2019
Poster Prize	DKFZ PhD Poster Award, 2017
Presentation Award	Science Slam, NCRO Meeting Dresden, 2016
School Award	Jugend denkt Zukunft, national winning team, 2006

Invited & International Presentations

Course	ECMP Refresher Course: Radiotherapy – Open Source Software for Radiotherapy Physics Research, Dublin, 2022

Course	ESMPE European School for Medical Physics Experts: Adaptive Radiotherapy: Pros and Cons of In-room versus Out-of-Room Imaging, Dublin, 2022
Course	Specialised Hadron Therapy Training Course, Online, 2022
Workshop	The mathematics of modern radiation therapy, Medellin (Online), 2021
Workshop	Course – Proton Therapy: the challenges and the opportunities, UT Austin Portugal Programm, Online, 2021
Seminar	Medical Physics Seminar, Brigham and Women's Hospital/Dana-Farber Cancer Institute/Havard Medical School, Boston (Online), 2021
Summer School	Virtual Summer School 2021: Image Guided Radiation Therapy (IGRT) and Advanced Treatment Techniques, Heidelberg/Online, 2021
Summer School	3rd Virtual Summer School in Medical Physics: Applied Computational Methods for Radiotherapy, Heidelberg/Online, 2021
Summer School	HITRIplus Heavy Ion Therapy Masterclass School, Sarajevo/Online, 2021
Public	Interactive introduction of Ion Therapy to the General Public within the program "Physik am Samstag" at University of Mainz (Online), 2021
Workshop	The 7th Annual Loma Linda workshop on Particle Imaging and Radiation Treatment Planning, Loma Linda (Online), 2021
Workshop	The 5th Annual Loma Linda workshop on Particle Imaging and Radiation Treatment Planning, Loma Linda, 2019
Highlight	Highlight presentation at the 19th ICCR, Montréal, 2019
Workshop	DGMP – Working Group Computer, Aachen, 2019
Symposium	ESTRO 38, Milan, Italy, 2019 (as co-author)
Seminar	Karlsruhe Institute of Technology, Germany, 2019
Workshop	1st ESTRO Physics Workshop, Glasgow, UK, 2017
Seminar	UniversitätsSpital Zürich, Switzerland, 2017
Seminar	Universitair Medisch Centrum Utrecht, Netherlands, 2014

Teaching Experience & Student Supervision

Student supervision	(Co-)supervision of the following theses projects:,
	A. Bennan (PostDoc): *Sustainable development of the open source treatment planning toolkit matRad* (ongoing),
	J. Hardt (PhD): *Dose simulations and treatment planning strategies using mixed Helium-Carbon Beams* (ongoing),
	T. Ortkamp (PhD): *Inverse Radiotherapy Treatment Planning using Machine Learning Outcome Prediction Models* (ongoing),
	P. Stammer (PhD): *Uncertainty quantification in Monte Carlo dose calculation algorithms for proton therapy* (ongoing),
	N. Homolka (PhD): *Intensity-modulated dose calculation & treatment planning for carbon ions* (ongoing),
	M. Palkowitsch (MSc): *Robustness in jointly optimized mixed-modality treatment plans* (ongoing),
	J. Hardt (MSc): *Efficient effect-based optimization strategies for (N)TCP based treatment planning* (2022),
	A. Bennan (PhD): *Joint optimization of combined photon & carbon ion therapy* (2022, co-supervision),
	J. Kunz (BSc): *Accelerating the open-source treatment planning toolkit matRad with GPGPU computations* (2022),
	M.W. Kheshfeh (BSc): *Development of an Unit-Testing-Framework for the open-source toolkit matRad* (2021),
	R. Yulvina (BSc): *A bi-directional Python binding for the open-source toolkit matRad* (2021)
	C. Hormazábal (MSc): *Dose and grading uncertainties in Xerostomia prediction using Machine Learning classification* (2020),
	P. Meder (MSc & res. ass.): *Heterogeneity corrections for analytical proton dose calculation algorithms* (2020),
	A. Neishabouri (MSc & res. ass.): *Performing proton dose calculation using Artificial Neural Networks*, (2019, co-supervision),
	A. Sage (MSc): *Efficient uncertainty propagation through MC dose calculations for radiation therapy*, (2019, co-supervision)
Summer terms 2019 – 2022	**Physics of charged particle therapy**, *three lectures & three practical courses for physics master students in the course of Prof. Joao Seco*, University of Heidelberg
since 2017	**Spezialkurs Partikeltherapie**, *yearly hands-on particle treatment planning course for professionals*, German Cancer Research Center – DKFZ
since 2020 2015 – 2017	**Treatment Planning Course**, *yearly course for students within the Major in Cancer Biology programme*, German Cancer Research Center – DKFZ

Winter term 2015/2016	**Practical physics course for students of biotechnology**, *supervision & evaluation of experiments on radioactive decay of 14 student groups*, Department of Physics & Astronomy, University of Heidelberg
Summer terms 2016 2013 2012	**Practical physics course for medical students**, *supervision & evaluation of experiments on optics, acoustics, hydrodynamics & electronics for 17 student groups (per course)*, Department of Physics & Astronomy, University of Heidelberg
Winter term 2012/2013	**Basic course on key competences**, *continued supervision of a students group in 20 tutorials teaching key competences for study managing*, Department of Physics & Astronomy, University of Heidelberg, included a three-days certified tutor qualification course
Winter terms 2012/2013 2011/2012	**Beginner's practical physics course**, *supervision & evaluation of experiments on fourier optics & RLC circuits for 20 student groups (per course)*, Department of Physics & Astronomy, University of Heidelberg

Peer-reviewed Publications

Journal Article — Vargas-Bedoya, E., Rivera, J. C., Puerta, M. E., Angulo, A., **Wahl, N.** & Cabal, G. Contour Propagation for Radiotherapy Treatment Planning Using Nonrigid Registration and Parameter Optimization: Case Studies in Liver and Breast Cancer. *Applied Sciences* **12,** 8523. doi:10.3390/app12178523 (17 2022)

Journal Article — Marc, L., Fabiano, S., **Wahl, N.**, Linsenmeier, C., Lomax, A. J. & Unkelbach, J. Combined proton-photon treatment for breast cancer. *Physics in Medicine & Biology* **66,** 235002. doi:10.1088/1361-6560/ac36a3 (2021)

Journal Article — Stammer, P., Burigo, L., Jäkel, O., Frank, M. & **Wahl, N.** Efficient uncertainty quantification for Monte Carlo dose calculations using importance (re-)weighting. *Physics in Medicine & Biology* **66,** 205003. doi:10.1088/1361-6560/ac287f. arXiv: 2106.11885 (2021)

Journal Article — Bennan, A. B. A., Unkelbach, J., **Wahl, N.**, Salome, P. & Bangert, M. Joint optimization of photon – carbon ion treatments for Glioblastoma. *International Journal of Radiation Oncology*Biology*Physics* **111,** 559–572. doi:10.1016/j.ijrobp.2021.05.126 (2021)

Journal Article — Neishabouri, A., **Wahl, N.**, Mairani, A., Köthe, U. & Bangert, M. Long short-term memory networks for proton dose calculation in highly heterogeneous tissues. *Medical Physics* **48,** 1893–1908. doi:10.1002/mp.14658. arXiv: 2006.06085 (2021)

Journal Article — **Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. Analytical probabilistic modeling of dose-volume histograms. *Medical Physics* **47,** 5260–5273. doi:10.1002/mp.14414. arXiv: 2001.04884 (2020)

Journal Article — Wieser, H.-P., Karger, C. P., **Wahl, N.** & Bangert, M. Impact of Gaussian uncertainty assumptions on probabilistic optimization in particle therapy. *Physics in Medicine & Biology* **65,** 145007. doi:10.1088/1361-6560/ab8d77 (2020)

Journal Article — Wieser, H.-P., **Wahl, N.**, Gabryś, H. S., Müller, L.-R., Pezzano, G., Winter, J., Ulrich, S., Burigo, L. N., Jäkel, O. & Bangert, M. matRad - an open-source treatment planning toolkit for educational purposes. *Medical Physics International Journal* **6,** 119–127 (2018)

Journal Article — **Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. Analytical incorporation of fractionation effects in probabilistic treatment planning for intensity-modulated proton therapy. *Medical Physics* **45,** 1317–1328. doi:10.1002/mp.12775 (2018)

Journal Article — Wieser, H.-P., Cisternas, E., **Wahl, N.**, Ulrich, S., Stadler, A., Mescher, H., Müller, L.-R., Klinge, T., Gabrys, H., Burigo, L., Mairani, A., Ecker, S., Ackermann, B., Ellerbrock, M., Parodi, K., Jäkel, O. & Bangert, M. Development of the open-source dose calculation and optimization toolkit matRad. *Medical Physics* **44,** 2556–2568. doi:10.1002/mp.12251. pmid: 28370020 (2017)

Journal Article — Wieser, H.-P., Hennig, P., **Wahl, N.** & Bangert, M. Analytical probabilistic modeling of RBE-weighted dose for ion therapy. *Physics in Medicine and Biology* **62,** 8959–8982. doi:10.1088/1361-6560/aa915d (2017)

Journal Article	**Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. *Efficiency of analytical and sampling-based uncertainty propagation in intensity-modulated proton therapy.* *Physics in Medicine and Biology* **62,** 5790–5807. doi:10.1088/1361-6560/aa6ec5 (2017)
Journal Article	**Wahl, N.**, Bangert, M., Kamerling, C. P., Ziegenhein, P., Bol, G. H., Raaymakers, B. W. & Oelfke, U. *Physically constrained voxel-based penalty adaptation for ultra-fast IMRT planning.* *Journal of Applied Clinical Medical Physics* **17,** 172–189. doi:http://dx.doi.org/10.1120/jacmp.v17i4.6117 (2016)

Peer-reviewed Conference Contributions

Oral Presentation	**Wahl, N.** & Wieser, H.-P. *Scenario-free probabilistic proton dose optimization using expected dose influence and total variance* PTCOG 60, Miami. 2022
Poster	Stammer, P., Burigo, L., Jäkel, O., Frank, M. & **Wahl, N.** *PO-1728: Efficient modeling and quantification of time-dependent errors in IMPT* in *Radiotherapy and Oncology* ESTRO. **170** (Elsevier, Kopenhagen, 2022), S1529–S1531. doi:10.1016/S0167-8140(22)03692-1
Oral Presentation	Foka, P., Mamaras, A., Skrjiel, D., Seco, J., Graeff, C., Pulia, M., Wieser, H.-P. & **Wahl, N.** *Particle therapy masterclass* in *EPJ Web of Conferences* A Virtual Tribute to Quark Confinement and the Hadron Spectrum (vConf21). **258** (EDP Sciences, 2022), 01002. doi:10.1051/epjconf/202225801002
Oral Presentation	Palkowitsch, M., Bennan, A. B. A. & **Wahl, N.** *The role of uncertainties in jointly optimised mixed carbon/photon treatments* DGMP 2021, Online. 2021
Oral Presentation	Stammer, P., Burigo, L., Jäkel, O., Frank, M. & **Wahl, N.** *Efficient uncertainty estimates in Monte Carlo dose calculation using importance reweighting* PTCOG 59, Online. 2021
Oral Presentation	Homolka, N., Meder, P. A., Burigo, L., Wieser, H.-P., Bangert, M., Jäkel, O., Ellerbrock, M. & **Wahl, N.** *Degradation of particle depth dose in lung tissue: An efficient and consistent model for Monte Carlo and analytical dose calculation* PTCOG 59, Online. 2021
Poster	Marc, L., Fabiano, S., **Wahl, N.**, Linsenmeier, C., Lomax, A. J. & Unkelbach, J. *PO-1905: Combined proton-photon treatment for breast cancer using a fixed proton beamline* in *Radiotherapy and Oncology* **161** (Elsevier, 2021), S1625–S1627. doi:10.1016/S0167-8140(21)08356-0
Oral Presentation	Neishabouri, A., **Wahl, N.**, Burigo, L. N., Köthe, U. & Bangert, M. *OC-0215: LSTM networks for proton dose calculation in highly heterogeneous tissues* in *Radiotherapy and Oncology* ESTRO. **152** (Elsevier, 2020), S108–S109. doi:10.1016/S0167-8140(21)00239-5
Poster	Homolka, N., Wieser, H.-P., Bangert, M., Ellerbrock, M. & **Wahl, N.** *PO-1490: Lung degradation effects on RBE-weighted dose in proton, carbon and helium treatment plans* in *Radiotherapy and Oncology* ESTRO. **152** (Online, 2020), S801–S802. doi:10.1016/S0167-8140(21)01508-5
Poster	**Wahl, N.**, Wieser, H.-P., Burigo, L. & Bangert, M. *PO-1377: Monte Carlo vs. pencil-beam dose calculation for uncertainty estimation in proton therapy* in *Radiotherapy and Oncology* ESTRO. **152** (Online, 2020), S731. doi:10.1016/S0167-8140(21)01395-5
Symposium	Bangert, M., **Wahl, N.** & Wieser, H.-P. *SP-0469: Mitigation of range uncertainties with probabilistic IMPT optimization* in *Radiotherapy and Oncology* ESTRO. **133** (Milan, 2019), S241. doi:10.1016/S0167-8140(19)30889-8
Oral Presentation	**Wahl, N.**, Doerner, E., Burigo, L. N., Ramirez, D., Neishabouri, A., Bennan, A. B. A., Wieser, H.-P. & Bangert, M. *Development report for the open source dose calculation and optimization toolkit matRad* 19th ICCR, Montréal. 2019
Oral Presentation	**Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. *Confidence constraints for probabilistic radiotherapy treatment planning* 19th ICCR, Montréal. 2019
Oral Presentation	Wieser, H.-P., **Wahl, N.**, Hennig, P. & Bangert, M. *OC-0088: Simultaneous consideration of biologyical and physical uncertainties in robust ion therapy planning* in *Radiotherapy and Oncology* ESTRO. **127** (Barcelona, 2018), S46–S47. doi:10.1016/S0167-8140(18)30398-0

Poster	**Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. *EP-1898: Smooth animations of the probabilistic analog to worst-case dose distributions* in *Radiotherapy and Oncology* ESTRO. **127** (Barcelona, 2018), S1028–S1029. doi:10.1016/S0167-8140(18)32207-2
Poster	**Wahl, N.**, Hennig, P., Wieser, H.-P. & Bangert, M. *PO-0909: Analytical probabilistic models for dose quality metrics and optimization objectives* in *Radiotherapy and Oncology* ESTRO. **127** (Barcelona, 2018), S486–S487. doi:10.1016/S0167-8140(18)31219-2
Oral Presentation	Wieser, H.-P., **Wahl, N.**, Hennig, P. & Bangert, M. *Analytical probabilistic modeling of range and setup uncertainties in carbon ion therapy planning* 18th ICCR, London. 2016
Oral Presentation	**Wahl, N.**, Hennig, P. & Bangert, M. *Probabilistic proton treatment planning using accelerated analytical probabilistic modelling* 18th ICCR, London. 2016
Poster	**Wahl, N.**, Kamerling, C. P., Heinrich, H., Hennig, P. & Bangert, M. *Robust Planning for Intensity-modulated Proton Therapy using Analytical Probabilistic Modeling* in *International Journal of Particle Therapy* PTCOG & PTCOG-NA. **2** (San Diego, 2015), 314f. doi:10.14338/IJPT.15-PTCOG-NA.1

Books & Monographs

Textbook	Kommer, C., Tugendhat, T. & **Wahl, N.** *Tutorium Physik fürs Nebenfach* 2nd ed. (Springer Spektrum, Berlin, Heidelberg, 2019)
Dissertation	**Wahl, N.** *Analytical Models for Probabilistic Inverse Treatment Planning in Intensity-modulated Proton Therapy* PhD thesis (Ruprecht-Karls Universität Heidelberg, Heidelberg, 2018). doi:10.11588/heidok.00025127
Textbook	Kommer, C., Tugendhat, T. & **Wahl, N.** *Tutorium Physik fürs Nebenfach* 1st ed. doi:10.1007/978-3-662-47244-6 (Springer Spektrum, Berlin, Heidelberg, 2015)

Preprints and other Publications

Preprint	Barkmann, F., Censor, Y. & **Wahl, N.** *Superiorization as a novel strategy for linearly constrained inverse radiotherapy treatment planning* 2022. doi:10.48550/arXiv.2207.13187. arXiv: 2207.13187 [physics]
Preprint	Liu, R., Charyyev, S., **Wahl, N.**, Liu, W., Kang, M., Zhou, J., Yang, X., Baltazar, F., Palkowitsch, M., Higgins, K., Dynan, W., Bradley, J. & Lin, L. *An Integrated Biological Optimization framework for proton SBRT FLASH treatment planning allows dose, dose rate, and LET optimization using patient-specific ridge filters* 2022. doi:10.48550/arXiv.2207.08016. arXiv: 2207.08016 [physics]
Preprint	Stammer, P., Burigo, L., Jäkel, O., Frank, M. & **Wahl, N.** *Multivariate error modeling and uncertainty quantification using importance (re-)weighting for Monte Carlo simulations in particle transport* 2022. arXiv: 2202.02379 [physics, stat]
Online Article	Stammer, P., Burigo, L., Jäkel, O., Frank, M. & **Wahl, N.** *Efficient uncertainty quantification for Monte Carlo dose calculations using importance (re-)weighting* ESTRO Physics Newsletter. https://www.estro.org/About/Newsroom/Newsletter/Physics/Efficient-uncertainty-quantification-for-Monte-Car (2022)
Online Article	Bangert, M., Jäkel, O., **Wahl, N.** & Wieser, H.-P. *Developing matRad, an Open-Source Dose Calculation and Optimization Toolkit for Radiation Therapy Planning* MathWorks Techical Articles and Newsletters. https://www.mathworks.com/company/newsletters/articles/developing-matrad-an-open-source-dose-calculation-and-optimization-toolkit-for-radiation-therapy-planning.html (2020)