

# Pre-Damping Ring/Damping Ring

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## Pre DR

Pre DR@ISG2    bunch spacing 2.8 nsec

# of bunch: 90

# of bunch train :  $N_{\text{train}} = 1$

Rep.Rate : 150 Hz

--> Short Insertion Region for RF & INJ/EXT

==> Pre DR with  $N_{\text{train}} = 2$

Injected Positron Beam

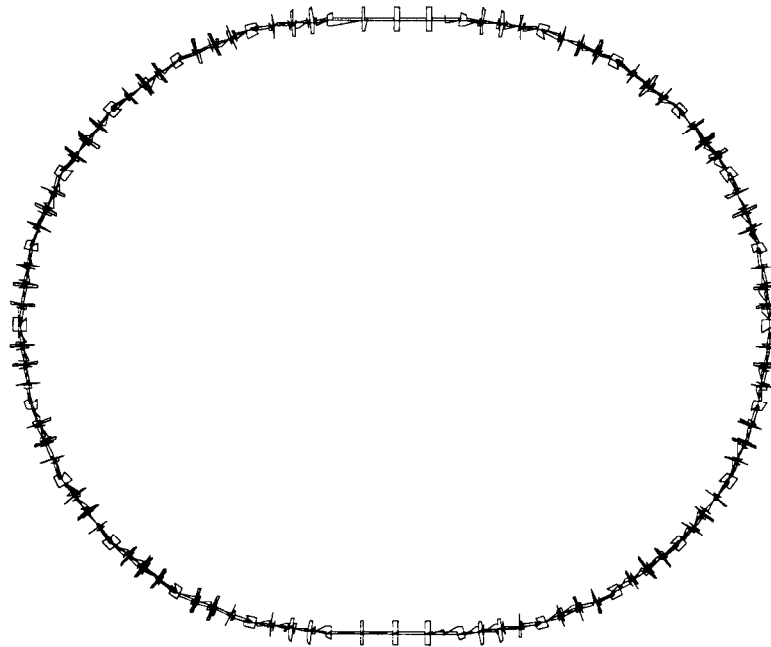
$$\gamma\epsilon_{\text{in}} \approx 3 \times 10^{-3} \text{ m}$$

Goal for the Extraction Beam

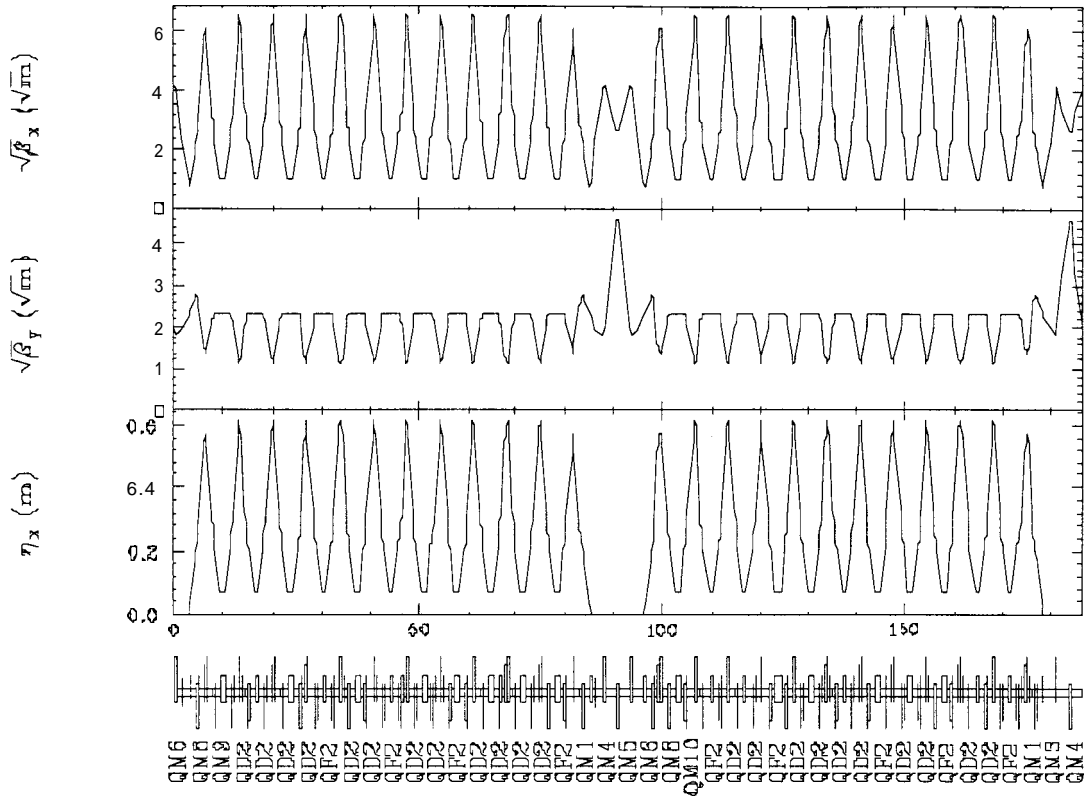
$$\gamma\epsilon_{\text{ext}} \approx 1 \times 10^{-4} \text{ m}$$

Acceptance  $> 3 \sigma_{\text{inj}}$  ( $\gamma\epsilon > 0.027 \text{ m.rad}$ ) &  $dp < \pm 2\%$

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geometry of the ring



predr3 optics

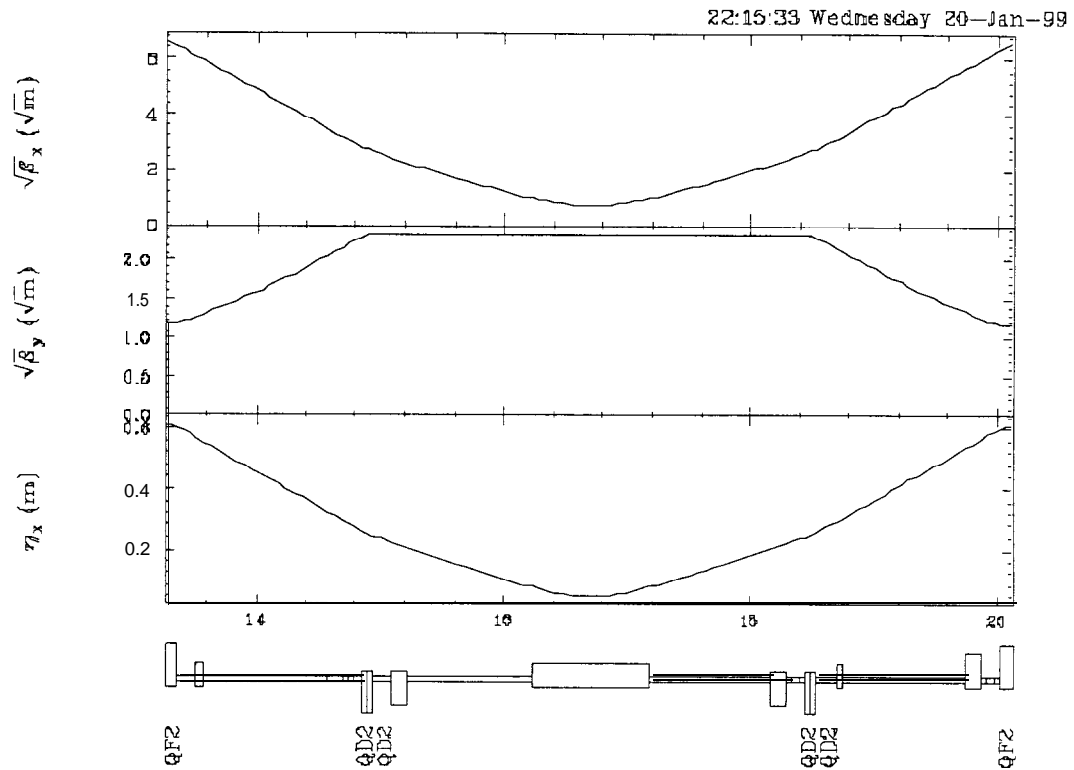
Parameters

Equilibrium Emittance $\epsilon_x$	$7.75 \times 10^{-9}$ m
Damping Time $\tau_y$	6.64 msec
Emittance at Extraction $\gamma\epsilon_x$ $\gamma\epsilon_y$	$8.36 \times 10^{-5}$ m $5.41 \times 10^{-5}$ m
Momentum Compaction Factor a	$1.68 \times 10^{-j}$
Tune	$\nu_x=11.71, \nu_y=7.92$
Energy Loss/Turn $U_0$	0.371 MV
Energy Spread	$8.87 \times 10^{-4}$
Accelerating Voltage $V_c^{*})$	2MV
Bunch Length <sup>*)</sup>	4.07 mm
Bucket Height <sup>*)</sup>	2.50 %

<sup>\*)</sup>:Temporary value

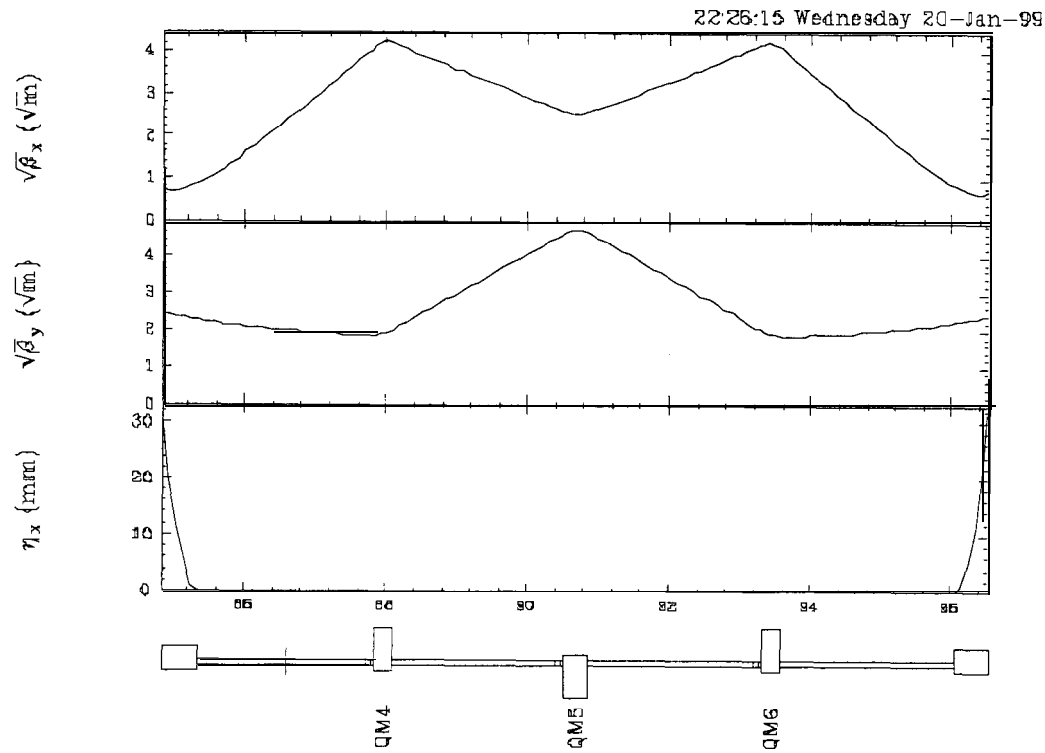
# Arc Cell

## TME with Sep. Fn. B



Number of Cells	I 24
$\beta_x$ @Center of B	0.50 m ( 4 $\beta_{TME}$ )
$\eta_x$ @Center of B	0.043 m ( 4.1 $\eta_{TME}$ )
Bending Magnet	Sep. fn. & rectangular
Bending Angle	15°
Length	0.96 m
B	1.8 T
Max. B @pole-tip	
Quadrupole Magnets	0.8 T
Sextupole Magnets	0.6 T

# Insertion



predr3 insertion

Single Drift Space Length	2.4 m
Max. B of Quadrupole Magnets @pole-tip	0.8 T

## Dynamic Aperture

Tracking by SAD ( 1000 turns )

Initial condition( at injection kicker )

$$x = n_T \sigma_x, \quad y = n_T \sigma_y, \quad dp = n_L dp_0$$

$$\text{where } \sigma_x^2 = \beta_x \epsilon_0, \quad \sigma_y^2 = \beta_y \epsilon_0, \quad dp_0 = 1\% \text{ and } \gamma \epsilon_0 = 1 \times 10^{-4} \text{ m}$$

Score

$$\text{score} = \sum_{n_L=-2}^2 (\text{Max}[n_T] + 1)$$

Assuming round cross section of DA,

$$30 \text{ of inj. beam } (\gamma \epsilon_{in} \approx 3 \times 10^{-3} \text{ m})$$

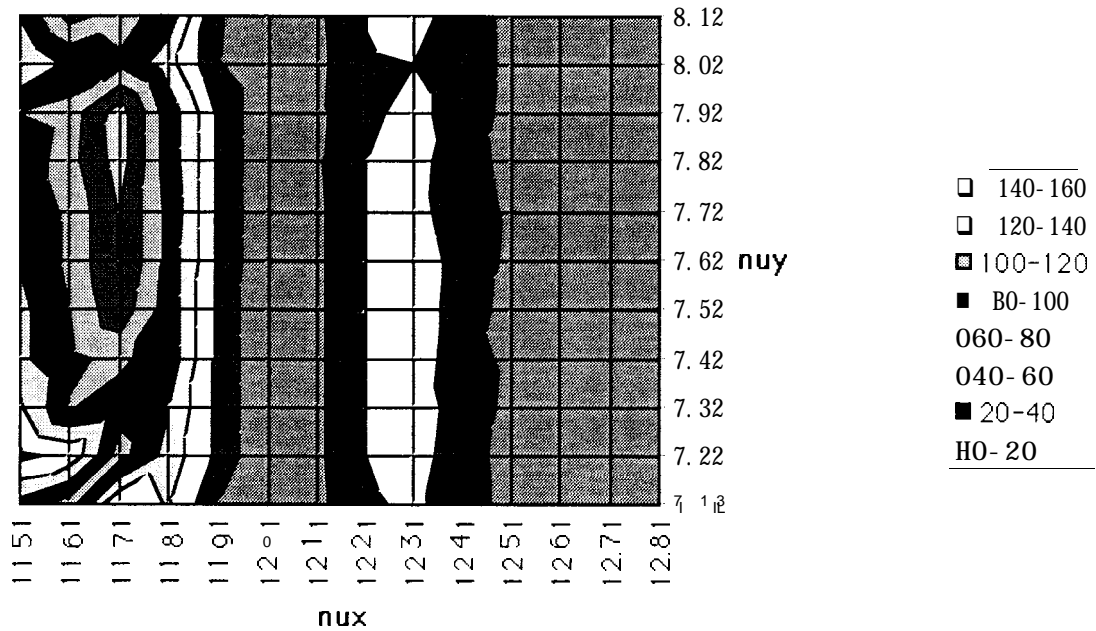
$$\rightarrow \text{goal } n_T \text{ for single } n_L \approx 11.6$$

For  $dp < \pm 2\%$ , score  $> 63$

# Tune Scan( preliminary )

predr3

tune survey



## Best Operation Point

Tune	$v_x=11.71, v_v=7.92$
Score	151
$n_T$ (dp=-2%)	30-1
$n_T$ (dp=-1%)	31-1
$n_T$ (dp=0%)	33-1
$\bar{I}n$ , (dp=1%)	30-1
$\bar{I}n$ , (dp=2%)	27-1
Ave. $n_T$	$29.2 \leftrightarrow 7.6 \sigma_{ini}$

## Summary of PreDR Study

Injected Positron Beam

$$\gamma\epsilon_{in} \approx 3 \times 10^{-3} \text{ m}$$

Repetition Rate  $f_{rep}$ : 150 Hz

	$N_{train} = 1$ ( ISG2 )	$N_{train} = 2$
Equilibrium Emittance $\epsilon_x$	$6.7-8.9 \times 10^{-9} \text{ m}$	$7.8 \times 10^{-9} \text{ m}$
Damping Time $\tau_y$	3.3 msec	6.6 msec
Emittance at Extraction $\gamma\epsilon_x$	$7.8-8.7 \times 10^{-5} \text{ m}$ ( $3.3-4.1 \times 10^{-5} \text{ m}$ )	$8.4 \times 10^{-5} \text{ m}$ ( $3.7 \times 10^{-5} \text{ m}$ )
$\gamma\epsilon_y$	$5.3 \times 10^{-5} \text{ m}$ ( $0.7 \times 10^{-5} \text{ m}$ )	$5.4 \times 10^{-5} \text{ m}$ ( $0.7 \times 10^{-5} \text{ m}$ )
Dynamic Aperture ( $dp < \pm 2\%$ )	$7.8-13 \sigma_{inj}$	$7.6 \sigma_{inj}$

Numbers in ( ) are for  $f_{rep} = 100 \text{ Hz}$

With errors

$\sigma_x$ for B & Q	SO-100( 50 ) $\mu\text{m}$
SX	200( 50 ) $\mu\text{m}$
$\sigma_y$ for All Element	200( 60 ) $\mu\text{m}$
$\sigma_\theta$ for All Element	1( 0.5 ) mrad
$\sigma_k$ for All Element	0.1%
Monitor Offset for x & y	100 $\mu\text{m}$

Numbers in ( ) are for 'JLC Design Study'

	$N_{train} = 1$ ( ISG2 )	$N_{train} = 2$
Emittance at Extraction $\gamma\epsilon_x$	$8.9-11 \times 10^{-5} \text{ m}$	-----
$\gamma\epsilon_y$	$5.5-6.0 \times 10^{-5} \text{ m}$	-----
Dynamic Aperture ( $dp < \pm 2\%$ )	$2.9-4.4 \sigma_{inj}$	-----

## DR

### Summary of DR Study

Injection Beam :  $\gamma\epsilon_{in} \approx 1 \times 10^{-4}$  m

Goal for the Extraction Beam

$$\gamma\epsilon_{0x} < 3 \times 10^{-6} \text{ m}$$

$$\tau_y < 4.8 \text{ msec}$$

$$\text{s.t. } \gamma\epsilon_{extx} \approx 3 \times 10^{-6} \text{ m, } \gamma\epsilon_{exty} \approx 3 \times 10^{-8} \text{ m}$$

Acceptance  $> 3 \sigma_{inj}$  ( $\gamma\epsilon > 9 \times 10^{-4}$  m.rad ) &  $dp < \pm 1\%$

Momentum Compaction Factor  $a > 5.0 \times 10^{-4}$  ???

DR with bunch spacing 1.4 nsec

# of bunch: 85

# of bunch train :  $N_{train} = 5$

Rep.Rate : 150 Hz

### Parameters

	FOBO	TME	FODO
Equilibrium Emittance $\gamma\epsilon_x$	$2.5 \times 10^{-6}$ m	$2.9 \times 10^{-6}$ m	$2.2 \times 10^{-6}$ m
Damping Time $\tau_y$	4.8 msec	4.5 msec	4.7 msec
Momentum Compaction Factor $a$	$8.0 \times 10^{-4}$	$6.1 \times 10^{-4}$	$6.2 \times 10^{-4}$
Number of Cells	40	40	60
k(B)	$-0.67 \text{ m}^{-1}$	0	0
L(B)	1.2 m	0.9 m	0.37 m
# of Wiggler Magnets	36	36	36
( $dp < \pm 1\%$ ) Aperture w/o Error	$6 \sigma_{inj}$	$27 \sigma_{inj}$	-----
Misalignment Tolerance	-----	-----	-----

DR with bunch spacing 2.8 nsec  
 # of bunch: 90

Parameters

	FOBO (racetrack/square)	TME (square)	FODO
Equilibrium Emittance $\gamma\epsilon_x$	$2.2 \times 10^{-6}$ m	$2.9 \times 10^{-6}$ m	-----
Damping Time $\tau_y$	4.2 msec	4.4 msec	--m-e---
Momentum Compaction Factor a	$(5.7/5.4) \times 10^{-4}$	$4.8 \times 10^{-4}$ ( ok ? )	-m--e---
Number of Cells	40	40	60
k(B)	$-0.67 \text{ m}^{-1}$	0	0
L(B)	1.2 m	0.9 m	0.37 m
# of Wiggler Magnets	72	72	-----
Dynamic Aperture w/o Error ( $dp < \pm 1\%$ )	-----	-----	-----
Misalignment Tolerance	-----	-----	-----