# 3.5 GeV Superconducting Positron Stacking Ring

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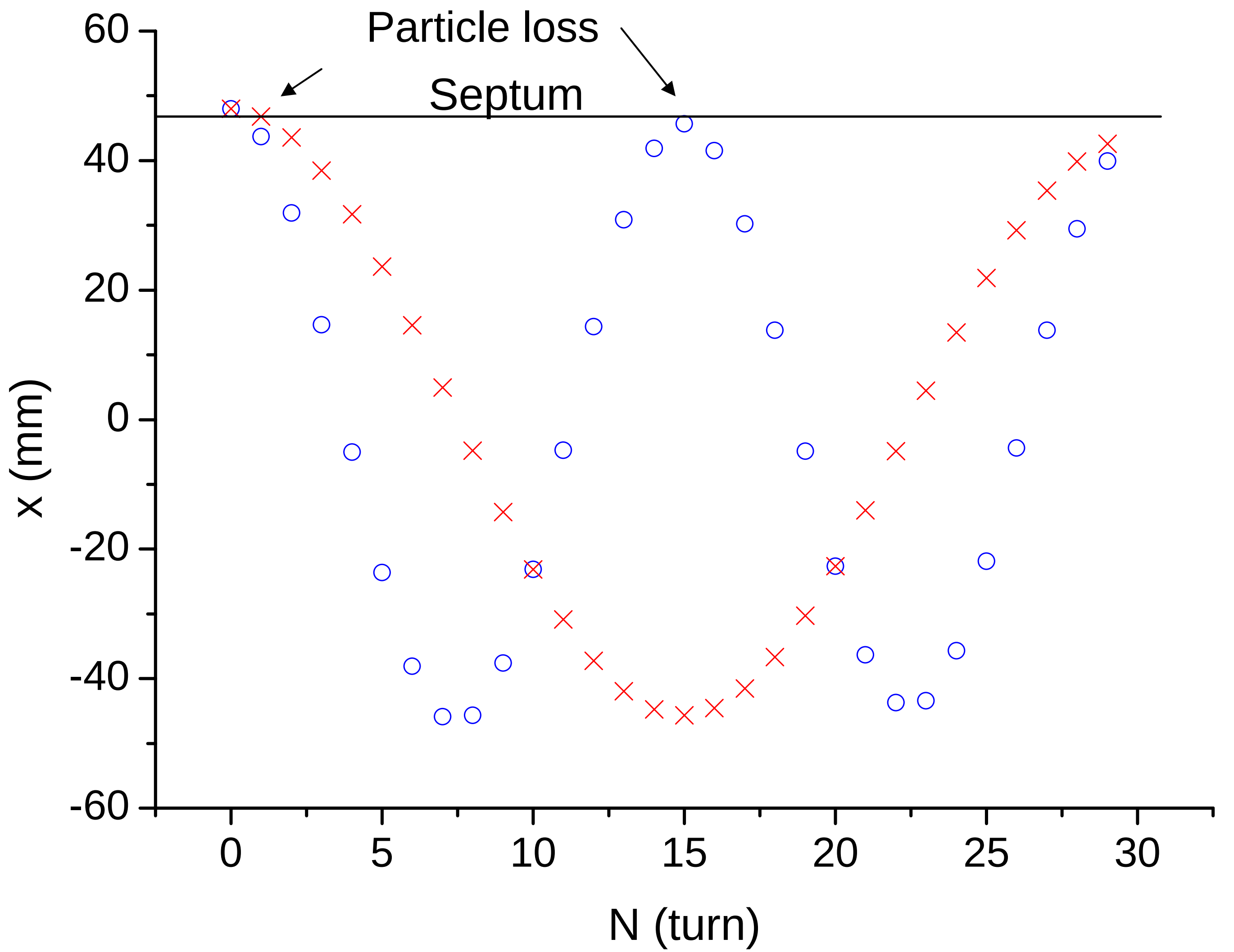
## Conclusions:

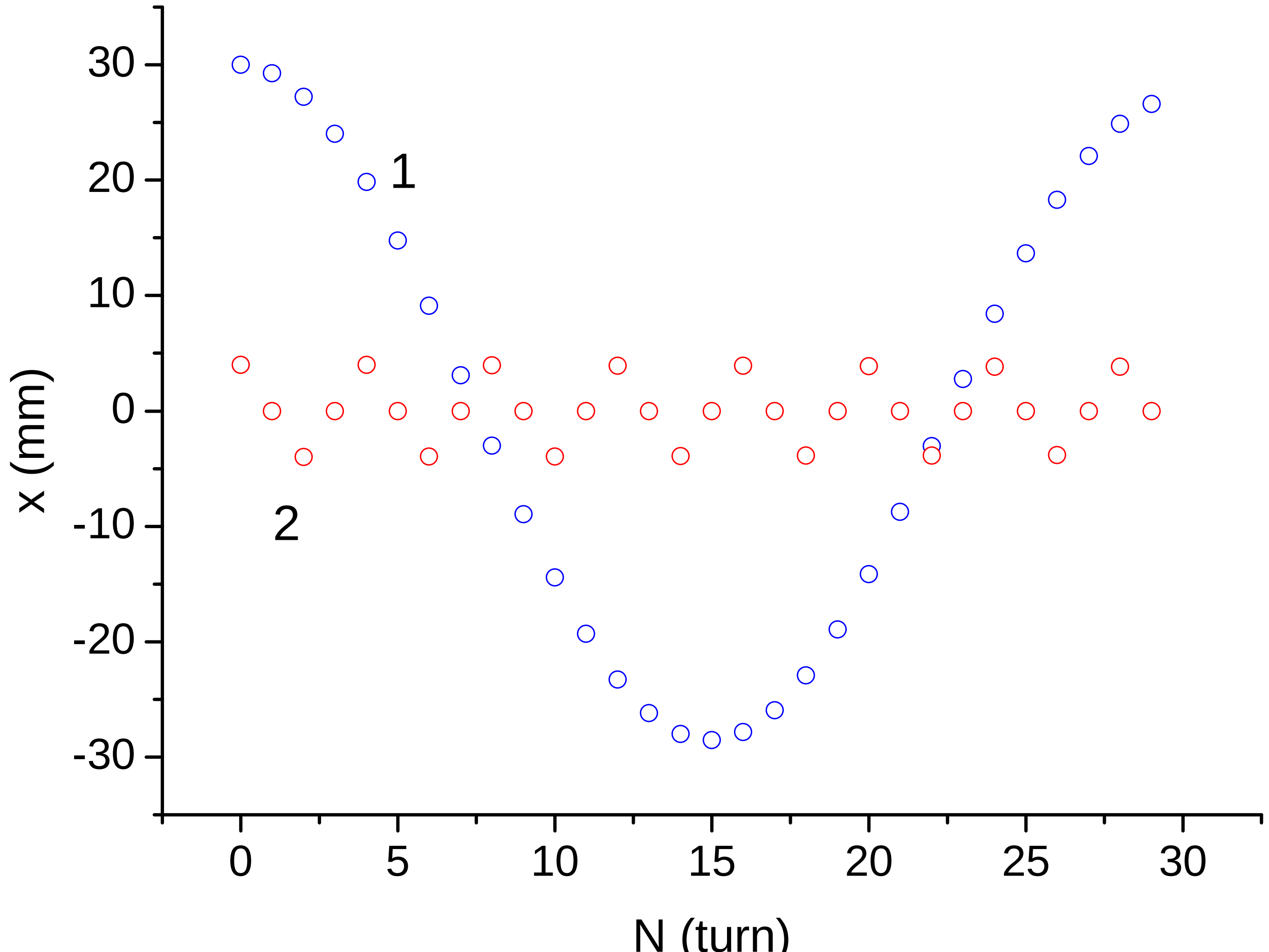
**For continuous positron injection**
**we need SR with damping time of 100 μs**

## Possible ways:

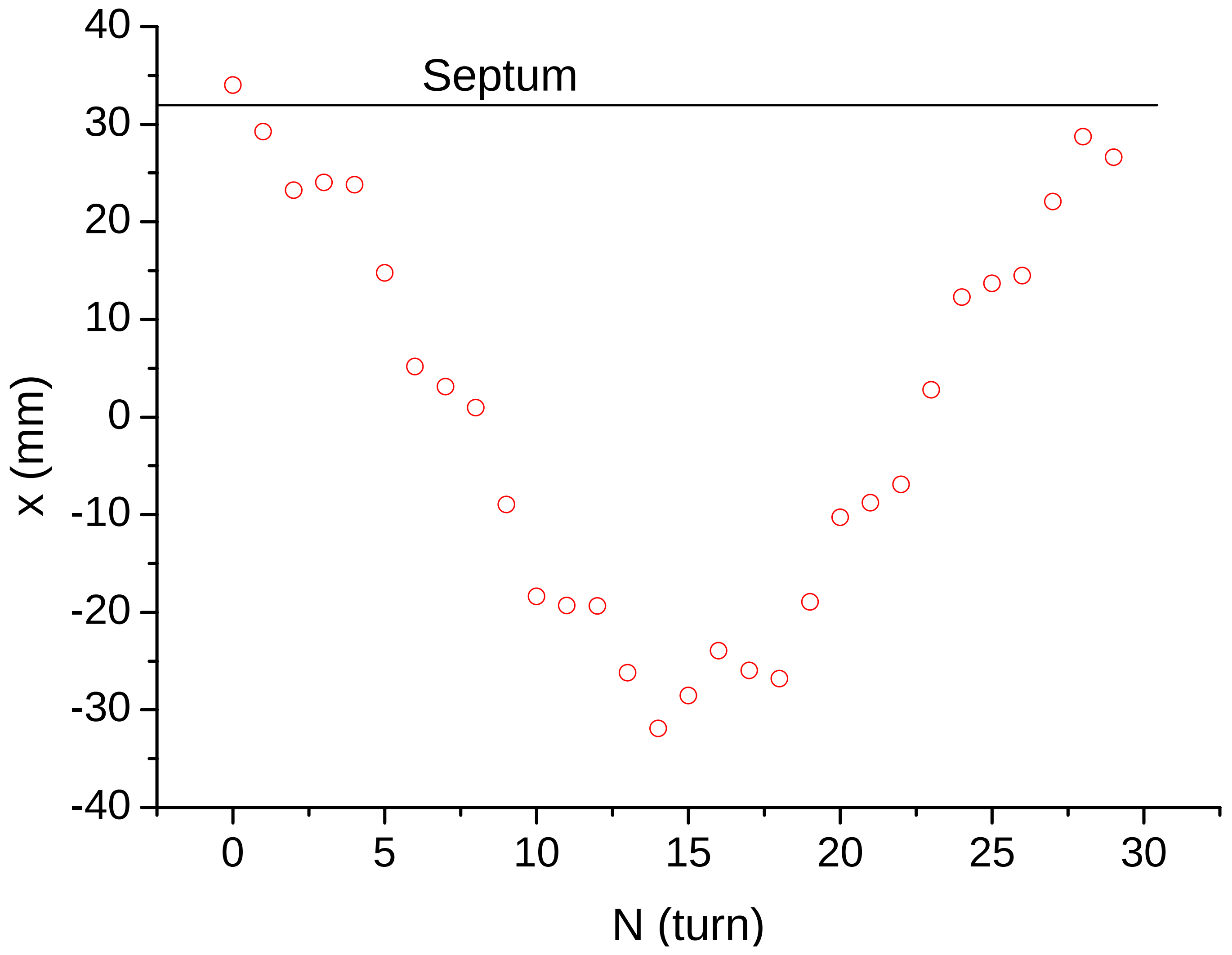
**Inection in longitudinal plane;**
**Fast damping under extremely intensive CS;**
**Superconducting ring**



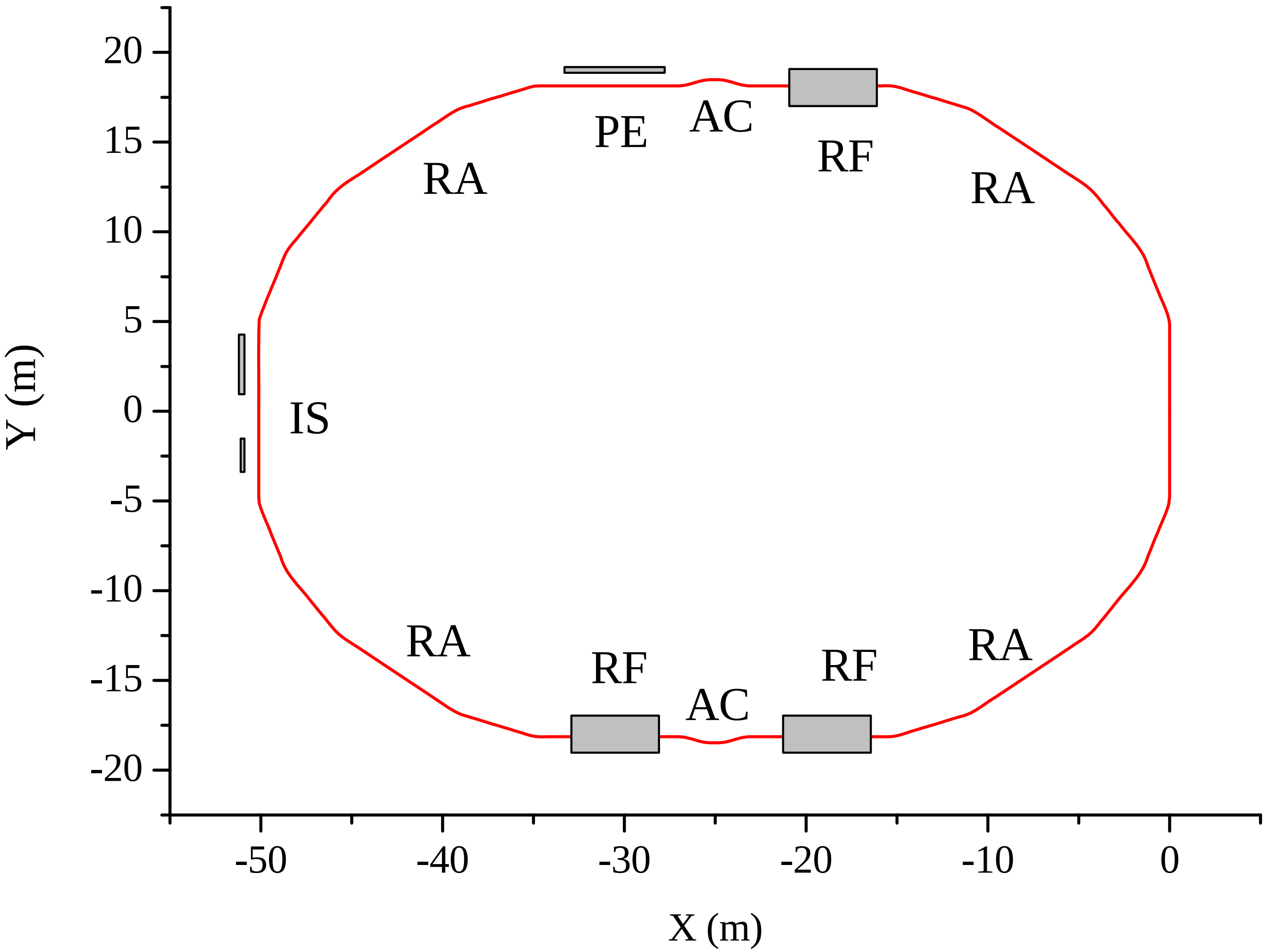

**Positions of equilibrium orbit. Dispersion at injection azimuth $\eta$=0.6 m, momentum deviation $\Delta p/p$=8 %, synchrotron frequency $Q_s$ =1/15; 1/30. Ring circumference C=100 m, synchrotron damping $\tau_s$=100 $\mu$s (333 turns)**



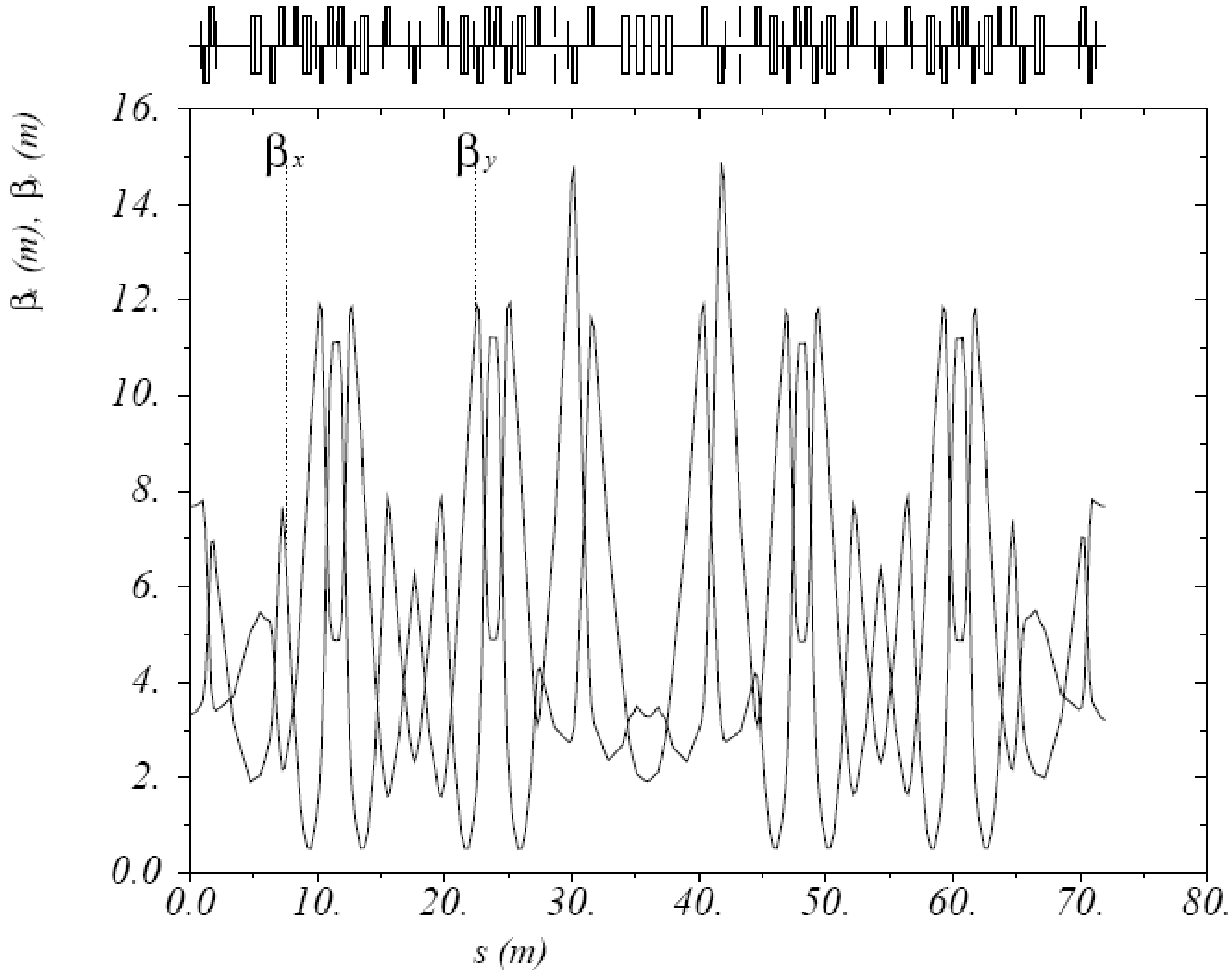

**Positions of equilibrium orbit (1) and betatron oscillations (2). Dispersion at injection azimuth $\eta$=1.0 m, momentum deviation $\Delta p/p$=3 %, synchrotron frequency $Q_s$ =1/30, fractional part of betatron tune $Q_b$ = 1/4**



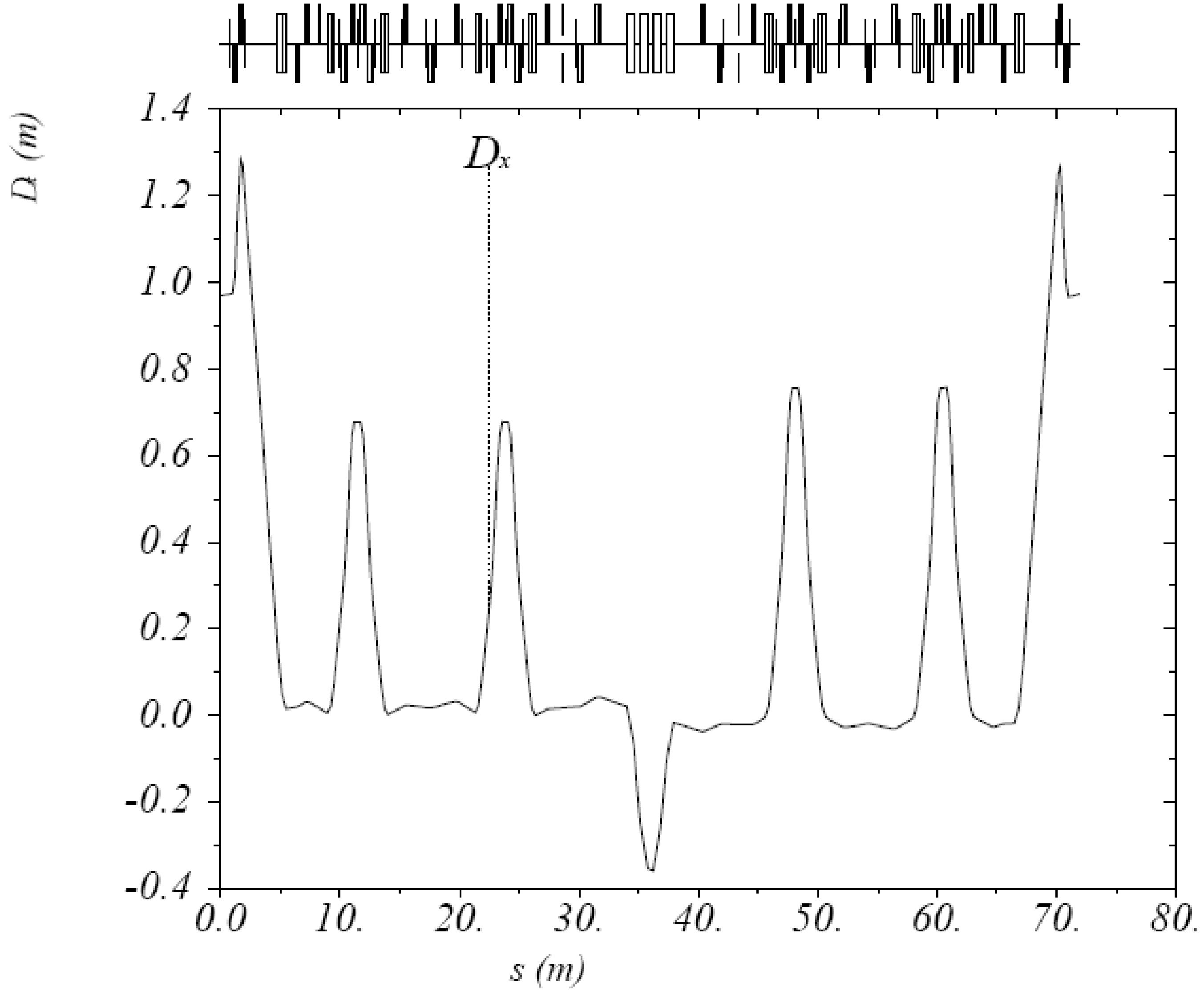

**Resultant motion of injected particle. Dispersion at injection azimuth $\eta$=1.0 m, betatron amplitude $X_b$=5 mm,momentum deviation $\Delta p/p$=3 %, synchrotron frequency $Q_s$ =1/30, betatron tune $Q_b$ = 1/4**



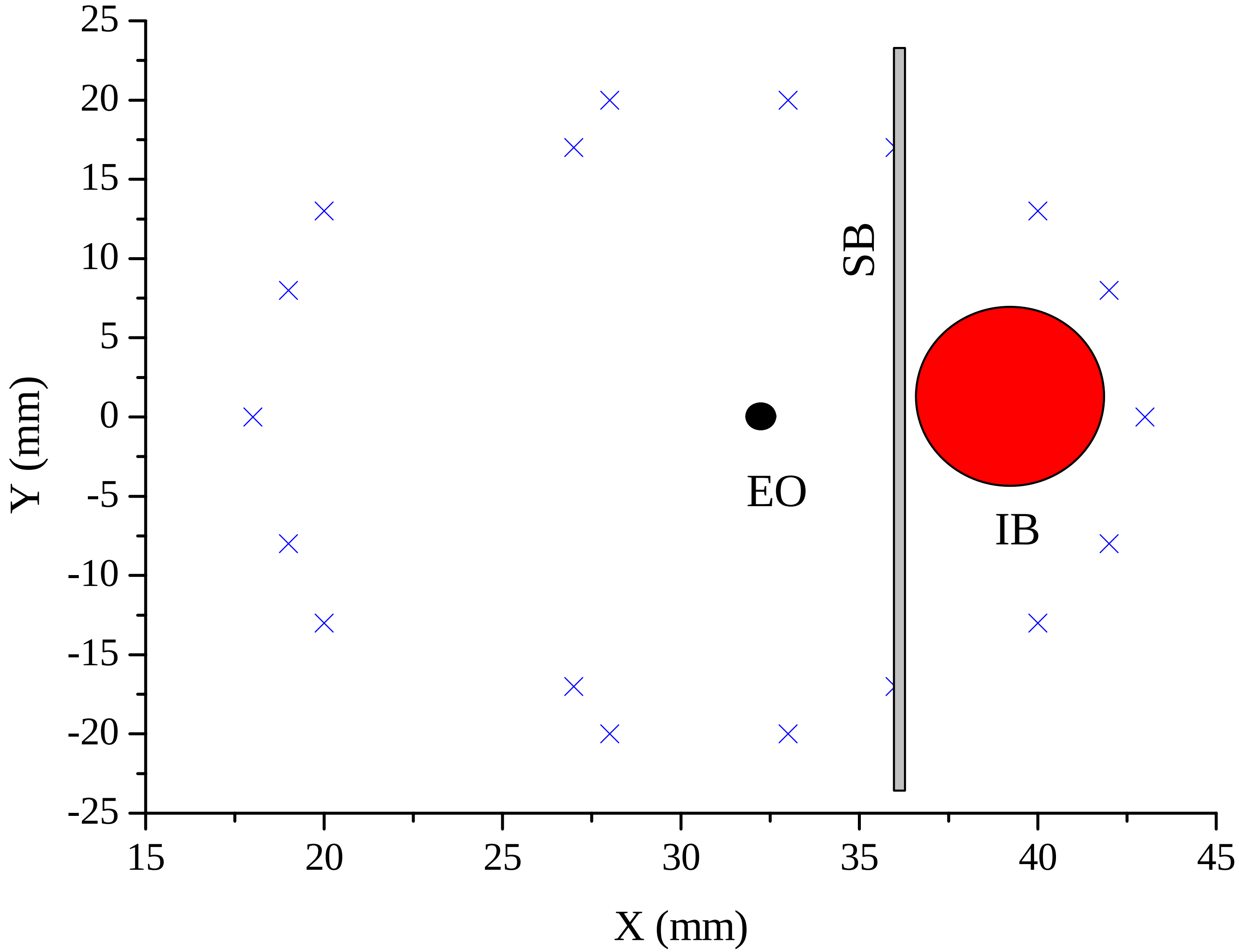

**Ring layout. Energy $E_0$=3.5 GeV, circumference C≈144 m, bend.field B=6 T, energy losses ΔE≈9.4 MeV / turn, synchrotron damping time $\tau_s$≈250 μs. RA, regular arcs; AC, additional chicanes; IS, injection septums; RF, rf-sections; PE, positron extraction.**



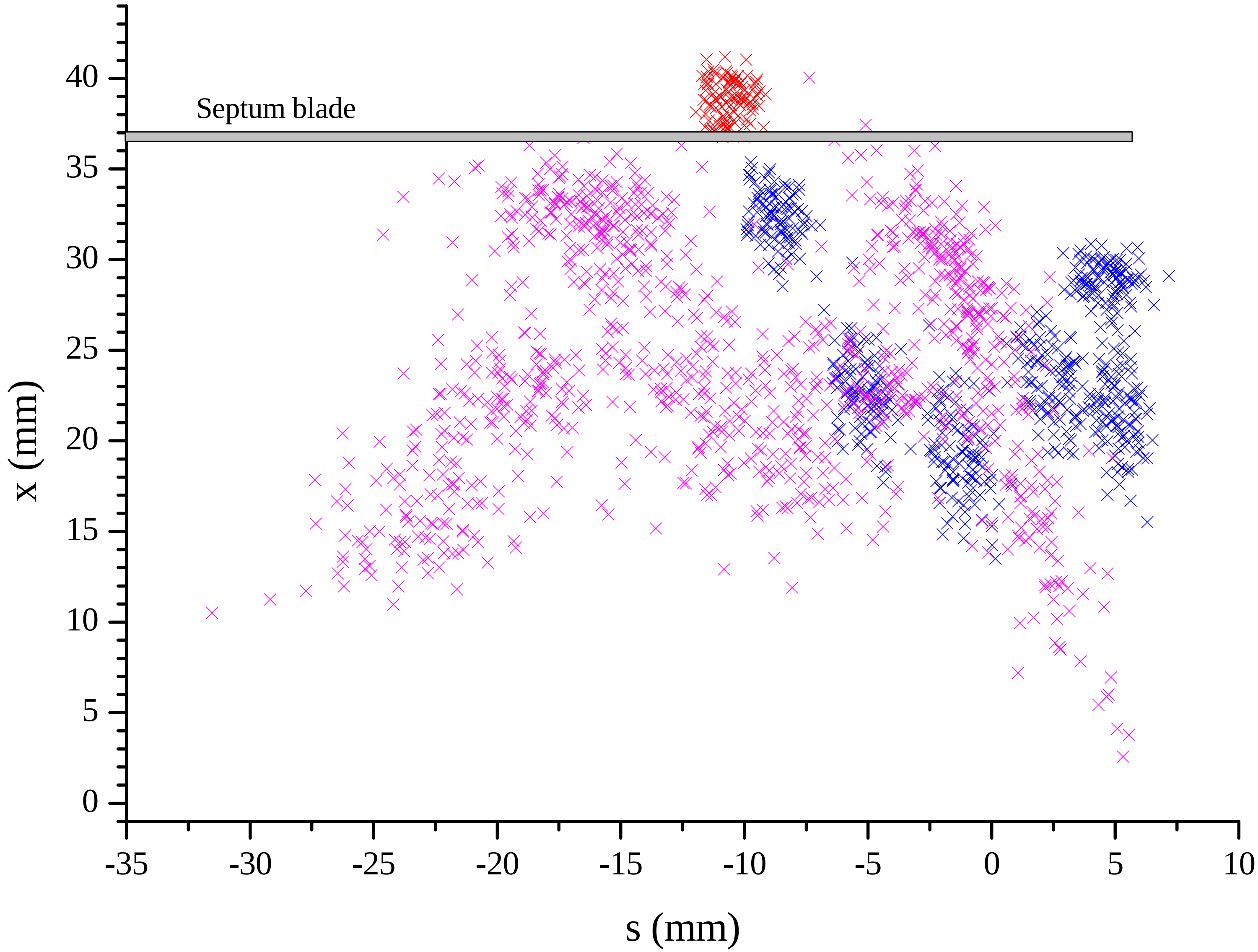

## Amplitude functions of single superperiod




## First order dispersion of single superperiod




**Dynamic aperture at injection azimuth. Momentum deviation $\Delta p/p_0$=3.5 %, dispersion at injection azimuth $\eta$=0.975 m. IB, injected beam; EO,equilibrim orbit; SB, septum blade.**




**Injection simulation. Injected beam (red "x");**
**eam at the first turns (blue "x"); beam at synchrotron cycle end (magenta "x**

# Simulation parameters&results:

**Number of injected particles 1000;**
**Transversal beam emittance (rms) $2000*10^{-6}$ m*rad (normalized);**
**Longitudinal beam emittance (rms) 0.15% x 1 mm;**
**Beam distributions are cutoff Gaussian:**
**2.5 rms in transversal planes;**
**1.5 rms in longitudinal plane;**
**Position of injected beam center $\Delta x$ = 38.5 mm;**
**Thickness of final septum 0.5 mm;**
**Pulse deviation of injected beam from reference $(p_{inj}-p_o)/p_o=3.4$ %.**

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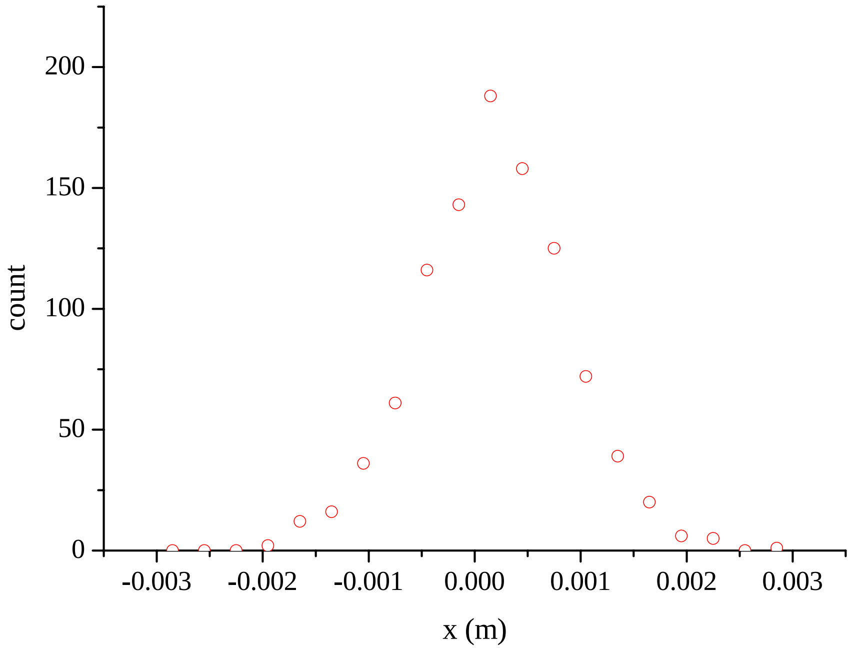
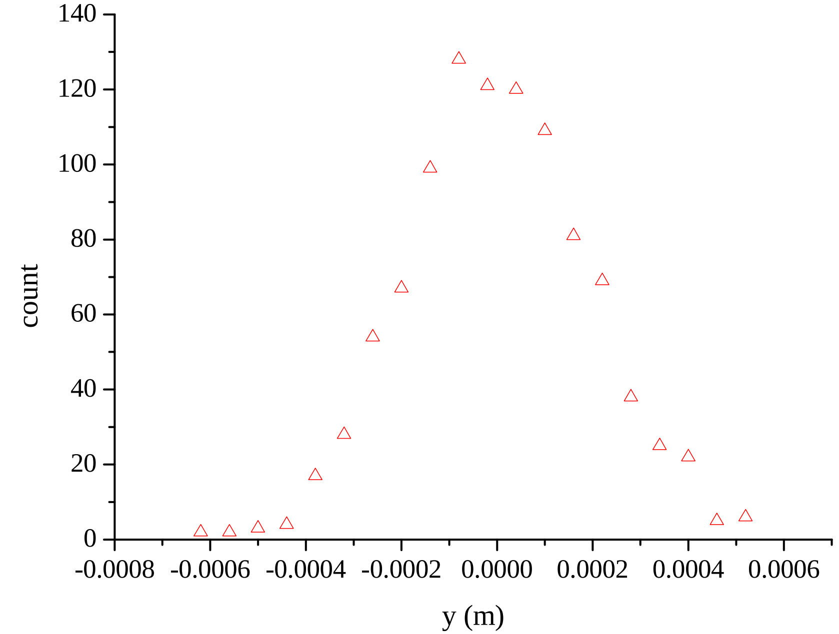
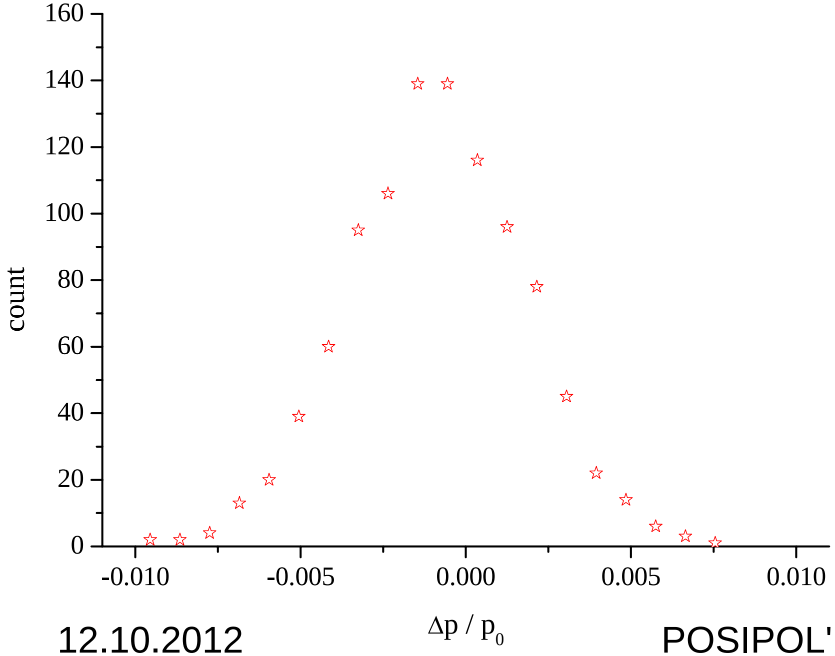
**48 particles are being lost on septum blade at end of the first synchrotron cycle; after that particles are not being lost.**

**Thus, 952 particles are successfully injected, i.e. the injection efficiency is equal to 95 %.**

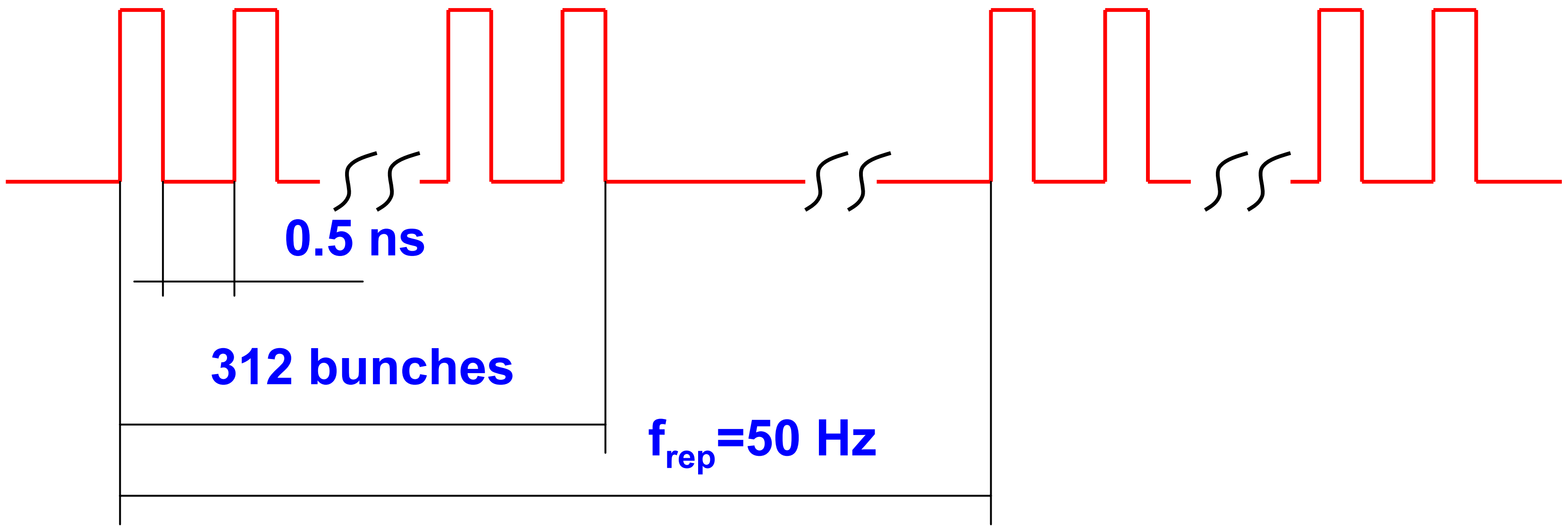


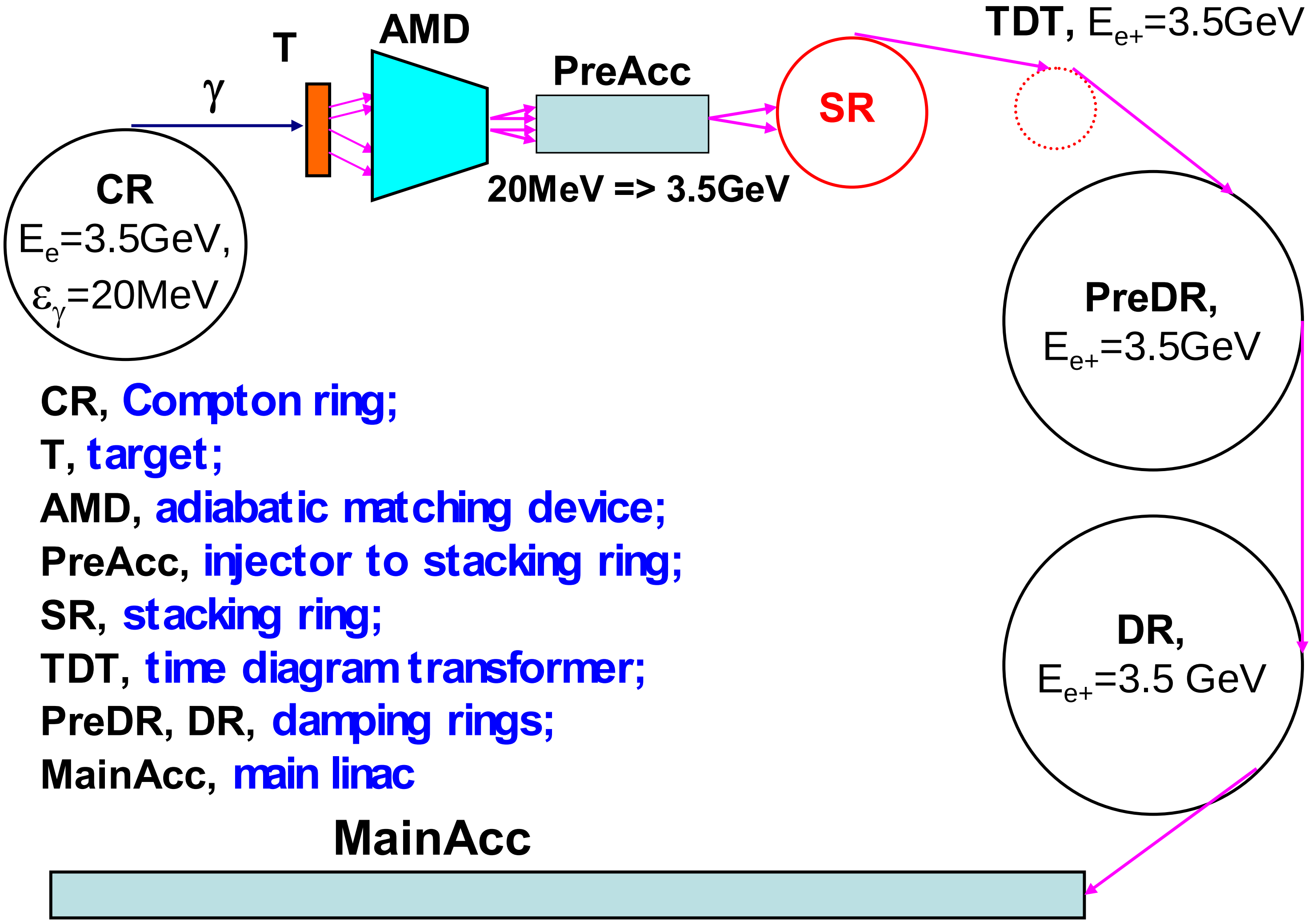

**Final beam distributions at extraction azimuth**

# Issue – large SR (RF) power

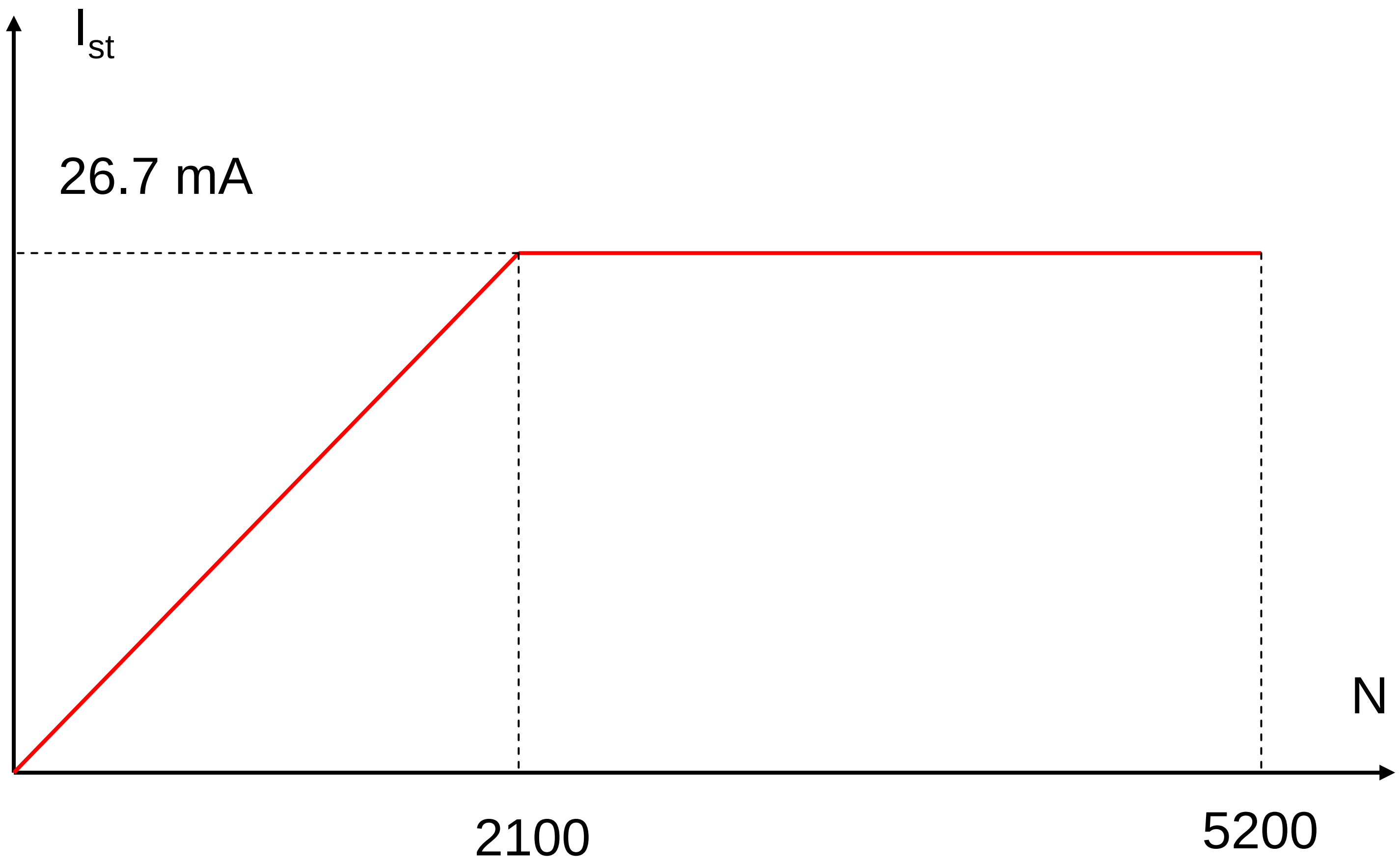



**$N_{pb}=4*10^9$ => $Q_b \approx 0.64$ nC => $\langle I_{stor} \rangle = 0.64$ A,**
**$\Delta E = 9.4$ MeV, $P_{SR} = 6$ MW**

# Positron source



# Power load




**$N_{pb} = 4*10^9/3 \Rightarrow < I_{st} > = 0.22$ A; $N_{bb} = 8 \Rightarrow < I_{st} > = 27$ mA;**

**$< I_{st} > = 21.5$ mA $\Rightarrow P_{SR} \approx 200$ kW**

# Main parameters of stacking ring

| Parameter | Value |
|---|---|
| Positron energy, GeV | 3.5 |
| Ring circumference, m | 143.9 |
| Bending field, T | 6 |
| RF frequency, GHz | 2 |
| RF voltage, MV | 25 |
| Harmonics number | 960 |
| Bunch spacing, ns | 4 |
| Beam energy losses, Mev/turn | 9.4 |
| Synchrotron damping time, μs | 250 |
| Normalized emittance of injected beam, m*rad | $2000*10^{-6}$ |
| Dispersion at injection azimuth, m | 0.975 |
| Pulse deviation of injected beam, % | 3.4 |
| Injection efficiency, % | ~95 |

# Summary

**Stacking ring with the superconding bendings for the continuous positron injection is proposed .**

**The injection efficiency into proposed stacking ring is close to 95 %**

**The proposed ring can be used as the base for the further R&D**

**From the point of beam emittance it would be as very desirable to exlude the TDT from positron complex – three times lengthening of the CLIC pulse ?**