

## **Introduction to medical accelerators**

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The application of particle accelerators in medicine started with the discovery of x-rays by W. Roentgen in 1895. Nowadays there are nearly 20,000 particle accelerators in operation worldwide, about half of them employed for biomedical uses. Modern medical accelerators can essentially be divided into three classes: 1) electron linacs for conventional radiation therapy, including advanced modalities such as cyberknife, intra-operative radiation therapy (IORT) and intensity modulated radiation therapy (IMRT), 2) low-energy cyclotrons for the production of radionuclides for medical imaging and 3) medium-energy cyclotrons and synchrotrons for hadron therapy with protons (250 MeV) or light ion beams (400 MeV/u  $^{12}\text{C}$  ions). The operating principle of the electron linac, the cyclotron and the synchrotron will be briefly reviewed. The lecture will then mainly focus on the use of cyclotrons and synchrotrons for cancer radiation therapy with protons and carbon ions, showing some examples of the more recent clinical facilities. Some novel accelerator concepts will also be illustrated.