

RAPTOR

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Editorial

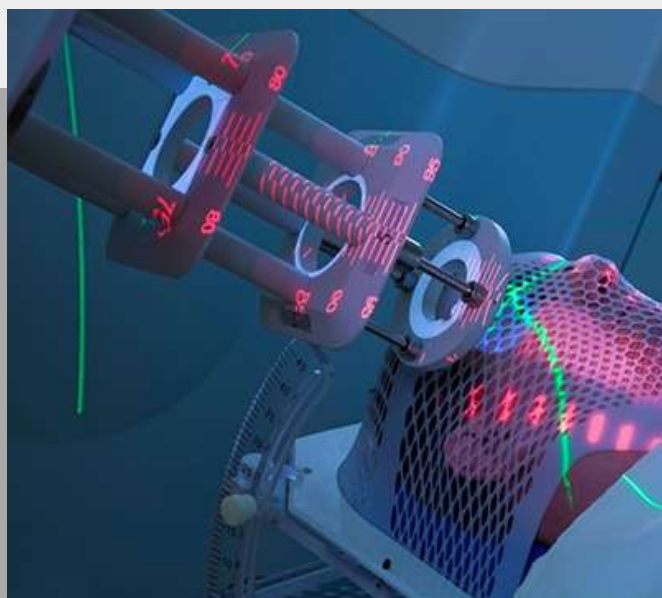
Welcome to the first issue of the RAPTOR newsletter.

The objective of this newsletter is to keep the consortium updated with the main activities that are going on during the project, summarizing the interesting results in terms of secondments, training, scientific results, vision and dissemination activities. We also want to communicate our outcomes to a wider audience, find more opportunities for collaborations and exchange of ideas with interested readers outside the consortium.

RAPTOR newsletter will be published quarterly. Each issue will be available for download from the RAPTOR web site at <https://raptor-consortium.com/>.

In this first issue we introduce the 15 Early Stage Researchers (ESRs), the main characters of this project and the bearers of new ideas and energies. Furthermore, we report about the Mid-term meeting and the feedback received by the European Officer. Finally, we give an overview of upcoming events and important dates.

Happy reading!





Meet the Early Stage Researchers

Andreas Smolders Paul Scherrer Institute – PSI

I am Andreas Smolders, 25 years old, Belgian, and currently doing a PhD in Medical Physics at the Paul Scherrer Institute, under the supervision of Francesca Albertini. My main degree is a Master in Mechanical Engineering, but I also studied Economics and Artificial Intelligence. I am an adventurer, always looking for new challenges, both professional and personal. I love the mountains, skiing, hiking and climbing, which, to be honest, did count in the decision to come to Switzerland.

My research focus is on deformable image registration for daily adaptive proton therapy (Dose Accumulation and uncertainties estimation). We try to develop (machine learning) models to predict the uncertainty associated with registration, with the aim of taking this uncertainty into account when deciding for the optimal treatment for the patient. We hope to have implemented some of my work in the clinical routine by the end of my PhD. Speaking of impact, that counts.

I chose this PhD because proton therapy is an innovative and highly technology-driven branch of medicine. You can have a positive impact on severely ill people, whilst working on cutting-edge technology and state-of-the-art research. Having the best understanding of the problem and finding the most creative solutions will result in a significant improvement in the quality of life of our patients. That makes it easy to start working every morning!



Faculty of Mathematics and Physics of the University of Ljubljana

I am Luciano A. Rivetti, 25 years old, from Argentina. I did my bachelor's in physics and my master's degree in Medical Physics at the Instituto Balseiro, Argentina. I am doing my PhD in Physics at the Faculty of Mathematics and Physics of the University of Ljubljana. I live my life following my curiosity, my passions, and dreams. I am always looking for challenging experiences which can help me to grow as a scientist and as a person. In my free time, I enjoy hanging out with friends, doing sports, and reading.

In my project, I am going to work with deformable image registration and optimization algorithms to propagate the contours of the planning CT to the daily anatomy. We are going to put much attention into the development of robust methods which can mitigate the effect of the segmentation uncertainties in the dose delivered to the patient.

My curiosity in Physics and my passion to apply it in a field which can generate a relevant change in people's life drove me to study Medical Physics. I find amazing the idea of creating new methods which can make medicine more quantitative and patient specific. Proton therapy caught my attention since it is an incredibly challenging field in which precision is indispensable to take advantage of all the therapeutical properties of protons. I like the fact that it combines my interest in physics (interaction of radiation with matter), mathematics (optimization algorithms) and programming (software development).



Saba Hussain MedPhoton

I am Saba Hussain, from Pakistan, and currently working as an early-stage researcher at medPhoton, Salzburg, Austria under the supervision of Heinz Deutchman and registered as a Ph.D. candidate at Ludwig Maximilian University (LMU), Munich, Germany under the co-supervision of Prof. Dr. Katia Parodi. I have done Advanced Master in Medical Physics from Abdus Salam International Center for Theoretical Physics (ICTP) and the University of Trieste, Trieste, Italy. I like to spend my time doing outdoors activities i.e. cycling and hiking. My hobbies help me to stay focused and to connect with my inner self.

I am working on the project of CBCT enhancement strategies for adaptive ion beam therapy. We will use CBCT for particle dose calculations and generate adapted plans that consider the most up-to-date patient geometry and we are also planning to develop a CBCT-based synthetic CT generation suitable for particle dose calculation. We are also hoping to provide acquisition and correction techniques to enable particle adaptive treatment planning with (CB)CT developments for (vertical) scans. An Interdisciplinary research group is an excellent approach for advanced medical research. The Raptor project combines mentored research and well-equipped facilities and gives better opportunity to use my abilities to achieve collective goals. The offered program fulfill my passion for both research and clinical interest and the opportunity to share experience and knowledge with well-reputed institutes and well-known industry Professionals.





Arthur Galapon **University Medical Center Groningen**

My name is Arthur Galapon Jr, a Filipino and currently working as an early-stage researcher at the University Medical Center Groningen, under the supervision of Dr. Stefan Both. Academically, my degrees are all about physics – applied, medical, and nuclear. Personally, I enjoy doing electronics projects, listening to audio books, playing board games, and visiting science centers and museums around the world.

My work involves integrating the advantages offered by magnetic resonance imaging (MRI) in the adaptive proton therapy workflow. The first step is to develop a fast and accurate way of transforming MRI images to synthetic Computed Tomography (sCT) images using machine learning techniques. Further along the project, the goal is to utilize advanced MR-imaging techniques to assess the biological damage which can help provide indicators to trigger plan adaptation.

The way science improves people's lives always fascinated me – especially how physics can be used in medicine. My dream is to push the boundaries of medical physics the same way humans have explored space. This PhD is the first step to making it a reality. Let me take you along the next ones!



Anestis Nakas **Politecnico di Milano**

I am Anestis Nakas, from Greece, currently pursuing a PhD in Bioengineering at Politecnico di Milano under the supervision of Dr. Chiara Paganelli and Prof. Guido Baroni. I hold a BSc in Physics from the University of Athens and a MSc in Biomedical Engineering/Medical Physics from the Delft University of Technology. I am passionate and always willing to take up new challenges. I enjoy spending my leisure time doing sports and travelling.

My research is focused on 4DMRI and motion management in Particle Therapy (PT) of tumors subject to respiratory motion, such as abdominal and thoracic tumors. With my research group our objective is (a) to demonstrate 4DMRI's potential to address respiratory motion and its induced uncertainties within the treatment workflow and (b) exploit the integration of optical monitoring with 4D delivery, in order to enable an optimal treatment for the patient. We highly hope that some of our work would be clinically implemented in the future.

I chose this PhD because one aspect of my dream job that I have always considered vital is contribution, in the sense that the rest of the world would have a positive effect through my work. Thus, I wanted to be part of research that envisions the optimization of PT and would make a valuable contribution to the field of cancer treatment, out of which many patients would benefit in the future. This is where I see myself, doing research that aims in solving a real-world problem, that of treating cancer. To this regard, I am very enthusiastic about my research topic, since from my perspective it has great potential to make a contribution in the field of adaptive particle therapy of cancer.



Zihang Qiu **University of Amsterdam**

I am Zihang Qiu, the ESR6 of the RAPTOR project. I come from Chongqing, China, a city known for spicy food, which has added a touch of enthusiasm to my personality. I completed my Bachelor's and Master's degree in Physics and specialized in Medical Physics in my Master's study. I enjoy conducting research in radiotherapy, particularly treatment planning, because it is a combination of theory and practice, and it is a subject that benefits millions of people around the world.

Based at the University of Amsterdam, I aim to develop online treatment plan adaptation methods to account for interfraction anatomical changes under the supervision of Prof. Dick den Hertog (University of Amsterdam) and Prof. Thomas Bortfeld (Massachusetts General Hospital). The crux of my research topic is to minimize the time cost of the plan adaptation process while maximizing the quality of the adapted plans. To achieve this goal, I plan to incorporate prior treatment planning knowledge, e.g., the original plan of the patient or the previous plans of similar patients, into the online plan adaptation process, using mathematical optimization and machine learning.

I enjoy playing football and traveling around the world to see different cultures. I am also an early-stage saxophone player, as Jazz is one of my favorite music genres. On a nice day, I would also appreciate a good glass of whisky.



Nadine Vatterodt **Aarhus University**

I am Nadine Vatterodt, a German currently living in Denmark. I received my master's degree in medical physics from Martin-Luther University Halle-Wittenberg. Having always been enthusiastic about connecting with all kinds of people, I was financing my studies as a bartender and head of the bar. To me, the feeling of creating happy moments to guests is worth going an extra mile and to never lose my smile, even if the club is bursting at the seams.

With this background I am happy to challenge myself as a PhD in the international RAPTOR network. At Aarhus University and the Danish Center for Particle Therapy I am part of the computational medical physics research group of Stine Korreman. My studies focus on the investigation of individualized robust optimization strategies to account for anatomical changes in combination with different adaptation schemes. By collaborating with the clinical staff, we hope to facilitate the implementation of workflows providing anatomical robustness in the proton center and to ease the progress towards online adaptive therapy.

I truly believe that we have not yet reached the full potential of particle therapy. I am fascinated about the range of research working towards the overall aim of providing an optimal treatment by combining the power of math, physics, engineering, biology and medicine. Working in an innovative and interdisciplinary field and at the same time making an impact on patient's quality of life is the source of my passion.

Cosimo Galeone GSI Helmholtzzentrum für Schwerionenforschung

My name is Cosimo Galeone, I am 27 years old and I am Italian. I earned a Master's degree in nuclear engineering at the Politecnico di Torino. For my master's thesis I joined a team of University of Torino entirely devoted to medical physics that gave me the opportunity to get more and more interested in the field but also to grow personally by working with people coming from all over. Currently I am doing a dual-PhD between TU Darmstadt and University of Torino, respectively in electronic engineering and physics, under the supervision of Christian Graeff.

I love football, movies, but my real passion is music which keeps me company even when I work.

For my project we will develop a tool to reconstruct the delivered and planned dose in real-time during the treatment. The object is to assess the accuracy of the delivery and measure the dose errors. In the scenario of the daily adaptive particle therapy this comparison is crucial to adjust the plan for the following day. The work of my PhD aims at having a functioning tool, tested and ready to be applied in some clinic centers.

Working in research is captivating, it allows you to progress and interact with peers from all over the world. I decided to apply for this project because working in the particle therapy field gives me the opportunity to be continuously challenged and pushed to find new solutions, knowing that the results of my research could have a positive and significant impact on the health of ill people.



Sergei Diuzhenko Cosylab

My name is Sergei Diuzhenko and I am from Russia. I am a PhD student at University of Ljubljana and my RAPT host organization is Cosylab d.d. I graduated from MEPhI university with a Major in Medical Physics. I also worked as a clinical medical physicist in proton therapy center «Prometheus» in Obninsk, Russia during my master studies. In my free time I enjoy learning history, playing guitar and spent my time with my wife and our pets.

During my PhD studies I will work on the automated and fast machine and delivery log-file based quality assurance for online adaptive proton therapy. Since in this workflow the treatment plan will be optimized just before the treatment delivery, conventional measurement-based approach may be replaced with a rapid QA workflow which analyzes the log-files from irradiation to determine if there are any deviations from expected values. This new approach can save a lot of valuable beam time and reduce the cost of treatment.

I choose the RAPT because this is the state-of-art project and necessary step in proton therapy evolution. At the end it may solve several proton therapy issues e.g. uncertainties (range, anatomy changes etc.) or treatment cost, which is very important step to democratize and to exploit the full benefit of protons. This will be a very hard route full of challenges, but every overcome of an obstacle brings real patients closer to more accurate, safe and personalized treatment.



Choulilitsa Evangelia Paul Scherrer Institute - PSI

My name is Evangelia (Eva) Choulilitsa, I am 25 years old, and I was born in Athens, Greece. I am doing my PhD at Paul Scherrer Institute in Switzerland, under the supervision of Dr. Albertini Francesca. I hold an MSc in Applied Mathematical and Physical sciences and an MSc in Physics and Engineering in Medicine. My hobbies include playing music, practicing yoga, going for hikes but most importantly, travelling to see my favourite music bands live!

I was always interested in Medical Physics, and more specifically in proton therapy. Hence, I am really excited to work on a project which has as a main goal the support of the approval process of the daily plan, i.e. the plan which is adapted to the daily anatomy of the patient. This will be done via the development of rapid quality assurance tools, as well as through the creation of a comprehensive review of the whole treatment, which will take place when the patient is not being treated.

One of the main reasons that lead me to this PhD is the fact that the findings of this project are going to be clinically implemented. At the same time, working at an institute with a proton beam facility, gives me the opportunity to be directly exposed to the current needs of the proton therapy workflow. This, combined with the available state-of-the art technology, creates the necessary fertile ground for innovative and robust solutions.



Suryakant Kaushik Raysearch

My name is Suryakant Kaushik, and I come from India, the world's largest democratic country. Under the supervision of Dr. Albin Fredriksson, Prof. Iuliana Toma Dasu, and Dr. Jakob Ödén, I am pursuing a PhD in Medical Radiation Physics at Stockholm University while also working as an Industrial Doctoral student at RaySearch Laboratories AB in Sweden. I have a Master's degree in Physics and a Diploma in Radiological Physics. Following tech news and surfing the internet every day for new and intriguing things to study are two of my favourite hobbies.

I will be working on the project titled "Robust optimization considering uncertainties in the frame of proton adaptive radiation therapy." The project aims to analyse and develop methods to mitigate the uncertainties affecting proton adaptive radiation therapy, particularly to investigate robust and probabilistic optimization and evaluation strategies for treatment planning. Using the newly developed methodologies in practical scenarios, I expect to improve the benefit-to-cost ratio of proton therapy treatment.

I worked as a Medical Physicist in Proton Therapy Centres in my home country before starting my PhD. Working on various projects throughout this time has developed my personality as an independent thinker, and I have noticed a transition from being a practitioner to a researcher. I'm self-motivated, driven, and resolute in reaching my goals because the intelligence that gave birth to stars also breathes our breath.





Jacob Brunner Medical University of Vienna

I am Jacob Brunner, he/him, 24 years old from Germany and I started by PhD in Medical Physics at the Medical University Vienna under the supervision of Barbara Knäusel. I received my Masters in Medical Radiation Sciences from the TU Dresden. In my free time I like to go ballroom dancing and doing club sports (previously Baseball and Judo). I also enjoy cultural activities like theatre, museums, opera, as well as a lively nightlife. Vienna has plenty to offer in that regard and I am looking forward to taking her up on those offers in the future!

The title of my Project is »Development of an end-to-end test workflow for all RAPTOR real-time adaptive PT components«. We focus on implementing an end-to-end test and developing an appropriate phantom for the components my fellow ESRs will develop. End-to-end tests are an important step a radiotherapy facility performs before they implement a new treatment. To assure the innovative techniques developed for adaptive particle therapy work as intended, will also require building a phantom tailored to the needs of novel treatment options. Something which drove me to this project in particular is working closely with the other ESRs. I love asking other people about the ins and outs of their work. »How does that work? Can you be sure about that? Where would this process fail?« – future me to another ESR, probably. Being curious about other peoples work is basically in the job description, which motivates me to deliver good work at the end of the day!



Stefanie Bertschi Oncoray

I am Stefanie Bertschi, I am 26 years old, Swiss and I did both my Bachelor and Master in Physics at ETH Zurich. Next to my studies, I love to play volleyball and being in the mountains for skiing and hiking.

I did both my Semester and Master thesis at the Center for Proton Therapy at the Paul Scherrer Institute. I was fascinated, how close research is to practical application and how it has a direct impact on improving treatments and therefore saving peoples' lives. The RAPTOR project allows me to continue in the field of Proton Therapy and to collaborate with people from various universities and facilities. I chose the PhD position in Medical Physics at Oncoray in Dresden under the supervision of Prof. Christian Richter and with Prof. Stine Korreman from Aarhus university as my mentor. This project is about real-time monitoring of the beam during patient irradiation using Prompt-Gamma-Imaging (PGI). This was first clinically implemented in Dresden using a knife-edge slit-camera prototype. My main focus is the development of an automated decision making tool for treatment intervention based on PGI information. I chose this project as it involves the application of machine learning algorithms as well as participating in a clinical study, therefore gaining direct insights into daily patient treatments. By the end of my PhD, I hope to provide some tools to help facilitating PGI in an adaptive workflow in future. This would enable clinicians to reduce safety margins and therefore sparing a considerable amount of healthy tissue while at the same time offering the possibility for online QA, which is much needed to support real-time adaptive proton therapy.



Beatrice Foglia Early-Stage researcher at Ludwig Maximilian University

My name is Beatrice Foglia, but everyone calls me Bea. I am almost 27 years old and I come from a little town next to Como, Italy. I am currently doing a PhD in Medical Physics at the University Ludwig-Maximilian in Munich, under the supervision of Katia Parodi and Marco Pinto. I first landed in Munich as an Erasmus student, after my Master in Physics applied to Medicine that I got at the University of Pavia. I consider myself quite an outgoing and dynamic person, but I don't dislike spending moments in quietness. I like sports and social events as well as I love spending time reading a good book or watching movies and TV series. I am vegan, I am an Harry Potter fan and, since I am here in Munich, I developed an addiction to brezeln. My research project is about dose quantification from prompt-gamma (PG) imaging for adaptive planning. PG imaging is a promising technique developed for in vivo range verification of proton therapy. The aim of my project consist in a fast dose reconstruction, starting from the PG signal, of few exploratory pencil beams from the original treatment plan. In case of detected deviations from the originally intended dose, the information will be in turn fed to the adjustable RAPTOR treatment adaptation framework to enable adapting the remaining of the planned delivery. I chose this PhD because, among the different branches of Medical Physics, radiation therapy is the one I fell in love with. My Master thesis was related to hadrontherapy, and I couldn't be happier to go on with this path. Even though proton therapy has been clinical applied for years and its feasibility has been clearly proved, giving hope to a lot of patients, it can be improved, and this is the aim of RAPTOR, so that its benefits could be made available to even more patient.



Giuliano Perotti Bernardini Cancer Research Center Groningen

I am Giuliano Perotti Bernardini, 29 years old, Argentinian, and currently doing a PhD in Medical Physics at the Cancer Research Center Groningen (CRCG) Research Institute of the UMCG, under the supervision of Prof. Dr. Stefan Both. For two years, I was part of the computational dosimetry and treatment planning group of Boron Neutron Capture Therapy (BNCT), of the National Atomic Energy Commission (CNEA) where I obtained a master-equivalent degree in Nuclear Engineering.

I am a curious person who is constantly running after new challenges, and I carry the grit to overcome obstacles and work with passion and perseverance. I enjoy travelling, exploring cities and trying new food. If I have to choose, water is a must in every place, be it a river, a lake, canal or sea, because I like to swim, dive, kayak or just sit around and relax drinking mate tea. And here, in the Netherlands I think I've found my place in the world. My research focuses on Proton Radiography (PR) which is a technique that has the potential to detect and isolate different sources of proton range uncertainty, such as setup errors, CT calibration curve errors, and anatomical changes. In our team we are working to improve this technique with the aim of incorporating it into the clinical treatment workflow to reduce the robust optimisation settings and enable accurate on-line treatment adaptation. I chose this PhD because since university I have been captivated by medical physics. I took my first steps in neutron research on BNCT and this is an excellent opportunity to work on a cutting-edge proton technique and contribute to the fight against cancer.



Finally, 16 months after the start of the project, we had the chance to meet in person.

On 8 and 9 June 2022, all ESRs and Principal Investigators met at the Paul Scherrer Institute in Villigen. Together, we assessed the project's progress with EU Officer Ana-Maria Grigore, who gave us a concise and incisive overview of the MSCA-ITN programme.

It was exciting to follow the speeches of the ESRs, which told us, in a very genuine way, something beyond examination grades, scholarships and scientific interests.

The exchange was constructive and aimed at strengthening cohesion and cooperation within the consortium.

The next in-person meeting with wider participation will be the second RAPTOR school in September. We look forward to meeting the entire RAPTOR network.

OBJECTIVES OF THE MEETING

ITN project consortia shall organise a mid-term check (MTC). The MTC assesses the fulfilment of the recruitment procedure, the eligibility of the fellows, any deviations of the original training programme and raises awareness on the fellows' and host institutions' rights and obligations.

Particular attention is paid to the fellow's rights:

- Career development plan
- Supervision and integration
- Training activities

Mid-term meeting
at Paul Scherrer
Institute, PSI

Next events and important dates

2nd RAPTOR SCHOOL -
LOOP REQUIREMENTS
4 - 9 September 2022,
Ljubljana @ Cosylab

SUPERVISORY BOARD -
ANNUAL MEETING
8 September 2022,
Ljubljana @ Cosylab

3rd RAPTOR SCHOOL -
LOOP ENGAGEMENT
10 - 15 September 2023,
Ascona @ Monte Verità



The main objectives of the 2nd RAPTOR School - Loop Requirements is to provide advanced scientific knowledge to translate and valorize ideas and concepts into novel clinical tools in order to increase the efficiency, cost-effectiveness and innovation capacity of the rapidly emerging PT field.

In addition to the technical and scientific classes, soft fundamental skills for entrepreneurship, intellectual property and certification management will be addressed.

The second Supervisory Board meeting will take place on Thursday 8 September 2022 at 14.00 in Ljubljana, during the RAPTOR school. All partners representative are invited to partake in person or virtually.

The 3rd RAPTOR SCHOOL will take place in Ascona, CH. The school is co-sponsored by ETH GRANT "Support for scientific meeting" and will be combined 4D- workshop. Save the date!



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Editorial Board:

Kristjan Anderle, Valentina Margaria, Hilda Veenstra-Korf, Phil Steininger, Stine Korreman, Christian Richter, Francesca Albertini, Luciano Rivetti, Nadine Vatterodt.

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Valentina Margaria, Kaja Alagic

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