BEAM ALIGNMENT ISSUES

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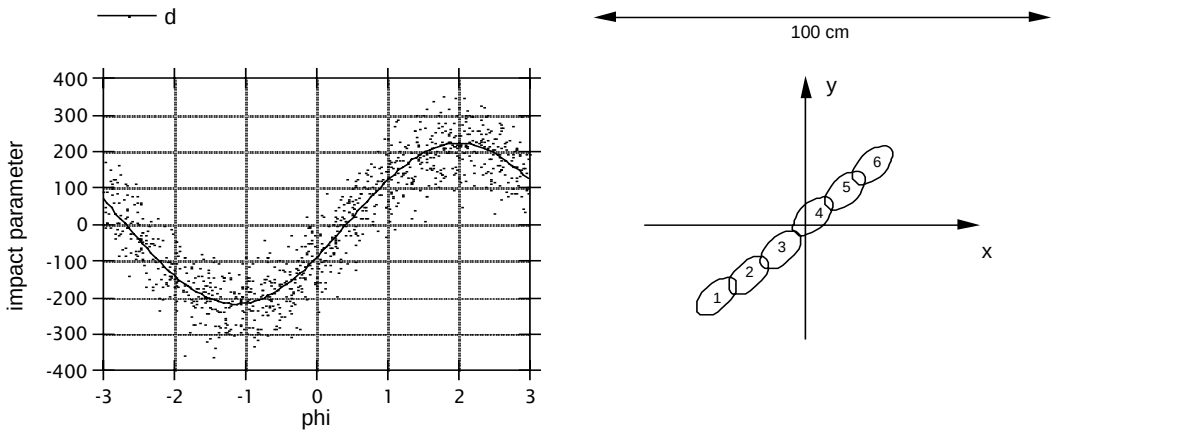
- Detector alignment
  - We assume that with a combined on-line and off-line analysis we can come up with a set of constants for SVT to compute constraints and track parameters within some 3D coordinate system: the "SVT coordinate system".
  - We do not need to change these constants unless the detector (SVT+COT) moves in some non-rigid way.
  - In principle these constants are NOT dependent on the position of the beam spot.
- Beam alignment
  - The goal of the beam alignment procedure is to always keep the beam spot of the Tevatron as close as possible to the "nominal beam position".
- Nominal beam position
  - This is where we want the beam spot to be during data taking.
  - Defined with respect to the SVT coordinate system
  - Position: (x, y) and slope (dx, dy)

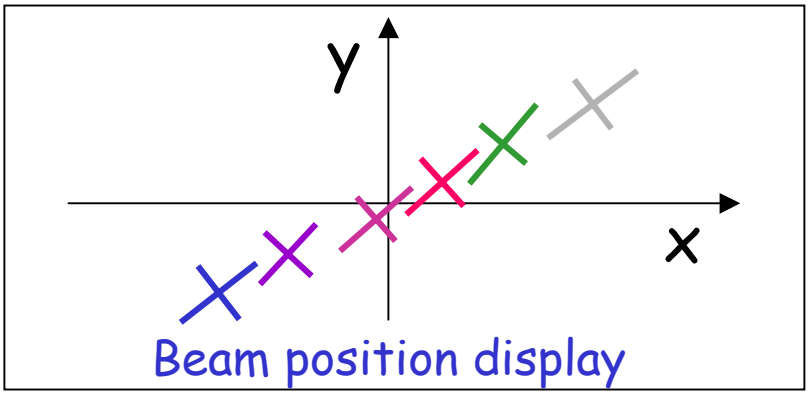
MEASURING 3D BEAM POSITION

- Semi-offline
  - Impact parameter and phi from SVT
  - z from offline tracks
- Online
  - Impact parameter and phi from SVT
  - Rough z from SVT segmentation



MEASURING 3D BEAM POSITION (online)

- Read BP_FIFO's of all Track Fitters
  - 32K tracks per phi sector
- Select "high quality" tracks contained in a single z segment
- Use (d, ϕ)
  - ϕ : phi angle at min distance from origin
- For each z segment accumulate quantities needed for the fit
  - $\sum d_i*\cos\phi_i$, $\sum d_i*\sin\phi_i$, $\sum \cos^2\phi_i$, $\sum \sin^2 \phi_i$...etc.
- For each value of z:
  - Solve 2x2 linear system to find beam center
    - (X_k, Y_k): k = 1...6
  - Perform a 3 parameter linear fit to find beam shape
    - $(\sigma_x, \sigma_y, \sigma_{xy})$: k = 1...6
- Beam spot parameters are obtained fitting X(z), Y(z)



Beam position display

DEFINING NOMINAL BEAM POSITION

- Find range of beam position control
  - Xmin, Xmax, Ymin, Ymax
  - DXmin, DXmax, DYmin, DYmax
- Define: nominal = (min + max)/2
- Physically move the detector until:
  - DXnom ~ 0
  - DYnom ~ 0

  may require iteration of detector alignment
- Shift SVT coordinate system to
  - Xnom = 0
  - Ynom = 0

  requires adjustment of fitting constants
- Define nominal beam position as
  - X = 0; Y = 0; DX = 0; DY = 0;

- Accelerator coordinate system vs. SVT coordinate system
  - calibration?