0. JLC beam parameter
1. Bem delivery system
2. IP layout
3. Superconducting QC1
4. Support system for QC1 and tungsten mask
5. Background
   5.1 muons
   5.2 synchrotron radiations
   5.3 e^+e^- pairs
   5.4 neutron background
6. Pair monitor for beam size measurement
7. Luminosity monitor and Active mask
8. Dump line
9. Future Plan
## Parameters of JLC

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminosity</td>
<td>$10^{34}$/cm$^2$/s</td>
<td>0.88</td>
<td>1.57</td>
</tr>
<tr>
<td>Nominal Luminosity$^3)$</td>
<td>$10^{34}$/cm$^2$/s</td>
<td>0.63</td>
<td>1.08</td>
</tr>
<tr>
<td>Bunch Population</td>
<td>$10^{10}$</td>
<td>0.75</td>
<td>0.55</td>
</tr>
<tr>
<td>No. of bunches/pulse</td>
<td>95</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>Bunch separation</td>
<td>ns</td>
<td>2.8</td>
<td>1.4</td>
</tr>
<tr>
<td>Linac length/beam$^7)$</td>
<td>km</td>
<td>5.21</td>
<td>5.54</td>
</tr>
<tr>
<td>AC power (2 linacs)</td>
<td>MW</td>
<td>117</td>
<td>126</td>
</tr>
<tr>
<td>Beam power/beam</td>
<td>MW</td>
<td>4.28</td>
<td>6.28</td>
</tr>
<tr>
<td>Loaded gradient $^4)$</td>
<td>MV/m</td>
<td>57.6</td>
<td>54.2</td>
</tr>
<tr>
<td>Bunch length $\sigma_z$</td>
<td>µm</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>$\gamma\varepsilon_x$ (DR exit)</td>
<td>$10^{-6}$ m</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>$\gamma\varepsilon_y$ (DR exit)</td>
<td>$10^{-6}$ m</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>$\gamma\varepsilon_x$ (IP)</td>
<td>$10^{-6}$ m</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>$\gamma\varepsilon_y$ (IP)</td>
<td>$10^{-6}$ m</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>Cavity align. tol.$^6)$</td>
<td>µm</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>$\beta_x^*$</td>
<td>mm</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>$\beta_y^*$</td>
<td>mm</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>IP beam size $\sigma_x^*$</td>
<td>nm</td>
<td>286</td>
<td>222</td>
</tr>
<tr>
<td>$\sigma_y^*$</td>
<td>nm</td>
<td>3.15</td>
<td>2.86</td>
</tr>
<tr>
<td>Diagonal angle $\sigma_x^*/\sigma_z$</td>
<td>mrad</td>
<td>3.18</td>
<td>2.77</td>
</tr>
<tr>
<td>Disruption param $D_x$</td>
<td></td>
<td>0.094</td>
<td>0.102</td>
</tr>
<tr>
<td>$D_y$</td>
<td></td>
<td>7.64</td>
<td>7.89</td>
</tr>
<tr>
<td>Pinch enh. $H_D^5)$</td>
<td></td>
<td>1.38</td>
<td>1.45</td>
</tr>
<tr>
<td>$\gamma_{ave}$</td>
<td>%</td>
<td>0.136</td>
<td>0.146</td>
</tr>
<tr>
<td>$\delta_{BS}$</td>
<td>%</td>
<td>4.42</td>
<td>4.39</td>
</tr>
<tr>
<td>$n\gamma$</td>
<td></td>
<td>1.07</td>
<td>1.01</td>
</tr>
</tbody>
</table>
Collimator (1200 m) 
Momentum: chicane $\Delta p/p < \pm 2\%$
Transverse: nonlinear collimator $6\sigma_x \times 40\sigma_y$

Big Bend (7 mrad, 200 m)

Final Focus (1600 m) 
asymmetric dispersion
momentum acceptance: $\pm 1\%$

Crossing angle (8 mrad) with crab crossing

longitudinal separation = 200 m
Transv. sep = 20 m

LinacLin 
ac 
IP1 
IP2

JLC: Beam Delivery System
Main Parameters of **Superconducting** QC1 and QC2

<table>
<thead>
<tr>
<th></th>
<th>QC1</th>
<th>QC2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Coil</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field gradient (T/m)</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>Current (A)</td>
<td>8406</td>
<td>5500</td>
</tr>
<tr>
<td>Peak field (T)</td>
<td>10.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Effective length (m)</td>
<td>2.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Current density (A/mm²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inner cable</td>
<td>458.4</td>
<td>301.8</td>
</tr>
<tr>
<td>outer cable</td>
<td>503.3</td>
<td>331.4</td>
</tr>
<tr>
<td><strong>Main coil (4 layer, grading coil)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inner radius (mm)</td>
<td>45</td>
<td>100</td>
</tr>
<tr>
<td>outer radius (mm)</td>
<td>91.3</td>
<td>146.3</td>
</tr>
<tr>
<td><strong>Multipole components @ r=1 mm</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( b_6 ) (x 10^{-4})</td>
<td>0.4</td>
<td>0.06</td>
</tr>
<tr>
<td>( b_{10} ) (x 10^{-4})</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>Stored energy (MJ)</td>
<td>1.43</td>
<td>4.14</td>
</tr>
<tr>
<td>Inductance (mH)</td>
<td>40.3</td>
<td>270</td>
</tr>
<tr>
<td>Magnetic forces per pole (octant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( F_x ) (MN)</td>
<td>2.62</td>
<td>3.75</td>
</tr>
<tr>
<td>( F_y ) (MN)</td>
<td>-5.21</td>
<td>-8.74</td>
</tr>
<tr>
<td>Cable:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>width (mm)</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>thickness (mm)</td>
<td>1.487</td>
<td>1.340</td>
</tr>
</tbody>
</table>

**Correction Coil (H-steering, V-steering coil)**

|                           |     |     |
| Field (T)                 | 0.1 (0.5 mm) | 0.1 (1.4 mm) |
| Coil radius (mm)          | 5 | 18 |
Cross section of QC1

- 90K
- 4K
- 1.9K
- SUS collar
- Correction coil
- Main coil

Dimensions:
- 9cm
- 51cm
### UNITS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>cm</td>
</tr>
<tr>
<td>Flux density</td>
<td>T</td>
</tr>
<tr>
<td>Field strength</td>
<td>A m⁻¹</td>
</tr>
<tr>
<td>Potential</td>
<td>Wb m</td>
</tr>
<tr>
<td>Conductivity</td>
<td>S m⁻¹</td>
</tr>
<tr>
<td>Source density</td>
<td>A cm⁻²</td>
</tr>
<tr>
<td>Power</td>
<td>W</td>
</tr>
<tr>
<td>Force</td>
<td>N</td>
</tr>
<tr>
<td>Energy</td>
<td>J</td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
</tr>
</tbody>
</table>

### PROBLEM DATA

- QUAD1-003h.st
- Quadratic elements
- XY symmetry
- Vector potential
- Magnetic fields
- Static solution
- Scale factor = 1.0
- 8272 elements
- 16771 nodes
- 28 regions

### Component: BMOD

<table>
<thead>
<tr>
<th>X [cm]</th>
<th>Y [cm]</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7.86736E-09</td>
</tr>
<tr>
<td>5.026007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.052</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
Support Tube (80cmφ x 12m) Analysis by ANSYS

Total weight = 50 tons

Result; Gravitational Sag

H. Yamaoka, 2nd ACFA-LC, Seoul, Nov., 1999
Spectrum Analysis by ANSYS

Model -A

Model -B

Input

Ground Motion at Tsukuba exp. hall

<table>
<thead>
<tr>
<th>Freq. (Hz)</th>
<th>μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.003</td>
<td>3.0</td>
</tr>
<tr>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>1.0</td>
<td>0.01</td>
</tr>
<tr>
<td>3.0</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Freq. 15Hz

Result; Relative displacement between ± 2 m
H. Yamaoka, 1/27, 2000

Structure of JLC detector at B=3 Tesla
Backgrounds

(1) Muons
10^7 muons/trains at the collimators
Assuming 0.1% flat beam-tail, 10^{-3}(tail) x 10^{10}(beam)x10^2(bunch)=10^9 electrons/train would hit the collimators.
Tolerance: One muon in 16x16x16m^3 at IP

(2) Synchrotron radiations in FF-system. collimation is important: 6 \sigma_x x 40 \sigma_y

(3) e^+e^- pairs created in collisions
number of pairs 25,000 / bunch
average energy 4 GeV (E_e > 3MeV )
total energy 100 TeV / bunch
signals for pair monitor for E_e = 300 ~ 500MeV

(4) neutrons (1 neutron/100MeV )
pairs at QC1 and masks \sim 30 TeV / bunch
3x10^5 neutrons / bunch
beamstrahlung photons 340 kW (4%x2)
2x10^{16} neutrons / sec
disrupted beam in dump line
Location of bending magnets and collimators

<table>
<thead>
<tr>
<th>element</th>
<th>s from IP (m)</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>bend1</td>
<td>90</td>
<td>-3.28 mrad</td>
</tr>
<tr>
<td>bend2</td>
<td>1600</td>
<td>7 mrad</td>
</tr>
<tr>
<td>COLLI1.8</td>
<td>1840.3</td>
<td>x', y' second colli.</td>
</tr>
<tr>
<td>COLLI1.7</td>
<td>1966.7</td>
<td>x', y' first colli.</td>
</tr>
<tr>
<td>COLLI1.6</td>
<td>2093.1</td>
<td>x, y second colli.</td>
</tr>
<tr>
<td>COLLI1.5</td>
<td>2219.5</td>
<td>x, y' first colli.</td>
</tr>
<tr>
<td>COLLI1.4</td>
<td>2357.4</td>
<td>momentum second colli.</td>
</tr>
<tr>
<td>COLLI1.3</td>
<td>2483.9</td>
<td>momentum first colli.</td>
</tr>
<tr>
<td>COLLI1.2</td>
<td>2725.4</td>
<td>(in the linac)</td>
</tr>
<tr>
<td>COLLI1</td>
<td>2855.6</td>
<td>(in the linac)</td>
</tr>
</tbody>
</table>
Muon Attenuator

(e\textsuperscript{-} beam)

Collimator

\( B \) (1 Tesla)

120 m

(average range of a 250 GeV muon)
Y. Namito, ISG3, SLAC, Jan. 1999

(b)

Distance from IP (m)

Distance from IP (m)

10 KG, $\mu^+ \text{ inside}$

10 KG, $\mu^- \text{ inside}$

0 KG

no shield

$e/\mu$

$e/\mu$

$10^{11}$

$10^{10}$

$10^{9}$

$10^{8}$

$10^{7}$

$10^{6}$

$10^{5}$

1800 2000 2200 2400 2600 2800 3000
Envelop of Collimated Beam

Distance from the IP (m)

Envelop of collimated beam (mm)

QC1 QC2 QC3 QC4 QC5

Last Bend (0.4 mrad)

JLC Design Study, April, 1997
QC1 and Synchrotron Radiation

Note: 9 cmφ aperture for superconducting QC1, Jan. 2000
Note: 4 cmφ beam pipe just in front of QC1.
1/100 bunch and $E_\gamma > 100\text{MeV}$, $E_e > 10\text{MeV}$ for display purpose

JIM simulation for $E_\gamma > 10\text{keV}$, $E_e > 200\text{keV}$
Photon Background

![Graph showing photon background at Z (cm) at r = 30 cm for 2 Tesla and 3 Tesla.]
Vertex detector hit density in stronger B fields

$\cos \theta < 0.9$

![Graph showing hit density vs. R (cm). The x-axis represents R (cm) ranging from 0 to 10, and the y-axis represents hit density in units of $\text{cm}^{-2}/\text{10 bunches}$ on a logarithmic scale. Three lines are present, each representing different magnetic field strengths: 2 T, 3 T, and 6 T.](image-url)
# Summary of pair backgrounds

Blue numbers are those of JLC parameter-\(Y\).

<table>
<thead>
<tr>
<th>name</th>
<th>(r)</th>
<th>(z)</th>
<th>(B=2) Tesla per 10 bunch crossings*</th>
<th>(B=3) Tesla per 10 bunch crossings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of (\gamma)'s</td>
<td>30.</td>
<td>(\pm 100)</td>
<td>3076</td>
<td>371</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6082</td>
<td>946</td>
</tr>
<tr>
<td>hits:vtx-1</td>
<td>2.5</td>
<td>(\pm 7.5)</td>
<td>2186, 0.9/mm(^2)/train</td>
<td>900, 0.4/mm(^2)/train</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3279, 2.8/mm(^2)/train</td>
<td>1205, 1.0/mm(^2)/train</td>
</tr>
<tr>
<td>vtx-2</td>
<td>5.0</td>
<td>(\pm 15.0)</td>
<td>720</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>920</td>
<td>306</td>
</tr>
<tr>
<td>vtx-3</td>
<td>7.5</td>
<td>(\pm 22.5)</td>
<td>406</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>545</td>
<td>138</td>
</tr>
<tr>
<td>CDC</td>
<td>45~230</td>
<td>(\pm 230)</td>
<td>121 (101)</td>
<td>12 (9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>235 (194)</td>
<td>37 (28)</td>
</tr>
</tbody>
</table>

hit#(track#) hit#(track#)

* 190 bunches/train for \(Y\) while 95 bunches/train for \(A\).
## Summary of pair backgrounds

Beam pipe with 1cm radius and Be-500 μm thickness at IP

<table>
<thead>
<tr>
<th>name</th>
<th>r</th>
<th>z</th>
<th>$B=2$ Tesla</th>
<th>$B=3$ Tesla</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cm</td>
<td>cm</td>
<td>per 10 bunch crossings</td>
<td>per 10 bunch crossings</td>
</tr>
<tr>
<td>no. of $\gamma$'s</td>
<td>30.</td>
<td>±100</td>
<td>11140</td>
<td>5857</td>
</tr>
<tr>
<td>hits:vtx-1</td>
<td>1.5</td>
<td>±4.5</td>
<td>10244, 12/mm²</td>
<td>3065, 3.6/mm²</td>
</tr>
<tr>
<td></td>
<td>1.8</td>
<td>±5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vtx-2</td>
<td>2.5</td>
<td>±7.5</td>
<td>1988</td>
<td>680</td>
</tr>
<tr>
<td>vtx-3</td>
<td>5.0</td>
<td>±15.0</td>
<td>600</td>
<td>402</td>
</tr>
<tr>
<td>CDC</td>
<td>45~230</td>
<td>±230</td>
<td>420(375)</td>
<td>259(217)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72(63)</td>
</tr>
</tbody>
</table>

Green numbers with 3cmφ beam pipe.
## Background tolerance

(1) CDC  10 % occupancy / train

<table>
<thead>
<tr>
<th>$r_{\text{min}}$ (cm)</th>
<th>B</th>
<th>2 tesla</th>
<th>3 tesla</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 cm hit#/train</td>
<td>△</td>
<td>1.2 k (2.4 k)</td>
<td>0.12 k (0.37 k)</td>
</tr>
<tr>
<td>1.8 cm</td>
<td></td>
<td></td>
<td>0.72 k</td>
</tr>
<tr>
<td>1.5 cm hit#/train</td>
<td>×</td>
<td>4.2 k</td>
<td>2.6 k</td>
</tr>
</tbody>
</table>

(2) VTX  1hit / mm$^2$ / train

<table>
<thead>
<tr>
<th>$r_{\text{min}}$ (cm)</th>
<th>B</th>
<th>2 tesla</th>
<th>3 tesla</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 cm hit#/mm$^2$/train</td>
<td>○</td>
<td>0.9 (2.8)</td>
<td>0.4 (1.0)</td>
</tr>
<tr>
<td>1.8 cm</td>
<td></td>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td>1.5 cm hit#/mm$^2$/train</td>
<td>×</td>
<td>4.3</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Values in ( ) are those of JLC-Y (high luminosity).

4,3 and 2cm$\phi$ beam pipes for $r_{\text{min}}=2.5, 1.8$ and 1.5 cm, respectively.
Magnetic field ($B_z$) distribution

A. Miyamoto, LC99, Oct., 1999

$B_z$ (kGauss)

Distance ($Z$) from IP (cm)

$r = 0$ cm

5 cm

10 cm

Comp. magnet

QC1
Neutron location at QC out

by Fluka-98

$E_n > 1\text{keV}$

$E_e > 10.511\text{MeV}$

$E_\gamma > 4\text{MeV}$
Neutron source points

by Fluka-98

$E_n > 1\text{keV}$

$E_e > 10.511\text{MeV}$

$E_\gamma > 4\text{MeV}$

CC + QCS

2T solenoid

A. Miyamoto, LC99, Oct., 1999
Summary of Neutron Background in VTX

Neutron yield at IP (/cm$^2$ /year)

$e^+e^-$: 
- Old (GEANT) $3 \times 10^7$
- New (Fluka98) w 2T solenoid $5 \times 10^7$
- New (Fluka98) w. CC and QC $7 \times 10^7$

beamstrahlung: 
- Old (GEANT) $1 \times 10^7$
- New (Fluka98) $2.5 \times 10^7$

Statistical error of new estimate is roughly a few $\times 10^7$ (guess)

New estimate based on Fluka98 is well below the requirement, $< 1.5 \times 10^{10}$ n/cm$^2$ for the CCD vertex detector

Neutron background from other sources in dump line are under study.
Pair Monitor

as a beam profile monitor

Active Pixel Sensor

double layer of silicon disks

- pixel size: 100 x 100 $\mu$m$^2$
- thickness: 300 $\mu$m
- inner radius: 2 cm
- outer radius: 8.5 cm
- location (z): 176 and 177 cm from IP

Measurement:

position and energy deposit
Pair Monitor

![Graph showing energy deposit and number of hits.](image)
Pair Monitor

Number of hits / 20 bunch crossing

- nominal (σ_y*)
- 2 x σ_y*
- 3 x σ_y*
- 4 x σ_y*
- 10 x σ_y*

r (cm)
Pair Monitor

![Diagram showing the Pair Monitor with azimuthal angle (radian) on the x-axis and r (cm) on the y-axis, with regions labeled H2, L1, H1, and L2.]
Pairs at the Monitor, 100 bunches, B=2 Tesla: Energy vs R and their projections

BM: Energy (GeV) vs R (cm)

ID=138, N=105928

BLOW BM: Energy (GeV) vs R (cm)

ID=139, N=6667

PROX BM: Energy (GeV) vs R (cm)

ID=140, N=82269

PROX BLOW BM: Energy (GeV) vs R (cm)

ID=141, N=6667
Pixel Beam Profile Monitor for Linear Collider

A. Miyamoto, Y. Sugimoto, T. Tauchi, K. Yokoya
High Energy Accelerator Research Organization (KEK)

G. Alimonti, T. Browder, C. Kenney, S. Olsen, S. Parker,
M. Rosen, K. Travelsi, G. Varner, H. Yamamoto
The University of Hawai‘i

1 Introduction

At linear colliders, it is expected that a large number of $e^-e^+$ pairs are created by the QED process $\gamma\gamma \rightarrow e^+e^-$ where $\gamma$ may be off-shell or near-on-shell[1]. Depending on the number of off-shell photons involved, they are classified as Landau-Lifshitz (both off-shell), Bethe-Heitler (one of them is off-shell), and Breit-Wheeler (both near-on-shell). These pairs are predominantly created along the beamline, and acquires $p_t$ kick by the electromagnetic field of the on-coming bunch. As long as the pair is relativistic and the direction is the same as the co-moving bunch, the net force due to the co-moving bunch $\pm e(\vec{E} + \vec{\beta} \times \vec{B})$ cancels out ($\vec{\beta}$ is the velocity of the pair particle in unit of $c$). One then only needs to consider the effect of the on-coming beam (Figure 1).

Typical parameters of the bunch is $\sigma_x/\sigma_y/\sigma_z = 260\text{nm}/3\text{nm}/80\mu\text{m}$, and the number of particles per bunch $N$ is $\sim 10^{10}$. If we assume a rectangular beam of $2\sigma_x \times 2\sigma_y \times 2\sigma_z$ with uniform charge density and $\sigma_y \ll \sigma_x$, this creates

$$E(\text{dyne/esu}) = B(\text{gauss}) = \frac{\pi eN}{2\sigma_x\sigma_z} \sim 3.6 \times 10^7$$

just above or below the on-coming bunch in the laboratory frame. For the typical value of $p = 300 \text{ MeV}/c$, the curvature due to both $E$ and $B$ fields is about $170\mu\text{m}$ which can be compared to the bunch length of $80\mu\text{m}$. If the charge of the particle and the on-coming bunch are opposite sign, the created particle would undergo a number of oscillations around the beam plane and the net $p_t$ acquired will be small. On the other hand, if the particle and the
Pixel Beam Profile Monitor

H. Yamamoto et al., University of Hawaii

The sensor arrangement; the top side faces the IP.

One 'segment'; the bottom side faces the IP.

3D Pixel

1. Fast charge collection
   < 1 nsec : bunch separation

2. Radiation hard
   >>50kRad/year, $10^7$ n/cm$^2$/year

3. Flexible geometry

4. Active edge
Luminosity Monitor and Active Mask

(1) Luminosity monitor

geometrical acceptance:
  \[ 163 < z < 178 \text{ cm} \quad \text{and} \quad 0.05 < \theta < 0.15 \text{ rad.} \]
made of tungsten only in this study
segmentation:
  \[ r \quad 32 \text{ divisions} \quad \Delta r \sim 5\text{mm} \]
  \[ \phi \quad 16 \text{ divisions} \quad \Delta \phi \sim 3.2 - 9.7 \text{ cm} \]
  \[ z \quad 128 \text{ divisions} \quad \Delta z \sim 1.17\text{mm} \]

(2) Active mask (front part of conical mask)

geometrical acceptance:
  \[ 30 < z < 37.5 \text{ cm} \quad \text{and} \quad 0.15 < \theta < 0.20 \text{ rad.} \]
made of tungsten(W) and silicon pad( Si,200\mu m)\(^\dagger\)
  \[ 5\text{mm}\!^\dagger W/Si/(1\text{cm}\!^\dagger W/Si)\] \^ 8 layers
segmentation:
  \[ r \quad 8-10 \text{ divisions} \quad \Delta r = 2\text{mm} \]
  \[ \phi \quad 32 \text{ divisions} \quad \Delta \phi \sim 0.9 - 1.2 \text{ cm} \]
Generated events
(1) $e^+e^-$ pairs by cain21d
parameter A at $E_{cm}=500\text{GeV}$
100 bunch crossings
  correspond to 1 train crossing
(2) an electron/ muon into luminosity monitor
and active mask
  50 GeV and 250 GeV electrons
  250 GeV muons

Simulation results
(1) Energy deposits in total volume

\begin{array}{|c|c|c|c|c|}
\hline
B=2T & e^+e^- pairs & 50\text{GeV} & 250\text{GeV} & 250\text{GeV} \\
\hline
\text{am} & 264\text{MeV} & 120.4\text{MeV} & 541.0\text{MeV} & 0.48\text{MeV} \\
\hline
\text{Im} & 152\text{GeV} & 49.9\text{GeV} & 249.5\text{GeV} & 1.67\text{GeV} \\
\hline
\end{array}

B=3T $e^+e^-$ pairs

\begin{array}{c|c|c}
\hline
\text{am} & 29.3\text{MeV} & \\
\hline
\text{Im} & 46.7\text{GeV} & \\
\hline
\end{array}

am=active mask, Im=luminosity monitor
a 50 GeV electron with 100 bunch crossings: Luminosity monitor

+ LM:energy deposit(keV):Z vs R

PROY + LM:energy deposit(keV):Z vs R

ID=212, N=2248

ID=213, N=125

PROX + LM:energy deposit(keV):Z vs R

ID=216, N=125

+ LM:energy deposit(keV):Z vs R
a 50 GeV electron with 100 bunch crossings: Luminosity monitor

PROX + LM: energy deposit (keV): Z vs PHI
A 50 GeV electron into active mask

AM: energy deposit (keV): Layer vs phi

+ AM: energy deposit (keV): Layer vs phi
a 250 GeV electron into active mask

AM:energy deposit(keV):Layer vs phi

+ AM:energy deposit(keV):Layer vs phi
Optics of Dump Line (1st version)  

K. Kubo

2nd focus point

Measurements of energy distribution polarization

-3.22 mrad
Vertical dispersion at 2nd IP in dump line

K.Kubo, Jan.2000

$\Delta E/E \, (%)$

$X \, (\mu m)$

$Y \, (\mu m)$
Energy Loss in dump line (5A)

Energy Loss (10^{18} \text{ eV} / \text{m/bunch})

Distance from IP (m)

Power Loss (kW/m)

Aperture = +/- 2 cm, 2.4% loss

+/- 5 cm, 1.4% loss

-3.22 mrad

K.Kubo, Feb.15, 2000
Particle loss in dump line (5A)

Aperture = +/- 2 cm
+/- 5 cm
Future Plan

1. IP layout will be optimized for the high luminosity upgrade.
   JLC-Y : 1.4nsec bunch spacing,
   190 bunches/train
   stronger beamstrahlung effects

2. “Pre-linac” collimation scheme must be established.
   It means collimation before the main linac.
   It may simplify the collimation system and the muon protection.

3. Superconducting QC1 will become the basic choice.
   The design shall be based on experiences of LHC-QC magnets, adding new features of correction magnets near the beam line for nano-meter beams.
   Prototype of QC1 must be necessary.

4. More detailed study on the support system will be pursued with respect to ground motions.
   Prototype system must be constructed to verify our estimations.
5. Background studies will continue based on detailed simulations with up-to-date geometries, especially for the neutron background.

6. The realistic design of the pair monitor shall be promoted by a collaboration between University of Hawaii and KEK. It will be finalized in this autumn.

7. R&D of active mask and luminosity monitor will be initiated by National Taiwan University group.

8. The “actual” dump line must be designed in order to control beam losses for the neutron backgrounds. Experimental methods must be established for measurements of beam energy spread and polarization.

9. All efforts should be concentrated for the first draft of the CDR in this autumn.