DESIGN OF A 720 MeV PROTON FFAG ACCELERATOR(*)

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A conceptual design for a 720 MeV proton FFAG accelerator has been prepared by the MURA and UCLA groups. The primary interest in such an accelerator is for the production of intense secondary pion beams of several hundred MeV energy. An FFAG accelerator has advantages for this application, arising mainly from beam stacking. A large flexibility in duty factor, from very small values to close to 100% , can be achieved by beam stacking.

Design parameters are tabulated below :

Energy	720 MeV
Injection energy	20 MeV (linac)
Maximum orbit radius	9.0 meters
Radial aperture	2.05 meters
k	8.1
N	16 (spirals)
M	72 (magnet blocks)
K (= 1/W)	66.1
ν_x	3.2
ν_y	2.25
A_x	$\pm$ 13.1 cm (average radial stability amplitude)
A_y	$\pm$ 4.5 cm (average vertical stability amplitude)
Magnet weight	800 tons
Coil weight	30 tons
Magnet power	4 MW

The non-scaling dynamics problems caused by the radial straight sections are similar to those in the proposed MURA 10 GeV high-intensity accelerator[1]. The use of 4.5 radial straight sections per spiral sector reduces the change of ν_x and ν_y with radius to acceptable values. There are now 8 superperiods in the accelerator; the essential resonance closest to the operating point is

$$\nu_x + 2\nu_y = 8 .$$

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The magnet-block design follows that of the proposed MURA accelerator. The spiral pole pieces are separately machined and mounted on standard yokes. It is possible to reverse some or all of the return legs to provide easier egress for particles.

Accelerating systems employing either tuned or untuned cavities can accelerate 100 μA with an average RF power less than 1 MW. The untuned system is less efficient, but also less complicated.

Output is limited by space-charge effects. A time-average current of 210 μA, or 1.3×10^{15} protons per second, can be accelerated, even including bunching effects.

A more detailed description of the design than is possible here is being submitted to Nuclear Instruments and Methods for publication.

Reference

1. MURA Staff, Proceedings of the International Conference on High Energy Accelerators (U.S. Atomic Energy Commission, Washington, D.C.),1961, p 57.