RF Aspects Along the Accelerator Chain

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Longitudinal Emittance Budget

The bottom-up approach of the first iterations of the parameter list has been superseded by the top-down one enshrined in the online database. This has led naturally to the introduction of emittance blow-up (cf., particle loss other than by decay) as the longitudinal emittance at the end of the accelerator chain is well defined by all the earlier work on stacking in the decay ring.

[eVs]	RCS inj	PS inj	SPS inj	SPS ej	DR stack
$^{6}He^{2+}$	0.51	0.64	0.80	1.0	15
$^{18}Ne^{10+}$	1.13	1.41	1.76	2.2	44

15×1eVs $^{6}He^{2+}$ injections and 20×2.2eVs $^{18}Ne^{10+}$ injections fill the stack acceptance of the decay ring. Each machine has been allowed a 25% blow-up margin working backwards from these figures established at the entrance to the decay ring.

Matching Voltages

In order to minimize space charge, we consider the bunch at injection into the PS and the SPS to occupy 80% of the available bucket length. (Injection into the RCS is multiturn, while ejection from the SPS is deliberately mismatched.) The previous table can then be translated into rf voltage at transfer.

[kV]	RCS ej	PS inj	PS ej	SPS inj*
$^{6}He^{2+}$	20	15	33	120
$^{18}Ne^{10+}$	1.4	1.2	9.6	5.3

* A new 40 MHz rf system is assumed in the SPS. To get an idea of its scale, one should note that acceleration at 1 T/s requires some 10 MV.

Remarks

Since the emittance ratio of 2.2 between $^{18}Ne^{10+}$ and $^{6}He^{2+}$ ions is essentially "taken care of" by the square root of their charge ratio, the disparity in matching voltages of the previous table is entirely accounted for by the factor $E/|\eta|$. This makes the rf voltage uncomfortably low for $^{18}Ne^{10+}$ transfers. Realistic voltages will mean shorter bunches and hence exacerbated space charge for this ion species. Bunch splitting before PS ejection would help, but only for the SPS.

The parameters of the proposed 40 MHz SPS rf system have still to be defined.

The decay ring stacking simulations need to be repeated with space charge turned on.

A radical means of compensating transient beam loading is required for the cavities of the decay ring.