BEAM INJECTION AND ACCUMULATION METHOD IN THE STORAGE RING FOR HEAVY ION FUSION

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Abstract

A combination of multiturn injection and RF stacking is proposed as an efficient beam injection method in storage rings for heavy ion fusion program. Five turn injection in each transverse phase space and four RF stackings give total stacking truns of 100 which is a result of compromizing the tolerable emittances and momentum spread in the ring. Space charge limit and coherent beam instabilities are investigated and it is found that the most severe limit is transverse coherent instability but it will be managed by the use of sextupole and octupole magnetic fields. Assuming a charge exchange cross section as 1×10^{-15} cm^2, the e-folding life time is estimated at 180 ms, while the stacking time is 40 ms.

Table 1 3 cases of target data and beam parameters.

E(MJ)	P_p(TW)	T(GeV)	r(mm)	t(ns)	t_p(ns)	g
1	100	5	2	20	6	8
3	150	10	2.5	40	16	30
10	300	10	4	70	20	120

CASE	A	B	C
E(MJ)	1	3	10
N($\times 10^{15}$)	1.25	1.875	6.25
T(GeV)	5	10	10
E_p(MJ)	0.6	2.4	6
N_p($\times 10^{15}$)	0.75	1.5	3.75
I_p(A)	2×10^4	1.5×10^4	3×10^4
I_{av}(A)	10^4	0.75×10^4	1.43×10^4

Ions are U^{+1} and following notations are used. E; Beam stored energy, P; Peak power, T; Kinetic energy, r; Target radius, t; Pulse width, g; gain of the pellet, N; No. of ions. Subcript p refers to peak value at the end of pulse.

Table 2 Ring parameters

Case	A	B	C	
Number of rings (n_r)	7	4	9	
Harmonic number	6	3	2	
Particles / ring	1.79	4.69	6.94	($\times 10^{14}$)
Particles / bunch	0.30	1.56	3.47	($\times 10^{14}$)
Emittance	30 π	30 π	30 π	($\times 10^{-6}$ m·rad)
Average radius	59.8	83.1	97.1	m
Radius of curvature (B = 5T)	31.6	44.9	44.9	m
Circumference	375.6	522	610	m

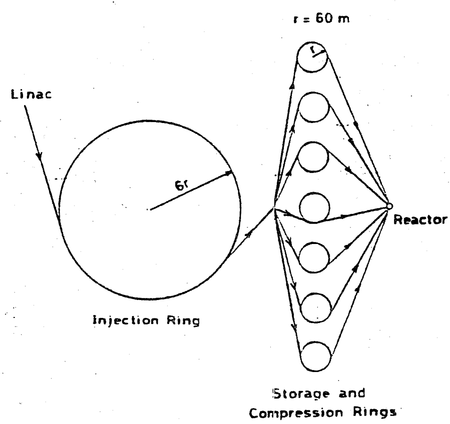

Fig.1 Schematic layout of the injection ring and storage rings for case A.