Bunch configuration with closed pretzel

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We suppose the electron and positron orbits are coincident between southeast and southwest horizontal separators. and that the minimum bunch spacing is τ which is some integer multiple of 2 ns. The maximum number of bunches in a single beam is $N = T/\tau$ where T is the revolution period. Now imagine we fill electron bunch 1. Clearly, we cannot populate positron bunch 1, as there would be collisions at the IP, or bunch two, etc. In fact, there will be collisions for all positron bunches less that

$$\text{Minimum gap } G = 2\frac{\Delta s}{c\tau}$$

If $\tau = 14$ ns, then $G = 19$ and if $\tau = 4$ ns, $G = 66$. (In practice G is somewhat bigger, as the parasitic crossing must be some finite distance from the separator. So this calculation will give an upper limit on number of bunches.)

The total number of trains in both beams is

$$\frac{N}{(N_{cars} + G)}$$

where the cars are space by τ. And the total number of bunches in both beams is

$$\frac{N}{(N_{cars} + G)} N_{cars} \tag{1}$$

The number of cars is limited by the length of the pretzel lobe. If there were separation everywhere north of the separators, (admittedly totally unrealistic) then the maximum number of cars would be when $N_{cars} + G < N$. For $\tau = 14$ ns, $N = 183$ and $N_{cars} = 164$. In this case there is a single train with $164/2 = 82$ bunches/beam. Of course the pretzel cannot support a train with 82 cars. If we suppose that there are three wavelengths with six lobes between the north and south separators, and the distance between the separators is 308 m, then the absolute maximum length of a train is $308/6 \sim 51$ m. And if there is effective separation for half the length of the lobe then the practical maximum train length is 25.5 m or $25.5/4.2 = 6$ cars. With $N_{cars} = 6$, our formula indicates the total number of bunches in both beams is

$$N_{max} < \frac{183}{6 + 19} 6 = 43$$

or 21 bunches/beam.

If $\tau = 4$ ns, then the maximum number of bunches/train is $25.5/2.1 = 21$ where the bunch spacing is 2.1 ns. Then

$$N_{max} < \frac{640}{21 + 66} 21 = 147$$

In summary, with 14ns spacing, the maximum number of bunches in both beams is 43 or 21 in one beam and 22 in the other. With 4ns spacing, the maximum number of bunches is 147 total, ~ 73/beam.

With 14ns spacing in one beam and 4ns spacing in the other, there might be 21 and 73 bunches. These numbers are upper limits. The practical limit will be determined by details of the pretzel orbit. If there are four rather than three wavelengths between the separators, the number of cars per train will necessarily be smaller, roughly by 3/4. Then as can be seen from Equation 1, the total number of bunches is also smaller, again by about 3/4.