

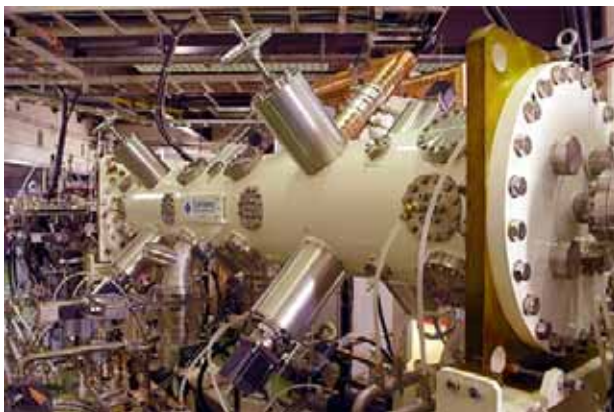
NIRS Takes Big Step Toward Making HIMAC Smaller

On October 20, the National Institute of Radiological Sciences (NIRS) announced its development of a compact radio-frequency quadrupole (RFQ) linear accelerator (linac), as well as its success in carrying out beam testing with it.

The RFQ linac will enable an 80% reduction in the length of the injector for the heavy-ion medical accelerator (HIMAC) in Chiba. HIMAC is composed of an injector – comprising an ion source, the RFQ linac and the DTL – and a synchrotron. Combining the RFQ linac with its new drift-tube linac (DTL), now under development, NIRS will carry out comprehensive tests of an injector for a more “practical” (i.e., smaller) version of HIMAC.

In charged-particle cancer therapy, patients are irradiated with high-energy carbon beams from a heavy-ion accelerator outside their bodies. To reach the interior of a human body, heavy-ion accelerators must be able to deliver a beam that can penetrate at least 25cm. In the case of carbon ions, that requires accelerating the ion beam to about 70% the speed of light.

HIMAC and other heavy-ion accelerator facilities that can achieve such performance are all very large and expensive to build, and are not so numerous worldwide. For the frequency of their medical use to be increased, then, they have to be made smaller and more economical. However, conventional R&D in the field of particle accelerators has tended to focus on achieving higher energies and densities, with hardly any work done toward making accelerators smaller per se.



RFQ linac just recently developed by NIRS

NIRS's RFQ linac allows the realization of an injector 2.5m long and 0.4m in diameter, about one-third the size of previous ones. By employing alternating-phase focusing (APF), the interdigital H-mode DTL now under development is expected to be similarly reduced, to dimensions of 3.5m long and 0.4m in diameter: one-seventh and one-fifth, respectively, the dimensions of the current Alvarez-mode DTL.

Alvarez-mode DTL requires three 1-MW-class radioamplifiers, whereas the new IH-mode DTL will need only one 500-kW-class radioamplifier. That will also substantially reduce construction costs.

Combining the RFQ linac and IH DTL, the total length of an injector can be reduced to 6m from the current 32m. Moreover, the current

In its two-year program, begun last year, to promote the increased use of HIMAC, NIRS has carried out research on smaller heavy-ion accelerators and the overall designing of a more practical version. In March 2004, NIRS successfully developed permanent magnet ECR ion sources. It plans to ascertain the performance of highly efficient small injectors, combining all of those elements, before the end of the current fiscal year (i.e., by March 31, 2006).

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