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A cyclotron-linac complex for carbon ion therapy

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The machines used today for carbon therapy are 20-25 m diameter synchrotrons. For the ARCHADE project IBA is building a 400 MeV/u superconducting cyclotron weighing 700 tons and needing a 15 metres long Energy Selection System.

In the years 1993-1995 TERA designed a proton linac (LIBO = LInac BOoster) which runs at 3 GHz. A module was built with CERN and INFN and accelerated protons with the expected gradient: 16 MV/m. A 27 MV/m gradient was also obtained, which entails a peak surface field of 2.5 Kilpatrick.

TERA is now working on CABOTO (Carbon BOoster for Therapy in Oncology) which is placed downstream of a superconducting cyclotron. After a 3 GHz design, to reduce the overall length the frequency has been increased to 5.7 GHz. This paper describes such a fast-cycling cyclotron-linac complex which runs at 300 Hz for the multipainting of moving tumours.

In 23 metres the linac accelerates from 120 MeV/u to 400 MeV/u either C+6 ions or H2+ molecules. The 300 Hz source is the Electron Beam Ion Source EBIS-SC by DReEBIT (Dresden) which produces in 3 μ s more than 108 C+6 ions. The K = 480 cyclotron weighs about 170 tons and the Cell Coupled Linac is made of eighteen 1.3 m long units (gradient = 40 MV/m, Kilpatrick = 2.9) powered by solid state modulators equipped with 12 MW klystrons.

By switching off the klystrons, the cyclotron-linac complex produces - in eighteen 15-16 MeV steps - beams of either C+6 ions or H2+ molecules with energies in the range 120 - 400 MeV/u. Smaller steps are obtained with a segmented 20 mm absorber and no Energy Selection System.

Please submit a short bio (max 1500 characters)

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