Synchrotron radiation studies in TOSYLAB

Work by summer student Alan Mak, September 2007

Oliver Grimm, 11 December 2007
Alignment laser port
Alignment laser work

- Calculated and mounted lens for better focusing
- Measured response of laser steering

Original idea:

Measure axis of infrared radiation in TOSYLAB, then align laser to this axis

Problem:

Back-projected axis does not pass through laser port
**Fluctuation analysis**

**Intention:** Establish simple monitoring for *on-crest* bunch length

- Measure many shots
- Determined fluctuation

Correct for baseline noise, charge and HV fluctuations ($\sigma_{G/G}=9\sigma_{U/U}=4\times10^{-4}$)

**Bunch length determination**
(assumes full incoherence, Gaussian shape)

\[
\sigma = \frac{1}{2\sigma_{\text{filter}}} \sqrt{\frac{\langle W \rangle^4}{\sigma_W^4} - 1}
\]

<table>
<thead>
<tr>
<th>$V_{PMT}$ (V)</th>
<th>$\sigma$ (ps)</th>
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</thead>
<tbody>
<tr>
<td>-1180</td>
<td>3.9 ±0.1</td>
</tr>
<tr>
<td>-1251</td>
<td>4.1 ±0.1</td>
</tr>
<tr>
<td>-1316</td>
<td>3.8 ±0.1</td>
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\[
\frac{\sigma_W}{\langle W \rangle} \approx 0.1\%
\]

for this measurement

Ref.: J. Krzywinski et al., TESLA-FEL 97-03  
F. Sannibale et al., Proc. PAC07  
M.S. Zolotorev, G.V. Stupakov, SLAC-PUB-7132
FWHM=(11±1) ps
\[ \rightarrow \sigma_{\text{on crest}}=(4.7±0.4) \text{ ps} \]

\[ \sigma_{\text{on crest}}=(6.6±0.4) \text{ ps} \]

FWHM=3.8 mm
\[ \rightarrow \sigma_{\text{on crest}}=5.4 \text{ ps} \]
Next steps

• Check fluctuation analysis with different filters
• Maybe try APD as detector
• Compression scan with this method

• Martin-Puplett reinstalled, mount LHe cooled bolometer → uncompressed and dark current signals?

• Install second container to enlarge lab space