ideas on KEKB crab-cavity studies

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possible visits

• December 2008 Rogelio Tomas (CERN)
  - for ATF2 (& KEKB?)
  - approval may depend on LHC progress
• December 2008 Rama Calaga (BNL, LARP)
  - for KEKB
• March or April 2009 Frank Zimmermann (CERN)
• ... + more?
two types of machine studies:

- understanding & solving drop in specific luminosity
- using KEKB as LHC crab-cavity testbed

LHC studies might help for KEKB problem and vice versa
KEKB blow up at high current

- **Symptoms** – luminosity, lifetime, beam size?
- **Single-bunch** or **multi-bunch effect**?
- **Incoherent** or **coherent** phenomenon?
- **Transverse** or **longitudinal** effect?
- Dependence on **working point**?
- Dependence on **tuning conditions**?
- One beam (LER) or both beams affected?
- ...
more thoughts & questions & studies

• similar specific luminosity drop for **few and many bunches?!** (rules out electron cloud as explanation)

• is strong decrease of luminosity related to **working point close to half integer** (Steve Myers’ question at EPAC)?; check further away from the 1/2 integer resonance? and/or do **1D or 2D tune scans** with and w/o crab cavity & compare with predicted sensitivity?

• **short-range wake field** of the crab cavity?

• **y blow up uniform along the train?** (or correlation with phase difference between the two beams)?

• **y beam size & lifetime of single beam** vs. current

• **crab cavity rf phase noise & phase error vs current ; RF high-frequency spectrum vs beam current**
more thoughts & questions & studies -2

• add **controlled rf noise** (sine like or white) until blow up due to beam-beam & measure variation w beam current

• transverse **tune shift & bunch length vs current** w & w/o (or w detuned) crab cavity; summary of all KEKB impedance measurements with & w/o crab cavity

• **change bunch length** \((\alpha_c)\)

• vary the **Piwinski angle** - e.g. via changes in beta* or bunch length - to study the effect of the crab cavities for several values of the Piwinski angle (Jean-Pierre Koutchouk)

• introduce large known aberrations – D*, IP coupling, β*, etc. - and then **compare specific luminosity with & w/o crab cavities** (to cut down tuning time and operate under well-defined “known” conditions)
more thoughts & questions & studies -3

- crab only one of the two beams; and ½ crab voltage
- for LHC: “turn on” or “ramp” crab cavities with beam
- for LHC: “beam transparency” studies - how much crab-cavity frequency detuning and which crab-cavity orbit correction are needed, e.g. to avoid transverse instabilities?
- **BTFs** with & w/o beam-beam and with & w/o crab cavities
- CERN simulations of KEKB?
- ...


## Piwinski angles in LHC and KEKB

<table>
<thead>
<tr>
<th></th>
<th>LHC nominal</th>
<th>LHC “ultimate”</th>
<th>LHC “FCC” upgrade</th>
<th>LHC “LPA” Upgrade</th>
<th>KEKB</th>
<th>Super-KEKB</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_z$ [mm]</td>
<td>75.5</td>
<td>75.5</td>
<td>75.5</td>
<td>118.0</td>
<td>7.0</td>
<td>3.0</td>
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<tr>
<td>$\sigma_x^*$ [μm]</td>
<td>16.6</td>
<td>15.8</td>
<td>6.3</td>
<td>11.2</td>
<td>103</td>
<td>69.3</td>
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<tr>
<td>$\theta_c$ [mrad]</td>
<td>0.285</td>
<td>0.315</td>
<td>0.673</td>
<td>0.381</td>
<td>22.0</td>
<td>30.0</td>
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<tr>
<td>$\phi$</td>
<td>0.64</td>
<td>0.75</td>
<td>4.1 (w/o crab)</td>
<td>2.0</td>
<td>0.75 (w/o crab)</td>
<td>0.65 (w/o crab)</td>
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</tbody>
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