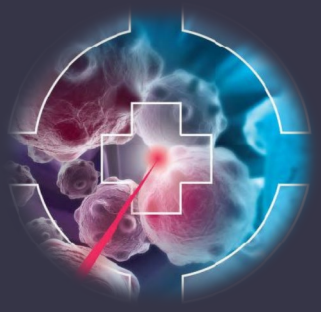


OMA Express
July 2021
Issue 16

Highlights

- OMA research paper wins Galileo Galilei award
- EU funds project on heavy ion therapy coordinated by CNAO
- Working towards next-generation cancer treatments

The power of OMA

I am delighted to share the exciting news that an OMA research paper was awarded the prestigious Galileo Galilei prize of the European Journal of Medical Physics – Physica Medica. This is a fantatic success for Dr Simon Jolly and his co-authors and ultimately for our entire network: The paper brings together researchers from no less than four OMA partner institutions. It would not have been possible without the network and the discussions that took place at many schools, workshops and our conference in 2019. You will find more information about the award including a formal statement from EJMP in this OMA Express.

Advanced training programs, such as OMA, are absolutely key to providing a steady stream of highly trained researchers to tackle the biggest challenges in science and society. In many ways, OMA has helped define new standards and already during the project lifetime, we have shared good practice with colleagues around the world and will continue to do so. To this end, I am happy to announce a special workshop which we will hold in September 2021 as an information and training event about MSCA networks in the new EU Framework Program, Horizon Europe. The MSCA scheme which generously funded OMA back in 2015 has undergone significant changes and it is important to fully understand these for institutions to put together the strongest ideas, consortia and proposals.

In the workshop, we will give an insight to the new doctoral networks, highlight best practice in researcher training and explain what is required for efficient academia-industry collaboration.

We will also answer any questions that will come up during the day.

The event is free of charge and if you are interested, please join us either in person or online. In any case, please help us spread the word and share the information about the news with your research partners!

With my very best wishes

Prof Dr Carsten P Welsch,
Coordinator

Research News

OMA research paper wins Galileo Galilei award

(Image: Physica Medica)

The Galileo Galilei Award in Medical Physics is given every year to the best paper published in the European Journal of Medical Physics in the previous year.
The journal has just announced that this year the paper **"Technical challenges for FLASH proton therapy"** by Simon Jolly, Hywel Owen, Marco Schippers and Carsten Welsch, published in Physica Medica, has been elected the best paper published in the journal in the year 2020.
The selection of the best paper has been performed on the basis of citations and downloads together with the assessment by the Editors, Associate Editors and members of the Editorial Board.

EJMP published the following statement:
"*In this paper the authors performed a comprehensive and systematic study and analysis of the technical challenges posed by the accelerator technology in order to be able to deliver FLASH proton therapy. Particular attention was given to FLASH proton delivery methods concluding that the hybrid approaches employing a combination of the scattering and scanning methods, particularly the use of scanned beams with patient-specific range modulators, are likely to method of choice for clinical proton FLASH delivery. Their work can be regarded as one of the major step towards the clinical implementation of the FLASH treatments using protons.*"

The four researchers were all members of the OMA network which facilitated the collaborative research. Study leader Dr Simon Jolly said: "*It is an honour and a privilege for us to receive this award. We are absolutely delighted that both our work on FLASH proton therapy and the burgeoning field of FLASH radiotherapy has been recognised in this way. It is a pleasure to share this award with a team of authors who have contributed so much to the field of accelerator physics, in particular the applications of medical accelerators.*"

This award is an testament for the quality of the research carried out in OMA.

Congrats to the winners of the Galileo Galilei Award 2020!

Technical challenges for FLASH proton therapy, *Simon Jolly, Hywel Owen, Marco Schippers and Carsten Welsch*
Physica Medica 78, 71 – 82 (October 2020)
https://doi.org/10.1016/j.ejmp.2020.08.005

Network News

OMA presented at the MSCA Cluster Event on Cancer Research and Innovation

The Research Executive Agency, in collaboration with the European Commission's Directorate General Education, Youth, Sport and Culture, organised a Marie Skłodowska-Curie Actions (MSCA) Cluster Event on Cancer Research and Innovation on 18-19 March 2021.
The virtual conference attracted distinguished cancer experts to exchange ideas with MSCA researchers and European Commission policy-makers on how to improve policies in the fight against cancer.
OMA Coordinator Professor Carsten P Welsch was invited to present the research outcomes of OMA in the form of a virtual poster, among 50 other MSCA cancer projects managed by the Research Executive Agency. The presentations covered many different areas of cancer research: Diagnostics, drug development and therapy, immunotherapy, prevention, and quality of life of patients and survivors.

Prof Welsch said: "*It was very impressive to see the fantastic research outcomes in the fight against cancer made possible by the Marie Skłodowska-Curie Actions. Our OMA project has significantly advanced technologies in beam and patient monitoring, facility design and optimization, as well as treatment planning systems. The cancer cluster event was a fantastic platform to present the excellent results from our Fellows*."

The Vice-Chair of the Cancer Mission Board and the Director of the Public Health Directorate participated in the opening session, where they presented the priorities of the Commission in the fight against cancer.
The summit achieved a total of 850 registrations, showing that there is an exceptional interest for the advances in cancer research, medication and prevention. The panel sessions were followed with great interest on the website and via live streaming, allowing many interactions and questions.

If you missed anything or you want to watch parts of the event again, you will find a full information on https://www.msca-cancer.eu/en/page/welcome

(Image: Research Executive Agency)

Fellows Activity

Ewa Oponowicz successfully defended her PhD thesis

On 24th March 2021 Ewa Oponowicz, the OMA Fellow based at the University of Manchester and the Cockcroft Institute, successfully defended her PhD thesis. The thesis titled 'Superconducting gantry for proton therapy and proton computed tomography' was a study on a novel beam delivery system capable of transporting protons of energies between 70-330 MeV. This single system can hence serve for two purposes: proton therapy (70-250 MeV) and proton imaging (330 MeV), i.e. proton computed tomography, a patient imaging method which can improve the accuracy of proton therapy planning.

Whilst the rigidity of a proton beam for imaging increases to 2.84 Tm (from max. 2.42 Tm for a treatment beam), the gantry is based on superconducting magnets and can be housed in a conventional proton treatment room. Pure dipoles and combined-function magnets (dipole and quadrupole components) are of canted-cosine-theta arrangement wound with a NbTi wire. The achromatic lattice of the gantry allows for an energy acceptance of +/-5% and eliminates the need of ramping the superconducting magnets during the treatment. The moderate energy acceptance, combined with a range shifter mounted in the nozzle, results in turn in high particle transmission and therefore, opens up possibilities towards proton FLASH therapy.

Additionally, within her thesis, Ewa also worked on a beam energy degrader optimisation. The derader could be potentially placed between the two achromatic sections of the gantry to enable a multi-layer treatment with static magnetic field of the first bending section. She examined various degrader geometries and compared a typical graphite with a novel boron carbide degrader to improve the particle transmission through the energy reduction system.

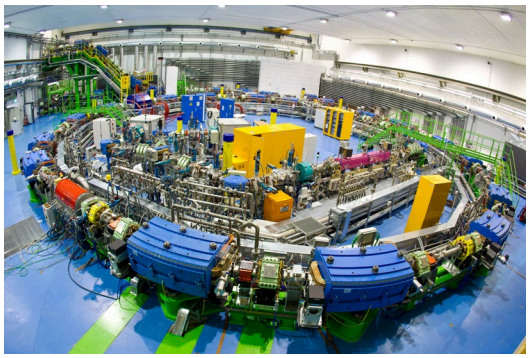
Since completing the thesis, Ewa has worked as a Fellow in the Beam Transfer Physics section at CERN. Her current project focuses on beam dynamics studies for GaToroid, a novel stationary system for heavy ion therapy.

Ewa Oponowicz

Partner News

EU funds project on heavy ion therapy coordinated by CNAO

OMA partner CNAO (Centro Nazionale di Adroterapia Oncologica, Italy) will lead the HITRIPlus (Heavy Ion Therapy Research Integration Plus) project funded by the European Union under Horizon 2020 to promote the creation of a network of collaboration between European centres using carbon ion beams.



The 80 m-circumference synchrotron at CNAO, which is isolated from the treatment rooms by reinforced concrete shielding.

The network will allow the use of these particles for research purposes, to open the centers to clinical researchers and operators interested in developing new technologies, involving companies.CNAO is one of the four centers in Europe to have a particle accelerator capable of generating beams of carbon ions for the treatment of solid tumors and for experiments in the technological field. The project has a total value of 5 million euros and brings together 22 universities and research centers from 14 European countries. CNAO will lead the project which involves realities such as CERN in Geneva, the National Institute of Nuclear Physics (INFN), the other three European centers with carbon ion accelerators (MIT in Marburg and HIT in Heidelberg in Germany and Medaustron in Austria), the Commissariat for Atomic Energy and Alternative Energy (CEA) in France, the Centro de Investigaciones Energéticas, Medioambientales y Tecnolocias (CIEMAT) in Spain.

The aim of the project, which will last 48 months, is to encourage research and technological development both in terms of applications of ions in the medical field, with the study of new components of ion accelerators, such as new sources, new linear accelerators and new systems dose distribution, and for industry with the development of new superconducting magnets (synchrotron carriers) more efficient and with lower production costs.

Sandro Rossi, director general of CNAO, underlines: "*As project coordinator, CNAO will make the synchrotron available to European scientists and industries engaged in clinical and technological research, will provide them with advice on the use of ions, will participate in joint projects aimed at refinement and development of new technologies for the acceleration of ions, such as superconducting magnets and the accurate analysis of the radiobiological effects of these particles with the aim of making oncological therapies even more precise and effective* ".

HITRIPlus wants to boost the spread of hadrontherapy in Europe, an advanced form of radiotherapy that uses heavy particles such as ions, more powerful and precise, to treat tumors resistant to traditional therapies or for tumours that are located in particularly difficult locations.

Typically, hadrontherapy began its experience on tumours of the base of the skull where it is necessary to be extremely precise in the delivery of the treatment since around the tumour mass there are very important structures, nerves and vessels that cannot be damaged.

Unlike traditional radiotherapy based on X-rays or electrons, hadrontherapy involves the use of proton and carbon ions. These hadrons have the advantage of being heavier and having more energy than electrons and, consequently, of being even more effective in destroying cancer cells. In order to be effective in hitting the tumour with extreme precision, the hadrons used in the treatment of hadrontherapy must undergo a very powerful acceleration by means of a particle accelerator. Worldwide, only six facilities are capable of delivering protons and carbon ions hadrontherapy.

Many of our OMA partners, including **CERN** in Geneva, **INFN** in Italy, **GSI** in Germany, **MedAustron** in Austria and **PSI** in Switzerland, teamed up to make this possible, sharing their data and experiences to further study the radiobiological effects of ions, to refine the quality and efficacy of particle beams extracted from accelerators with the general objective of further improving their use in the clinical area.

Finally, the project will make available to the scientific community an innovative design of an accelerator that can be used in centers interested in introducing oncological hadrontherapy.

Healthcare Instrumentation Workshop forms the basis for future collaborative projects and partnerships

With a growing concern for safe and effective prevention of diseases, as well as diagnosis, treatment and rehabilitation, there has been a significant increase of investment in research and development of healthcare instrumentation in the UK.

With the purpose of identifying the key research challenges in this area, and build partnerships between the University of Liverpool and the UK healthcare industry, the Physics Department held a Healthcare Instrumentation Workshop, sponsored by the OMA network.

The online event took place on Thursday 22 April and attracted over 60 participants, including academics and representatives from companies developing or manufacturing medical instrumentation, and organisations using such devices in a clinical setting.

The workshop was conducted by Constantinos Astreos, Business Development Manager of the Physics Department, and Prof Carsten Welsch, who presented the department's technical capabilities.

A panel of experts, chaired by Phil Carvil, HealthTec Cluster Manager of STFC, explored the technological trends and challenges in healthcare instrumentation, and Constantinos Astreos gave an overview of research funding opportunities from STFC, EPSRC, the Industrial Strategy Challenge Fund, EU and CRUK.

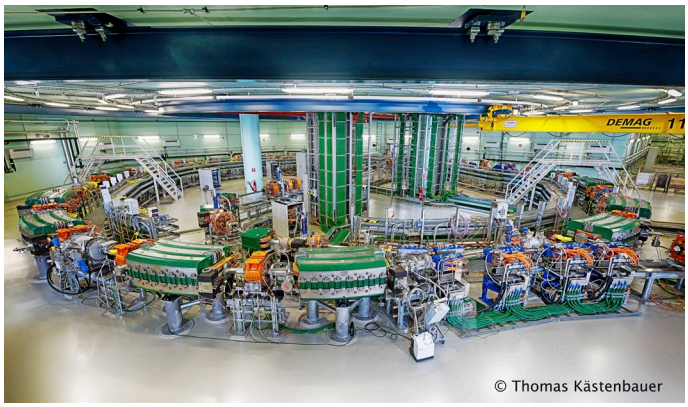
The workshop continued with focused group discussions on different areas of future research development. The discussions revolved around the challenges of data science and artificial intelligence in healthcare instrumentation; the effective diagnosis and treatment of medical conditions; and the optimisation of sensor technologies for improved beam diagnostics and patient treatment planning in radiotherapy.

UNIVERSITY OF LIVERPOOL

Constantinos Astreos said: "*Collaboration between researchers and industry experts is essential if we are to tackle today's research challenges in healthcare. The workshop enabled the building of new relationships and exchange of ideas which we will form the basis of future collaborative projects and partnerships.*"

Prof Welsch added: "*There are many healthcare challenges which require an interdisciplinary approach and in particular industry-academia collaboration under the guidance of clinical experts. Liverpool physics is in an ideal position to address these challenges given our unique capabilities, infrastructure and research activities. The workshop has allowed us to clearly define a list of healthcare instrumentation R&D priorities, as well as to establish and strengthen links with national and international partners.*"

Working towards next-generation cancer treatments



The MedAustron proton/carbon-ion synchrotron (credit: MedAustron/Thomas Kästenbauer).

OMA partner CERN's Next Ion Medical Machine Study (NIMMS) aims to drive a new European effort for ion-beam therapy based on smaller, cheaper accelerators that allow faster treatments, operation with multiple ions, and patient irradiation from different angles using a compact gantry system. Its predecessor the Proton-Ion Medical Machine Study (PIMMS), which was undertaken at CERN during the late 1990s, underpinned the treatment centres of OMA partner institutions CNAO (Italy) and MedAustron (Austria) that helped propel Europe to the forefront of hadron therapy.
Covering the period 2021–2024, two recently approved EC Horizon 2020 Research Infrastructure projects will support NIMMS while also connecting its activities to collaborating institutes throughout Europe. The multidisciplinary HITRIplus project (Heavy Ion Therapy Research Integration), includes work packages dedicated to accelerator, gantry and superconducting magnet design. The IFAST project (Innovation Fostering in Accelerator Science and Technology), lead by CERN, will include activities on prototyping superconducting magnets for ion therapy with industry, together with many other actions related to advanced accelerator R&D.

"*Over the past three years we have collected about €4 million of EC contributions, directed to a collaboration of more than 15 partners, representing about a factor of eight leverage on the original CERN funding*," says NIMMS project leader Maurizio Vretenar. "*A key achievement was the simultaneous approval of HITRIplus and IFAST because they contain three strong work packages built around the NIMMS work-plan and associate our work with a wide collaboration of institutes.*"

A major NIMMS partner is the new South East European International Institute for Sustainable Technologies (SEEIIST), an initiative started by former CERN Director-General Herwig Schopper and former minister of science for Montenegro Sanja Damjanovic, which aims to build a pan-European facility for **cancer research and therapy with ions in South East Europe**. OMA partner institutions CNAO and MedAustron are closely involved in the superconducting gantry design, CIEMAT in Spain will build a high-frequency linac section, and INFN is developing new superconducting magnets, with the TERA Foundation continuing to underpin medical-accelerator R&D.

Also successful in securing new Horizon 2020 funding is a project built around CERN's **MEDICIS** facility, which is devoted to the production of novel radioisotopes for medical research together with institutes in life and medical sciences. The PRISMAP project (the European medical isotope programme) will bring together key facilities in the provision of high-purity-grade new radionuclides to advance early-phase research into radiopharmaceuticals, targeted drugs for cancer, "theranostics" and personalised medicine in Europe.

Together with other project consortia, the MEDICIS and HITRIplus teams are also working to identify the relevance of their research for the **EC's future cancer mission**, which is part of its next framework programme, Horizon Europe, beginning this year.

Read original article in CERN Courier **https://cerncourier.com/a/european-projects-boost-cerns-medical-applications/**

CNAO pioneer in Italy with the BNCT: an advanced form of radiotherapy for the control of complicate tumors

At CNAO, for the first time in Italy, a small particle accelerator for the production of neutron beams will be installed in a space dedicated to clinical and medical research that will be built over the next two years. It will be made available, by **Tae Life Sciences** (TLS), a USA company. The neutron accelerator, part of TLS's Alphabeam™ Neutron System, will be used to deliver Boron Neutron Capture Therapy (BNCT), an advanced form of radiotherapy that allows the generation of a localized physical reaction, capable of destroying cancer cells, sparing normal ones.

The Alphabeam includes a compact neutron source based on a tandem accelerator and other components that offer a complete solution for BNCT delivery. The system is designed to be installed in hospital environments and can be configured in a single or multi-room BNCT center to meet various clinical, research and capacity needs.

In CNAO two irradiation rooms will be built and equipped: one devoted to research and the other reserved to patient treatments. Treatment rooms include a fixed beam, a Beam "shaping" assembly and a ceiling

fondazioneCNAO
Centro Nazionale di Adroterapia Oncologica

mounted robotic couch for optimal patient positioning.

The development of this technique, first conceived in 1936 by G.L. Locher from the Franklin Institute of Pennsylvania, was held back by the fact that, in the past, huge reactors were needed to produce neutrons, which had to be located outside healthcare structures. The recent development of neutron sources based on much smaller accelerators has allowed this technique to spread in many countries (several machines are being tested in Russia, Japan, United Kingdom, Argentina and United States).
BNCT consists of administering a drug (the most used today is Borophenylalanine-BPA), which carries the molecule of Boron-10 inside the cancer cells and which accumulates to a greater extent in cancer cells than in normal cells.

The next step involves irradiating the tumor with neutrons. The consequent reaction generates a therapeutic dose that selectively destroys cancer cells with boron-10 while sparing surrounding healthy cells. The combination of low-energy neutrons and boron-10 release an intense, highly localized capture reaction that emits alpha particles and destroys the cancer on a cell-by-cell basis. Pavia has already been a pioneer in this technique, applied to the treatment of two patients with liver metastases, thanks to the work carried out in the early 2000s by experts from Policlinico San Matteo and Pavia University. This expertise will breathe new life in the CNAO “BNCT” project. Due to its characteristics, the BNCT requires multidisciplinary research, which involves physicists and engineers for the design and implementation of the technology necessary for the production of neutron beams; chemists and biologists for the study and optimization of the bio-distribution of boron and the analysis of radiobiological effects; medical physicists and physicians for dosimetry, preparation of treatment plans and patient management.

Recent clinical trials carried out in Japan for advanced or relapsing head and neck cancers has led to the approval of BNCT for clinical use with national insurance coverage. Finland has also seen similar results in treating head and neck cancers where other available therapies fail. BNCT represents a potential useful cancer treatment for tumor destruction, control, and significantly improving patients’ quality of life.

Treatment room at CNAO. (Image credit: CNAO)

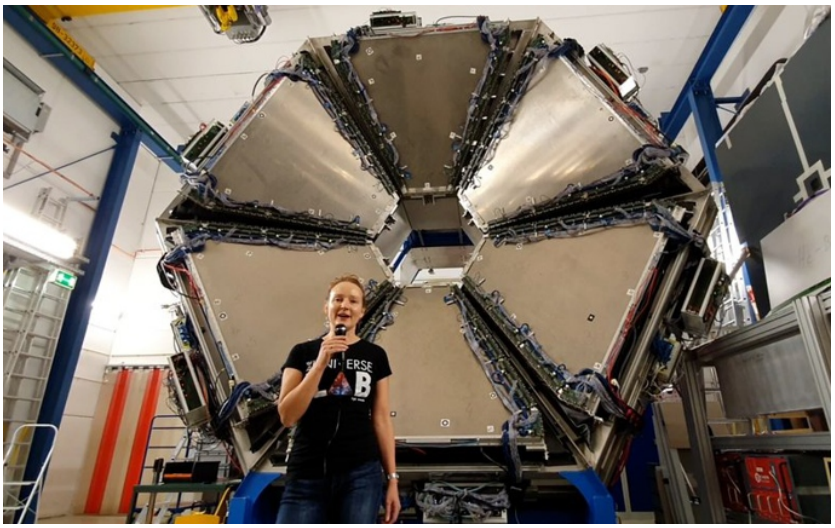
Visit GSI and FAIR Live – online!

OMA Partner GSI - Helmholtz Centre for Heavy Ion Research, based in Darmstadt is the German national center for heavy ion research and hosts a large accelerator facility where high beam intensities for heavy ions are accelerated up to several GeV/u. Next to the GSI-complex, a worldwide unique accelerator facility is currently being constructed for heavy ions and antiprotons, the Facility for Antiproton and Ion Research (FAIR). The facility is designed for first class research in the field of atomic, nuclear and plasma physics, material sciences and biophysics and will be used to create and study matter in the laboratory that otherwise only occurs in the universe. GSI hosted OMA Fellow Michelle Lis during her research projects.

Due to the Corona pandemic measures, visits to GSI's campus are currently not possible. Instead, they have organized online tours so that GSI and FAIR can be visit virtually. These tours have been very popular and as such a few more dates have been added to the schedule, including Thursday, 1 July 2021 14:00 CET / 13:00 BST (in English)

The live moderated events offer a comprehensive insight into current research and the experimental facilities at GSI/FAIR and allow individual questions to be asked, which will be answered by the presenters. Also included is an exclusive view at the mega construction site for the future accelerator center FAIR, one of the largest construction projects for research worldwide.
Following an introductory lecture, a guided video tour will take the participants to several research sites and facilities on campus: Among other things, the participants can visit the 120-meter-long linear accelerator UNILAC or the main control room online and learn a lot about the unique research at GSI and FAIR. Interesting facts inform about the construction of components for the international accelerator center FAIR, currently being built at GSI.

Detailed information on technical requirements and access to the digital discovery tour is available via www.gsi.de/en/besichtigung. Registration for the event dates is not necessary. Up to 500 people can participate.



Screenshot from the video tour – large detector HADESS (Image: GSI)

Upcoming Events

MSCA Networks - Training the next generation through collaborative programmes

29th September 2021, Liverpool and Online

Marie Skłodowska-Curie Actions (MSCA) target the development of excellent researchers through international and cross-sector mobility. MSCA networks support joint doctoral programmes, implemented by European partnerships of universities, research institutions, industry (incl. SMEs) and other non-academic organisations. The research training programmes are intended to provide doctoral students with excellent research skills, coupled with experience outside academia to develop their innovative capacities and employment prospects.

The QUASAR Group, based at the University of Liverpool / The Cockcroft Institute, has an exceptional track record in the coordination of MSCA networks through leadership in the DITANET, oPAC, LA^{3}NET, OMA and AVA projects. In combination, the Group has been in charge of the training of almost 100 Fellows and has coordinated the research and training at more than 100 partner organizations.

This workshop will share best practice and provide participants with a detailed understanding of the opportunities (and challenges) that the scheme offers. It is aimed at staff at academic and non-academic organisations in the UK and abroad, including industry, who are planning to participate in one of the next MSCA Doctoral Networks call, either as PI/CoI or admin staff.

The event is free of charge and will be hosted at the University of Liverpool on 29th September 2021. Remote connection will be made available and some of the speakers will join online. Advance registration is required and can be done via the following link: https://indico.ph.liv.ac.uk/event/358/

FLASH Radiotherapy and Particle Therapy Conference (FRPT 2021)

1st – 3rd December 2021, Vienna and Online

FRPT 2021 looks to build a worldwide organisation of scientists and professionals interested in FLASH Radiotherapy (RT) using protons, electrons, heavier charged ions and photons. The conference will gather researchers and students (from academia and industry) with professionals working in clinical oncology, and provide a multidisciplinary forum to discuss the latest developments in FLASH RT.

FRPT 2021 goes from basic science, through preclinical research and combines these with translational applications and clinical trials and treatment. The ultimate goal of the conference is to harness the potential for FLASH RT in a rigorous scientific and quality assured environment and to act as a forum for the very latest advancements in this rapidly developing field.

More information:
https://www.liverpool.ac.uk/oma-project/news/stories/title,1250187,en.html

Conference homepage:
https://frpt-conference.org/

Follow on Twitter @FlashRPT

Early Registration Deadline:
21st July 2021

Events	
28th June – 2nd July 2021	International Conference on Radio Frequency Superconductivity (SRF 2021), Virtual Conference
29th Sept 2021	MSCA Networks Training the next generation through collaborative programmes, Liverpool and Online
1st – 3rd Dec 2021	FLASH Radiotherapy and Particle Therapy Conference (FRPT 2021) , Vienna and Online

NOTICE BOARD

DEADLINE FOR THE NEXT NEWSLETTER **15th October 2021**

The newsletter is published on a quarterly basis. Help us keep it interesting by providing your news and updates.

www.oma-project.eu

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