The Crab crossing scheme allows a large crossing between collision vertices without introducing any synchronization. Non Crab crossing scheme.
SQUASHED CELL CAVITY

Coaxial Coupler
To Trap Only Crab-Mode

CRAB-MODE (TM up)

Prototype Coaxial Coupler

Cross section of the Crab Cavity with the Prototype Coaxial Coupler
- We are developing crab cavities in order to reach the tuneshift of 0.05. Crab cavities will be, if necessary, installed in 2003.

3. $\beta_y^*$

- 7 mm $\beta_y^*$ (design is 10 mm) has been already achieved

3. Beam currents

- Weak vacuum components (movable masks and IP bellows) limited the stored currents.

- During 2000 summer shutdown these components have been replaced.
Configuration of Type-1 movable mask.
- HER current is still limited by movable masks. We will be ready to replace them anytime after April.

4. Beam blowup in LER

- Photoelectrons excite head-tail instabilities in LER and beams blow up.

- This beam blow-up limits the luminosity.

- Effect of C-yoke magnets to cure the problem was not so evident.

- Solenoid coils were wound over LER vacuum chamber during 2000 summer shutdown and 2000-2001 winter shutdown.
3. Beam break-up (BBU)/Head-tail instability by the photoelectron cloud

To explain the blow-up, the beam break up/head-tail instability in a bunch caused by the electron cloud is proposed.

A. Model (F. Zimmermann, K. Ohmi)

- Electrons which is generated by the synchrotron radiation form a cloud by the attractive force of multi-bunch positron beam.

- Beam breakup/head-tail oscillation in a bunch occurs by the mediation of the cloud.
- 1999 Autumn - 2000 Summer
  Permanent magnet quads
  (C-yoke) were used

- 2000 Summer Shutdown
  Solenoids were wound over
  800 m

- 2000 - 2001 New Year Shutdown
  Solenoids were wound over
  additional 400 m
Photo-Electron Instability

5 cm

positron beam
- Solenoid coils partly cured the beam blow-up. We are not sure whether solenoids will cure the problem completely, after every field-free region is covered by them.

- R&D on ante-chamber has just started.

5. Prospects of luminosity increase

- By the summer of 2003, luminosity will go up by increasing currents and decreasing bunch spacing, even with mild beam-beam tuneshift of 0.03 up to \( 7 \times 10^{33} \, \text{cm}^{-2} \text{s}^{-1} \). We assume that beam blow-up will be cured.
Effect of solenoid on luminosity

CsI Specific/bunch

LER current (mA)

C yokes
Solenoid on
Solenoid off
Sell the bear's skin before one has caught the bear
<table>
<thead>
<tr>
<th>Luminosity (fb⁻¹)</th>
<th>Accumulated</th>
<th>Peak Luminosity (cm⁻² s⁻¹)</th>
<th>Yearly Integrated</th>
<th>Installation of Grid Cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>131</td>
<td>38</td>
<td>$7 \times 10^{33}$</td>
<td>$5 \times 10^{33}$</td>
<td>2002 Fall-2003 Summer</td>
</tr>
<tr>
<td>13</td>
<td>41</td>
<td>$3 \times 10^{33}$</td>
<td></td>
<td>2001 Fall-2002 Summer</td>
</tr>
<tr>
<td>32</td>
<td>25</td>
<td></td>
<td></td>
<td>2000 Fall-2001 Summer</td>
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<tr>
<td>381</td>
<td>100</td>
<td>$12 \times 10^{33}$</td>
<td>$10 \times 10^{33}$</td>
<td>2004 Fall-2005 Summer</td>
</tr>
<tr>
<td>281</td>
<td>83</td>
<td>$8 \times 10^{33}$</td>
<td></td>
<td>2003 Fall-2004 Summer</td>
</tr>
<tr>
<td>198</td>
<td>67</td>
<td></td>
<td></td>
<td>2003 Summer Shutdown</td>
</tr>
</tbody>
</table>

Prospects of Performance Improvement
- During summer shutdown of 2003 crab cavities will be installed. With high beam-beam tuneshift of 0.05, luminosity will reach $12 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$ in 2006.

- More than 300/fb is expected to be accumulated before LHC-B produce physics.

- Discussion on super KEKB of $10^{35} \text{cm}^{-2}\text{s}^{-1}$ has just started.