Tevatron IR Optics Measurement

Lattice measurements by Valeri Lebedev show that there is an error in the lattice and this is consistent with a larger beta* than expected.

Beta wave in arcs is some +-20%, beta^*
At CDF it is 53/43 cm
X and Y waists are some 40 cm apart at CDF
At D0 41/43 cm,

Valeri has proposal to make adjustments to the lattice and reduce the beta*.

Data was collected on Friday April 16th.
Valeri will analyze data.

Lattice may have changed since last measurement?

Changes to Tevatron

It seems likely that something real has shifted in the IR's over the last shutdown.

A number of dipoles and quadrupoles were re-aligned and this may affect the optics.

The B0 low beta quads were re-aligned horizontally.

12 dipoles were re-shimed to remove skew quadrupole component.

During startup we need to make large changes to the coupling (skew quadrupole) correctors in order to tune up the Tevatron.

The effect of these changes on the IR optics hasn't been estimated yet.

Effect of LB Quad rolls

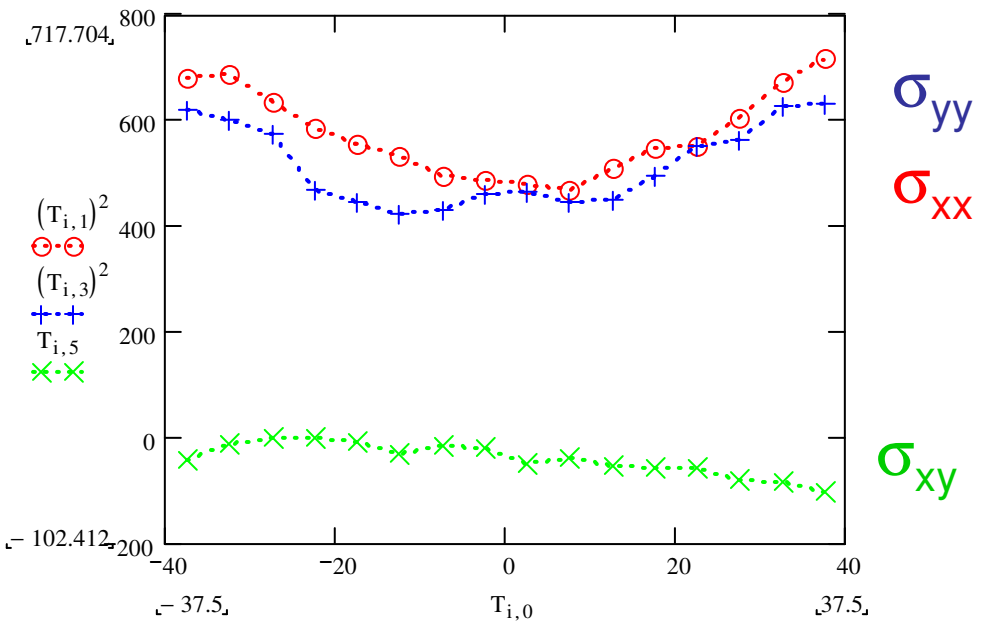
I have been calculating the effects of rolled low beta quadrupoles.

A rolled Low beta quad can give a "coupling term" -- i.e. a σ_{xy} correlation in the luminosity distribution -- but does not change β^*

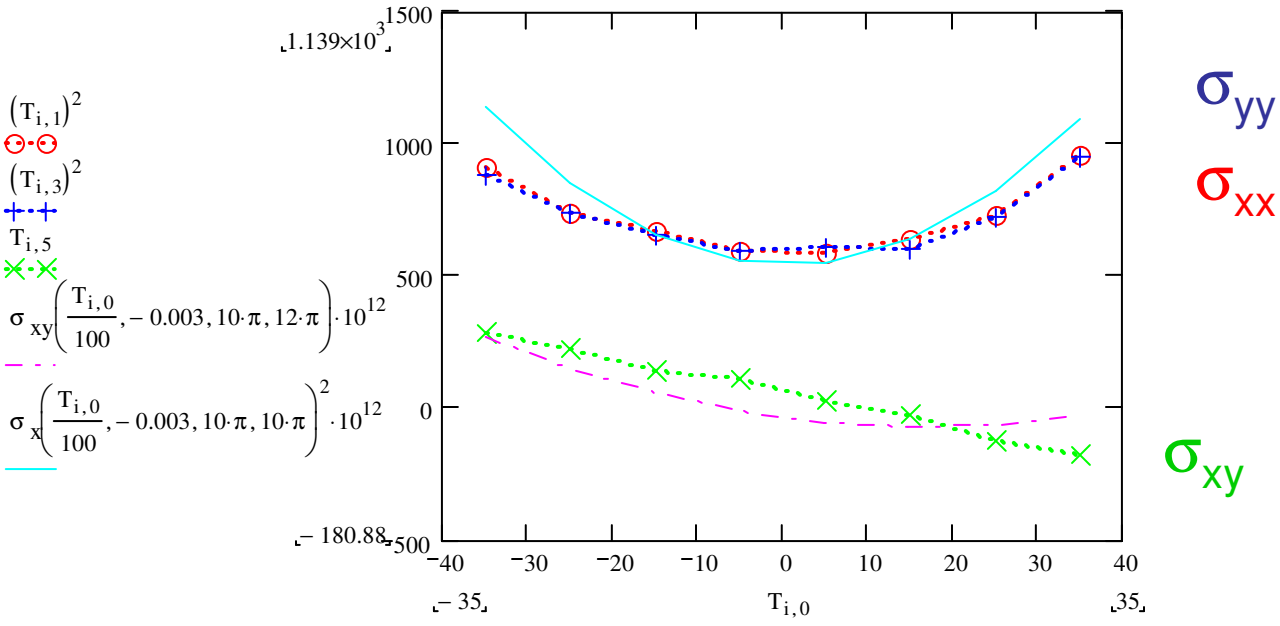
Example: A 3 mrad roll of the Q4 quadrupole changes σ_{xy} by a similar magnitude as by D0

I have yet to investigate the effects of other rolled quads and coupling sources from the ring, so I cannot make any conclusions at this time.

Is this related to shifts in IR distributions?
Should look at LB quad tilt-meters?



D0 Run 190349



D0 Run 174645
Compared to 3 mrad roll of Q4

Effect of Separators

There has also been some work done on understanding the electrostatic separators and the separated proton and pbar orbits.

The analysis suggest that we may have a crossing angle present.

We have switched the polarity of a separator over the shutdown so that we can improve our understanding of the crossing angle.

No beam studies on the crossing angle have been done yet, so we don't have any updated results?

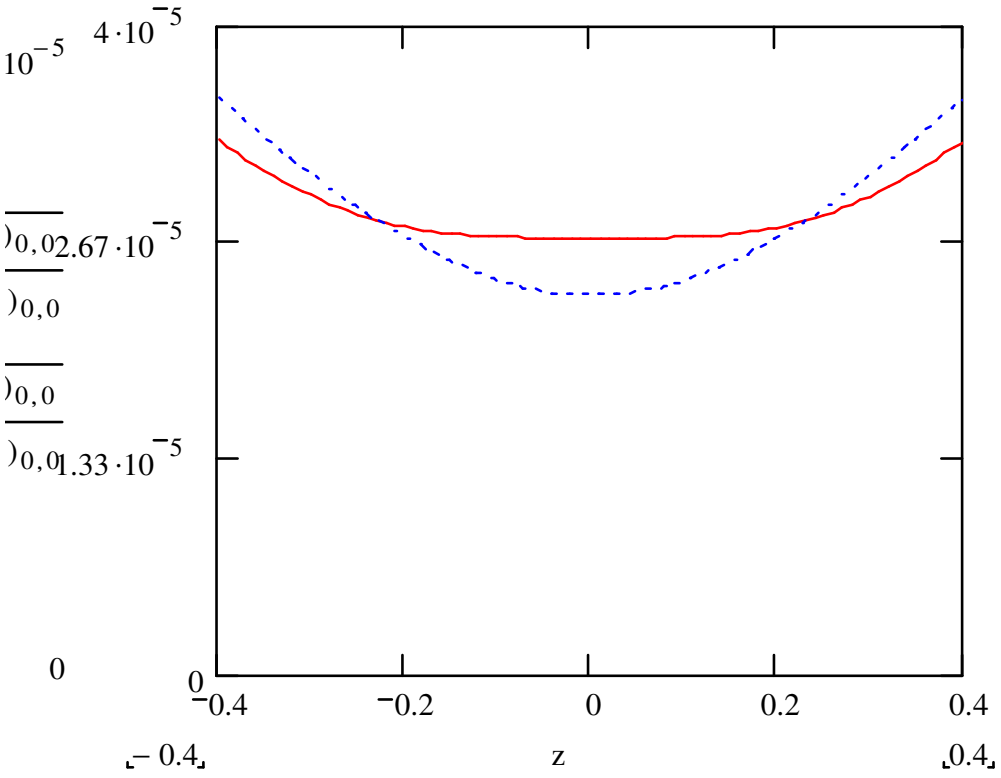
Effect of different optics for protons and pbars

Differences in the proton and pbar optics can change the luminosity distributions.

Can this explain "unusual" shape in D0 luminosity?

Protons and Pbars are on different orbits due to helical orbits. Can higher order multipoles – i.e. sextupoles – change the optics enough?

Example #1



σ_{xx}

Dashed line – design optics

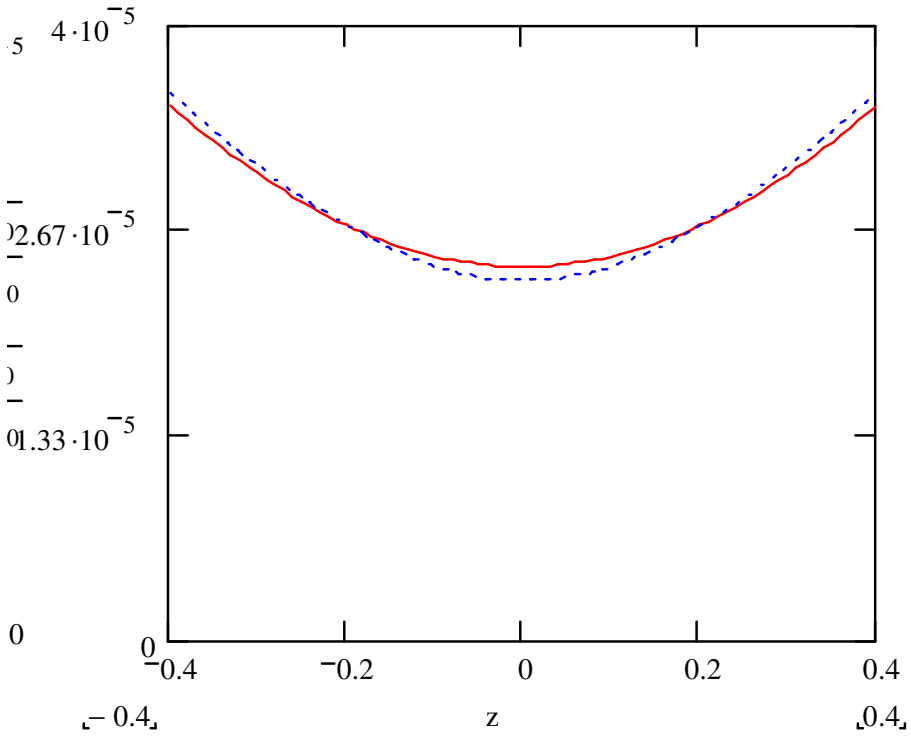
Solid line – z_0 shifted by +/- 20 cm

$z_{p\_x0} := 0.2$ $\beta_{p\_x0} := 0.35$

$z_{a\_x0} := -0.20$ $\beta_{a\_x0} := 0.35$

$\varepsilon_{p\_x} := 20\cdot\pi$ $\varepsilon_{p\_y} := 20\cdot\pi$

Example#2



σ_{xx}

Dashed line – design optics

Solid line – z_0 shifted by +/- 10 cm

$z_{p\_x0} := 0.1$ $\beta_{p\_x0} := 0.35$

$z_{a\_x0} := -0.10$ $\beta_{a\_x0} := 0.35$

$\varepsilon_{p\_x} := 20\cdot\pi$ $\varepsilon_{p\_y} := 20\cdot\pi$

Then $\beta^* \cong 50$ cm