

Developments in the Design of Proton and Ion Accelerators for Medical Use, P.J. BRYANT, CERN, Geneva - Accelerators and medicine have been close companions since cyclotrons first made biological studies possible with particle beams in the 1930s. Later improvements, such as H-minus extraction, made cyclotrons the foremost, commercially-available producer of medical isotopes. Although the world's first hospital-based proton treatment centre, Loma Linda, uses a synchrotron, the cyclotron is now also establishing a dominance in proton centres using passive beam spreading. However, two trends indicate a slightly different direction. The first is towards light ions and the second is towards pencil beam scanning with active energy control. Together, these point to a generation of synchrotrons with slow beam extraction systems that allow time for on-line dosimetry and provide very smooth spills. There are several variants for the slow extraction including the use of a betatron core and rf knockout. There are also methods for improving the spill quality such as rf channelling buckets and rf noise. The use of a synchrotron has the consequence of unequal emittances in the extracted beam, which, in turn, affects the design of extraction lines, passive and active scanning systems and the rotational optics of gantries.