Beam Position Monitoring

STT Meeting

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Beam Position

- Vertices on a line $\begin{cases} x = X_0 + A_x z \\ y = Y_0 + A_y z \end{cases}$
- Extra contribution to track impact parameter due to beam offset:

$$d(\phi_i, z_i) = (X_0 + A_x z_i)\sin\phi_i - (Y_0 + A_y z_i)\cos\phi_i$$

- Collect tracks from several events, and minimize average impact parameter (one matrix inversion):

$$\chi^2 = \sum_{i=1}^{n} \frac{(d_i - d(\phi_i, z_i))^2}{\sigma_i^2 + 2\sigma_{\text{beam}}^2}$$

- First iteration: all tracks
- Further iterations: tracks with $|d_i| < 0.1$ cm with respect to beam position from previous iteration, until no more tracks removed or less than 10% of tracks left

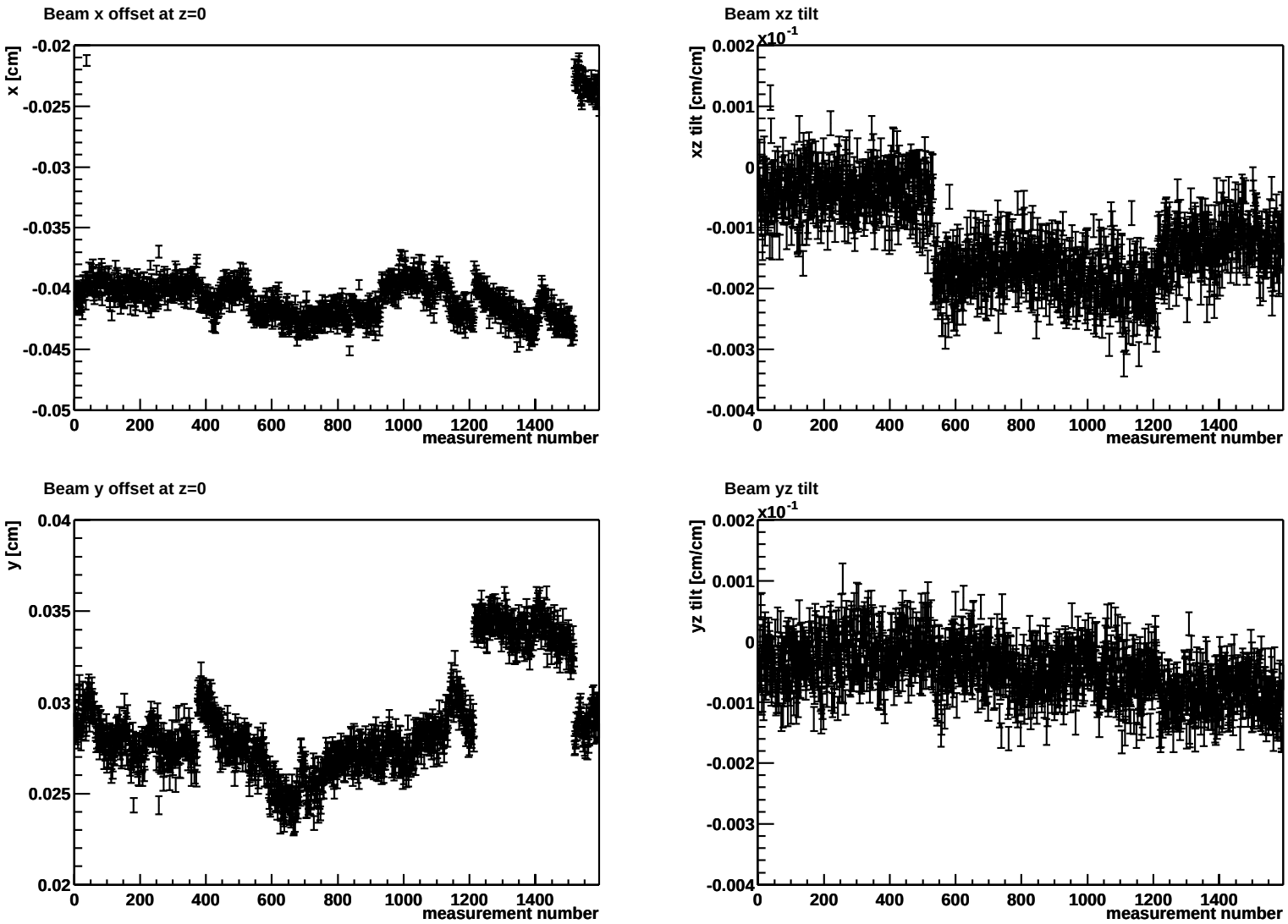
Beam Position

- Beam position written to a text file, including time stamp, runnumber, lbn

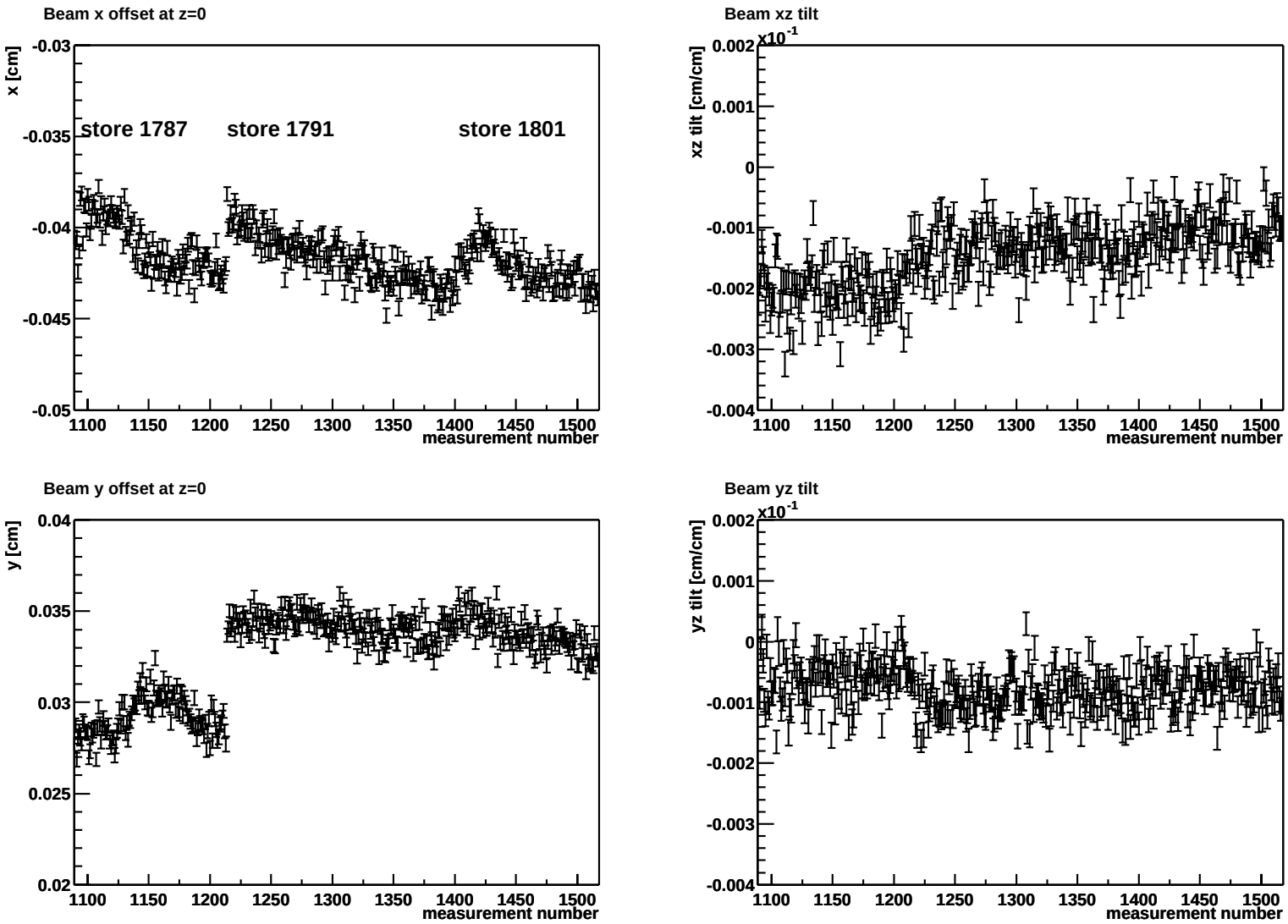
```
165601 1652313 04-10-2002_09:53:35
-0.0254016 0.0003813
-0.000144188 1.91953e-05
0.0284473 0.000414492
-5.87392e-05 2.06341e-05
end
```

- Fit every > 5000 tracks $\rightarrow$ every ~ 5 minutes

Beam Position (since Sept 13)



Beam Position (stores 1787,1791,1801)



Beam Position Error

- Runs 164605 & 164637

- If beam assumed to be stable. . .

run 164605, 37 points

RMS$_x = 7.3\ \mu$m	mean error$_x = 3.7\ \mu$m
RMS$_y = 7.4\ \mu$m	mean error$_y = 3.8\ \mu$m
RMS$_{xz} = 42\ \mu$rad	mean error$_{xz} = 19\ \mu$rad
RMS$_{yz} = 42\ \mu$rad	mean error$_{yz} = 20\ \mu$rad

run 164637, 29 points

RMS$_x = 7.4\ \mu$m	mean error$_x = 3.8\ \mu$m
RMS$_y = 6.8\ \mu$m	mean error$_y = 3.9\ \mu$m
RMS$_{xz} = 35\ \mu$rad	mean error$_{xz} = 19\ \mu$rad
RMS$_{yz} = 33\ \mu$rad	mean error$_{yz} = 20\ \mu$rad

$\Rightarrow$ Errors underestimated!

Beam Position at Begin of Store

- Beam does jump from store to store!

- Ideal scenario:
  - Get beam position from Beam Pickup Monitors (needs work)

- Current scenario:
  - Start global run with values from previous store
  - Measure beam position in `vertex_examine`
  - New measurement after $\sim$ 5 minutes (needs work)
  - Stop-start run if value changed

- Speedier scenario:
  - Run physics trigger with special prescale set
  - Run tracking in L3 nodes $\rightarrow$ high rate!
  - Get info out of L3 and calculate beam position
  - Stop run, download physics prescale set, download beam position, start run

Downloading Beam Position to STT / L3

- Needs to be done at start of run, not trigger download!
- Needs to be handled by COOR:
  - "Failsafe"
  - Record to `brun` file → Runs DataBase
  - COOR can do this!
- Parameters downloaded in STT crates should be read back in EPICS, for verification / monitoring
- If beam moves, stop-start run sufficient to redownload to STT
- L3 is different. . .