SVTRAD Background

Sensors

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SVTRAD Radiations Sensors

Reverse biased (50 V) Si PIN-diodes:
- Twelve 1cm x 1cm x 300µm diodes
- Ionizing rad. produces e-h pairs
- Charge proportional to dose
  - 1 nC = 5.2 mrad
- Suffers from high dark currents!!

Diamond Sensor:

Biased (500 V) CVD diamonds:
- Two 1cm x 1cm x 500µm
- 1 nC ~ 10-20 mrad (calibrated to be proportional to PIN diodes)
- No issues with dark current!
Background Categories

- Beam gas interactions
  - Bremsstrahlung \((e + H \rightarrow e + \gamma + H)\)
  - Coulomb scattering \((e + H \rightarrow e + H)\)
- (Trickle) injection
- “Beam instabilities”
  - Something causes “wild” background and SVTRAD system dumps both beams in \(~1\text{-}100\text{ms}\)
  - Some are known causes: Beam instabilities, pressure bursts, “dust”
- Luminosity - not seen in SVTRAD (maybe in SVT)
- Beam-beam - hard to quantify
Beam Gas Backgrounds

Interaction Region (top view)

**EAST**

Backward

Off-energy or off-angle e⁺'s hit east midplane diodes

East is LER

**WEST**

Forward

Off-energy or off-angle e⁻'s hit west midplane diodes

West is HER
Background Readout

SVTRAD measures dose rate every 2 seconds (Several EPICS panels and in Ambient DB)

Keeps track of integrated dose

Compares rates to expected rates (see next slides) Only for diamonds
Expected Background

Use fits to diamond data from January 2004 Bkgd runs:

Varying HER - BW Diamond

\[-1.724 + 24.532 \times \text{IHER} + 0.737 \times \text{Lumi}\]

Varying LER - BE Diamond

\[-0.510 + 1.151 \times \text{IHER} + 2.847 \times \text{ILER} + 0.102 \times \text{Lumi}\]

HER and LER single beam backgrounds dominate BW and BE signals. PIN-diodes calibrations are not reliably enough to give meaningful full ratios.
Run 5 Ratios

Reasonable description of conditions in Run 5

Clearly see periods where vacuum was broken and needed scrubbing

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Current Background Ratios

Currently LER vacuum is still being scrubbed

Note: ratio normally only plotted for delivery periods as injection backgrounds are not parameterized
(Trickle-) Injection Backgrounds

Injection backgrounds has short duration (few ms)
Want to know dose per injection shot
High dose can trip detector/reset SVT electronics!

Example of BAD injection
Dose measured for 12 ms after injection
Dose in next 12ms subtracted to remove stable beam contribution
# Injection Dose Readout

Report average and maximum dose per injected bunch in 2 second intervals.

## Injection Doses:

<table>
<thead>
<tr>
<th>HER Injection (0 shot(s) in last 2s)</th>
<th>Avg (mR)</th>
<th>Max (mR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW-Top</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>FW-Mid</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>FW-Btm</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>BW-Top</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>BW-Mid</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>BW-Btm</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LER Injection (20 shot(s) in last 2s)</th>
<th>Avg (mR)</th>
<th>Max (mR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE-Top</td>
<td>0.000</td>
<td>0.008</td>
</tr>
<tr>
<td>FE-Mid</td>
<td>-0.007</td>
<td>0.036</td>
</tr>
<tr>
<td>FE-Btm</td>
<td>-0.001</td>
<td>0.005</td>
</tr>
<tr>
<td>BE-Top</td>
<td>0.004</td>
<td>0.028</td>
</tr>
<tr>
<td>BE-Mid</td>
<td>0.006</td>
<td>0.035</td>
</tr>
<tr>
<td>BE-Btm</td>
<td>0.000</td>
<td>0.011</td>
</tr>
</tbody>
</table>

West diode used for HER injection.

East diode used for LER injection.

During good quality trickle injection, these should all be <0.1 mRad.
Trickle Background

Again only display quality during stable beams:

Very high doses (50 mRAd) can reset SVT electronics - causes loss of some data taking time

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SVTRAD Beam Aborts

On SVTRAD aborts, dose rates prior to abort is read out with fine-grained time-resolution

6.2 seconds at 651 Hz: 

0.4 seconds at 10kHz:

Plots for all aborts available on webpage:

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Beam Abort Examples

Aborts have different signatures
- there has been some attempts at correlating with PEP signatures
  (transverse/longitudinal instabilities, loss of other beam)
- not entirely successful so far