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# CNAO Radiation Protection studies for a facility made of an A-BNCT facility and two synchrotrons

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The National Centre for Oncological Hadrontherapy (CNAO) stands as one of the few facilities in the world capable of treating oncology patients using both protons and carbon ions accelerated by a synchrotron. In the near future, this machine will undergo an upgrade, incorporating a new ion source that allows the exploitation of helium, lithium, oxygen, and iron ions for both therapeutic and research purposes. Additionally, new accelerators will be added to the facility, i.e. a proton synchrotron with rotating gantry and an accelerator based BNCT facility.
All the accelerators are built within a single building, in a small area (about 30,000 $m^2$), and the particular location, near urban construction, such as hospitals, research institutes, and apartment buildings at a few hundred meters of distance, poses some particular issues when handling the radiation protection problems for the facility.
For these reasons, many peculiar solutions have been found to minimize the doses around the shielding of the machines and to assess new ions workloads inside the current shielding. Furthermore, extensive assessments have been carried out to minimize the production of neutron absorption gammas of radioactive gases released by the exhaust and by choosing ad hoc materials e.g. boronated concrete, barite boronated concrete in the construction of the BNCT facility.
The evaluations have been developed by deep-diving into some hypotheses that are usually taken as granted, by building a very precise Monte Carlo modeling of the facilities and by taking into account also the magnets self-shielding and by cross checking different Monte Carlo softwares for better robustness of the data. Particular attention was paid to the dispersion of radionuclides in the atmosphere involving a comparison between existing literature models and introducing an original Monte Carlo implementation of the Gaussian Plume model.

## Scientific Topic 1

Source terms, new accelerator facilities and related topics

## Scientific Topic 2

## Scientific Topic 3

## Scientific Topic 4

## Scientific Topic 5

## Scientific Topic 6

## Scientific Topic 7

Medical and industrial accelerators

## Scientific Topic 8

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