as well as percentage depth dose (PDD) curves. These results were then compared to measurements taken with a CC13 ion chamber in a water tank and Gafchromic film in solid water.

To date the simulated results are in good agreement with the measured data, for open field data agreement between PDDs was within 2%. The nominal energy of the system has been determined to be within the range of 5.6–6 MV, which matches the specifications of the linac. Analysis of the energy spectrum showed the photons downstream of the linac contained a higher low energy component compared with typical clinical radiotherapy beams due to the absence of a flattening filter.

This phase of the project is essential to obtain a comprehensive model of the complete system which will be used to develop a Monte Carlo treatment plan verification tool for the Australian MRI-linac.

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Abstract ID: 49 Monte Carlo simulation of breast screening programmes

C. Forastero [a], L.I. Zamora [b], D. Guirado [a,c], A.M. Lallena [c,d,*]

[a] *Unidad de Radiofísica, Hospital Universitario San Cecilio, Granada, Spain*
[b] *Servicio de Física y Protección Radiológica, Hospital Regional Universitario Virgen de las Nieves, Granada, Spain*
[c] *Instituto de Investigación Biosanitaria (ibs.GRANADA), Granada, Spain*
[d] *Departamento de Física Atómica, Molecular y Nuclear, Universidad de Granada, Granada, Spain*
* Presenting author.

Nowadays, there are still controversies about the justification of breast screening programs (BSPs). In this work we have developed a Monte Carlo tool that reproduces the outcomes of BSPs (annual detection rate, invasive/*in situ* rate, interval cancer rate, etc.) and that, once tuned, permits evaluating the mortality reduction rate and the overdiagnosis for different BSP configurations (age ranges and mammography frequencies).

In the simulations, the tumors diagnosed within BSP and those clinically detected (cancers of interval) were taken into account. This permitted estimating the annual reduction in breast cancer mortality due to mammographic screening for any configuration [1,2]. The comparison of the results obtained with those found for the same population without screening provided the overdiagnosis due to BSPs.

The tool was adapted to simulate randomized controlled trials (RCTs) and estimate the corresponding relative risks [3]. By considering the same population characteristics for different RCTs, their external validity was addressed; their internal validity was analyzed by investigating the disagreements observed between the relative risks obtained and those quoted for the RCTs considered.

One of the main results was that assuming a quicker growth of the invasive cancers was not necessary to reproduce empirical results. Mortality reductions of 12%–20% (between two and four deaths per year and 100000 women) were obtained for acceptances above 50%. This should be a threshold for the acceptance, which appeared to be a critical parameter.

Our tool allowed reproducing the known results of overdiagnosis. This varied between 10 and 20%, depending on the configuration. It was found that, after the end of the BSP, the number of invasive cancers detected was similar in control and screening groups and thus overdiagnosis is almost exclusively associated with *in situ tumors.*

Monte Carlo simulations appear to be a very powerful tool to investigate BSPs and RCTs, helping to establish which of their results may be extrapolated to other populations, to design the trial strategies and, eventually, to adapt them during their development.

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Abstract ID: 51 Monte Carlo optimization of a neutron beam from 5 MeV ^{9}Be(p,n) ^{9}B reaction for clinical BNCT

I. Postuma [a,*], S. Bortolussi [b], N. Protti [a], S. Fatemi [a,b], S.J. González [c,d], L. Provenzano [c,d], G. Battistoni [e], S. Altieri [a,b]

[a] *Istituto Nazionale Di Fisica Nucleare (INFN), Unit of Pavia, Italy*
[b] *Department of Physics, University of Pavia, Italy*
[c] *Comisión Nacional de Energía Atómica (CNEA), Argentina*
[d] *CONICET, Argentina*
[e] *Istituto Nazionale Di Fisica Nucleare (INFN), Unit of Milan, Italy*
* Presenting author.

Boron Neutron Capture Therapy (BNCT) is an experimental radiotherapy that uses the combination of neutron irradiation and ^{10}B to treat neoplasms. By means of this technique, many clinical trials were performed worldwide with promising results [1] using research nuclear reactors as neutron sources. Anyhow, these machines have several problems that hinder the development of dedicated BNCT hospitals. This issue can now be overcome by using intense-current proton accelerators, which coupled with beryllium or lithium targets yield more than 10^{14} neutron per second. This can be a boost to BNCT because accelerators are more compact and can be installed within hospitals.

The Italian National Institute of Nuclear Physics (INFN) designed and manufactured a Radiofrequency Quadrupole proton accelerator (RFQ) [2], which delivers 5 MeV protons with 30 mA current in a Continuous Wave (CW) mode and it is coupled to a beryllium target. This accelerator could be installed at Centro Nazionale di Adroterapia Oncologica (CNAO) in Pavia.

In this work we present the MC calculations for the tailoring of a BNCT neutron beam obtained by the described RFQ. Firstly, we show that MC transport codes such as MCNP and PHITS are not able to simulate the correct neutron spectra from 5 MeV protons interacting on beryllium. Therefore, the neutron double differential source implemented in MCNP was extracted from the measurements performed by Agosteo et al. [3]. As the energy range goes up to 3.5 MeV, neutrons need to be moderated and collimated by a Beam Shaping Assembly (BSA), because BNCT requires a spectrum peaked between 1 and 10 keV. Differently from the past, where the optimal configuration was chosen according to physical characteristics of the beam, in this case the results were evaluated on the basis of the dosimetry obtained in a real clinical case by treatment planning simulation. What emerges, is that the classical figures of merit employed for the tailoring of a clinical BNCT [4] should be taken as a first guideline, while the dosimetric assessment on realistic clinical scenarios is the most appropriate criterion for beam evaluations.

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Abstract ID: 53 Impact of the true sensitive volume on ion chamber response in magnetic fields

Victor N. Malkov *, D.W.O. Rogers

Carleton University, Department of Physics, Ottawa, Canada
* Presenting author.

Development of magnetic resonance guided radiation therapy (MRgRT) has sparked interest in evaluating the performance of ion chambers in the presence of magnetic fields. The effect of the field on electron trajectories alters ion chamber response [1]. In most Monte Carlo (MC) simulations, the geometric sensitive volume, often beginning at the edge of chamber's stem, is used instead of the potentially unknown true collection volume [2]. This work evaluates the sensitivity of chamber response in the presence of magnetic fields to the collection volume used in the MC calculation. The egs_chamber application of the EGSnrc system is used with a recently validated magnetic field transport algorithm [3] to simulate the response of several ion chambers. The chambers are simulated in a PMMA phantom with an incident Co-60 photon beam and magnetic fields between 0 and 2 T, perpendicular to both the incoming photon field and the long axis of the ion chamber. The dose, normalized to 0 T, is calculated in the geometric sensitive volume with either the first 0, 0.5, or 1.0 mm of the volume away from the stem excluded. Increases in chamber response with a maximum of 1.77 ± 0.03% and 3.33 ± 0.03% are observed for a reduction in the length of the collection volume by 0.5 mm and 1.0 mm, respectively. For four chambers, the reduced volumes generally give better agreement with experimental results [4]. Various chamber orientations are under investigation to minimize the effect. This is an important effect that must be addressed to ensure proper calibration of MRgRT machines.

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Abstract ID: 55 Beam characterization for the TULIP accelerator for protontherapy through full Monte Carlo simulations

Caterina Cuccagna [a,b,*], Stefano Benedetti [c], Vittorio Bencini [a], Daniele Bergesio [a], Pedro Carrio Perez [a], Enrico Felcini [a], Adriano Garonna [a], Wioletta Kozlowska [d], Mohammad Varasteh Anvar [a], Vasilis Vlachoudis [c], Ugo Amaldi [a]

[a] *TERA Foundation, Geneva, Switzerland*
[b] *University of Geneva, Geneva, Switzerland*
[c] *CERN, Geneva, Switzerland*
[d] *Medical University of Vienna, Austria*
* Presenting author.

TULIP, Turning LInac for Protontherapy, is a novel accelerator systems for protontherapy mounted on a rotating gantry designed by the TERA Foundation and CERN [1,2].

TULIP is natively designed with a 3D active scanning system that, besides the transverse scanning with fast magnets, features a fast beam energy variation from the linac to scan in the longitudinal direction in few ms.

The main goal of this research is to characterize TULIP's beams, through Full Monte Carlo (MC) simulations.

The study combines the multi-particle tracking programs, RF Track [2], Travel [3], MADx-PTC [4] and the FLuka Monte-Carlo code [5,6], enabling to follow each particle from the source through the linac, the beam transfer lines and the nozzle elements, until the isocenter such that transverse and longitudinal phase space characteristics are accounted for each particle.

The particle fluence results in air at the isocenter and in upstream and downstream positions along the beam direction and the depth-dose curves are obtained and presented in a beamline model for a set of beam energy values and scanning magnet kick strengths.

The results, suitable for characterizing in detail the beam spots for this particular accelerator system, can be used as input to generate a beam model in a commercial TPS and thus to allow the comparison with Fluka results in real patient case scenarios.

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Abstract ID: 60 Monte Carlo simulation and experimental validation of glandular dose coefficients in digital breast tomosynthesis

G. Mettivier [a,b], F. Di Lillo [a,b], A. Sarno [a,b], K. Bliznakova [c], Z Bliznakov [d], H. Bosmans [e], P. Russo [a,b]

[a] *Università di Napoli Federico II, Dipartimento di Fisica "Ettore Pancini", Via Cintia, I-80126 Napoli, Italy*
[b] *INFN Sezione di Napoli, I-80126 Napoli, Italy*
[c] *Department of Electronics, Technical University of Varna, Varna 9010, Bulgaria*
[d] *Laboratory of Computer Simulations in Medicine, Technical University of Varna, Varna 9010, Bulgaria*
[e] *University Hospitals of Leuven, Department of Radiology, Herestraat 49, Leuven 3000, Belgium*

The mean radiation dose to the glandular tissue and its dependence on the irradiation geometry, beam quality, breast size and composition in digital breast tomosynthesis (DBT) exams have been studied extensively via Monte Carlo calculations [1]. On the other hand, there are few comprehensive studies on the dose distribution