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Invited talk: Status of the RDH project

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RDH (Research and Development in Hadrontherapy) is the INFN project which aims to coordinate together different research groups which are involved in the field of charged particle oncological therapy, i.e. radiotherapy based on the use of charged hadron beams (protons or light nuclei). This technique is the result of fruitful collaboration of medicine, physics and biology. It exploits the properties of energy deposition in matter by massive charged particles, with many advantages with respect to conventional radiotherapy based on X-rays. Charged particle therapy has indeed a high potential in terms of precision and selectivity. However, there exist uncertainties mostly connected to physics and biology (range uncertainties, radiobiological effects) which at present still represent significant limitations. Furthermore, as in the case of normal radiotherapy, there are requests to implement quality control and in-vivo monitoring techniques, which stimulate the development of applications deriving from the experimental techniques of nuclear and particle physics. In addition, since hadron accelerators have higher costs with respect to standard medical electron LINACs, the development of new and more efficient acceleration systems is another topic in which the expertise of physics community can be fundamental. The program of RDH, similarly to that of other several institutes in the world, includes several of the mentioned chapters: specific radiobiological investigations, development of software tools (in particular for treatment planning), design of new accelerator sources and the development of particle detection techniques. These find different applications, ranging from the monitoring of therapeutic beams to medical imaging techniques. In particular the concern is focused on two different aspects: in vivo monitoring, exploiting the production of secondary particles and radioisotopes induced by the primary beam, and imaging aimed to achieve a more precise range assessment, and therefore a more precise planning of the treatment. One of the most promising approaches in this respect is proton tomography (pCT). All these experimental developments benefit from the knowhow in particle detectors and nuclear electronics deriving from basic research.
The status of the different parts of RDH project will be reviewed, highlighting the most recent results and the general perspectives of these researches.

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