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INJECTION PARAMETERS

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Injection Parameters

The effective aperture of the magnet, allowing for the thickness of the vacuum chamber, etc., is approximately $\pm$ 3 cm in the vertical plane, and $\pm$ 6.5 cm in the horizontal plane.

For the purpose of the design of the injection path, this aperture will be allocated as follows:

Electrons Stage 1

$\pm$ 1 cm in both planes is allowed for total misalignment, and field errors.

$\pm$ 1 cm in both planes is allowed for the injector emittance. $\pm$ 1 cm corresponds to an acceptance of 5.75×10^{-6} m. rad. The specification for the injector calls for a maximum emittance of 3.2×10^{-6} m. rad.

Total aperture required in the vertical plane is thus $\pm$ 2 cm.

In the horizontal plane, $\pm$ 4.5 cm is available for synchrotron oscillations, equivalent to 2.12% $\Delta p/p$.

If the initial synchronous phase angle is 170°, the maximum value of $\Delta p/p = 1.9\%$ which is within the above limit.

For this ϕ_s the acceptance for $\Delta p/p = \pm \frac{1}{2}\%$ is from 36° to 274°, an interval of 238°.

With seven bunches from the injector in one synchrotron cycle, five bunches occupy a phase angle of 205°. The limits on phase jitter between the synchrotron and injector r.f. has been specified as $\pm 5^\circ$, so that a total acceptance angle of 215° is needed. This is within the 238° interval for $\phi_s = 170^\circ$.

Thus five bunches out of seven from an injector coming within the specification should be accepted. For 0.6μs injection period and a circulating current of 272 mA, the current from the injector will be 470 mA. The specification calls for at least 500 mA.

Positrons Stage 1

The number of positrons accelerated increases approximately directly as the emittance, and so it is important to allocate as large a proportion of the aperture as possible for the emittance.

Allowing, as previously, $\pm$ 1 cm in both planes for misalignments and errors, $\pm$ 2 cm is available in the vertical plane for the injector emittance. This corresponds to an acceptance of 23×10^{-6} m. rad.

Assuming the same acceptance in the horizontal plane, $\pm$ 3.5 cm is available for synchrotron oscillations, corresponding to $\pm$ 1.66% $\Delta p/p$.

If $\phi_s = 166^\circ$, the maximum value of $\Delta p/p = \pm$ 1.61%, which is within the above limit.

The acceptance for $\phi_s = 166^\circ$ and $\Delta p/p = \pm$ 1% is 77° to 244°, an interval

of 167°.

Four bunches out of seven occupy 154°, or 164° with the tolerance for phase jitter, which is just within the acceptance.

For the above conditions, $^{4}/_{7}$ of the positron current coming within the limits of 23×10^{-6} m. rad. and $\pm$ 1% $\Delta p/p$ should be accepted.

Electrons Stage 2

If all the charge is in one bunch per synchrotron cycle, this bunch can be placed at the correct synchronous phase angle, within the jitter tolerance, and so the whole of the aperture allowance for synchrotron oscillations can be taken up by the initial momentum variation, so $\Delta p/p$ could be up to $\pm$ 2.1%.

Alternatively, the aperture could be reallocated, and the allowable emittance increased to 23×10^{-6} m. rad., the maximum allowable momentum variation becoming $\pm$ 1.65%.

The required beam current, coming within these limits, would be 333 mA.

Positrons Stage 2

As the alternative case for electrons, the whole positron current coming within the limits 23×10^{-6} m. rad. and $\pm$ 1.65% $\Delta p/p$ should be accepted. This should lead to an increase in positron current over the Stage 1 case by a factor of nearly three.