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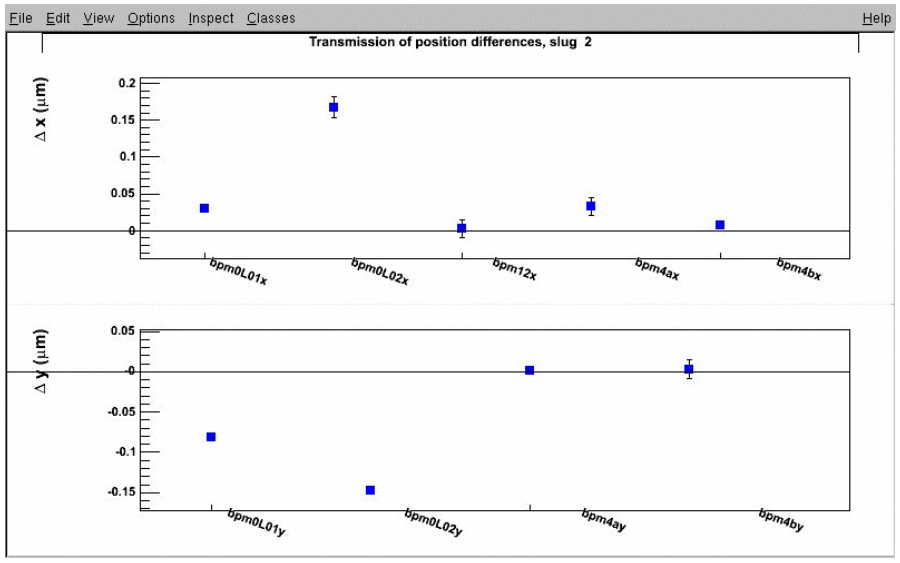
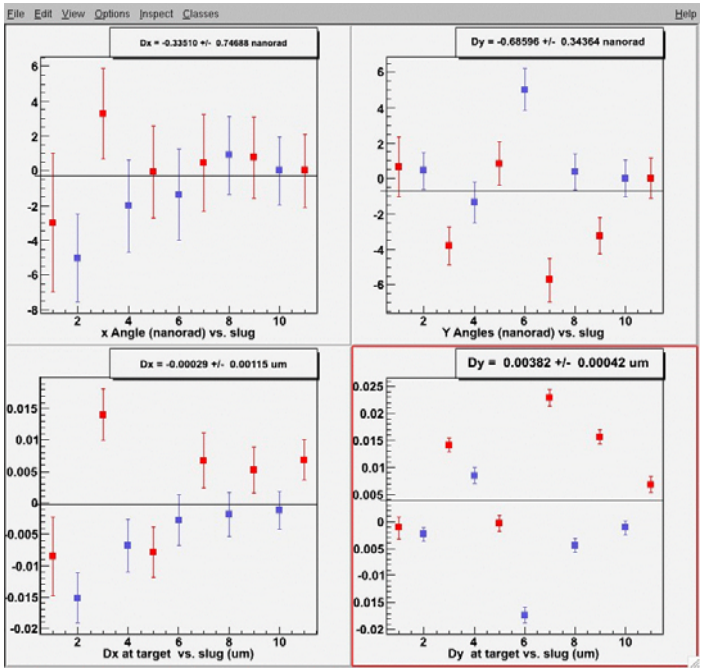
Injector Matching in the Context of G0 Backward Angle

Numerology (Very Hand-waving)

	30 hz PZT	Happex Helicity Correlated Orbit[1]	Extrapolated HC-Orbit at 360 MeV/c	Extrapolated HC-Orbit at 680 MeV/c
5 MeV Orbit Amplitude	200-400 μm	100-400 nm		
Happex Target Position	3-20 μm	10 nm	30 nm	22 nm
3 GeV Pos / 5 MeV Amp	10-100	10-40		
Happex Target Angle	2-5 μrad	3 nrad	9.0 nrad	6.6 nrad
3 GeV Ang / 5 MeV Amp	40-200 m^{-1}	30-120 m^{-1}		

Will also need all the tricks pulled by Happex Laser table setup.





[1] **From Paschke & Snyder**

Have not Exploited Disparate M_{12}'s in the Accelerator and the Detectors

Detector Sensitivity to Helicity-Correlated Position & Angle:

$$R \propto \left(\frac{X}{A}\right)^2 + \left(\frac{X'}{B}\right)^2$$

Happex: A/B = 1 m

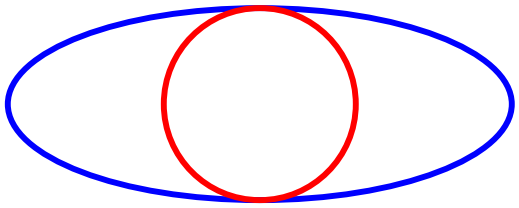
G0: A/B = 10 m

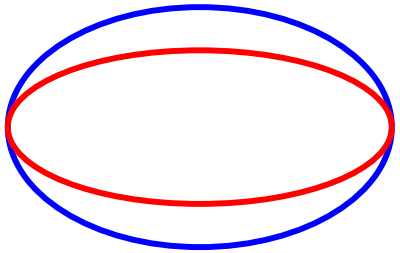
Courant Snyder Invariant in the Accelerator:

$$C \propto \gamma X^2 + \beta X'^2 \propto \left(\frac{X}{m_{12}}\right)^2 + \left(\frac{X'}{1}\right)^2 , \alpha = 0$$

Typical M_{12}: ~ 10 m

- We can manipulate phase before target to achieve minimal detector sensitivity while conforming to CS constraints (Phase trombone).
- Currently this phase has not been optimized for Happex and it sits somewhere between the two extremes. The Extrapolated G0 numbers are based on this semi-Happex-optimized data.
- We may need to exploit this for G0 with its specific geometry.

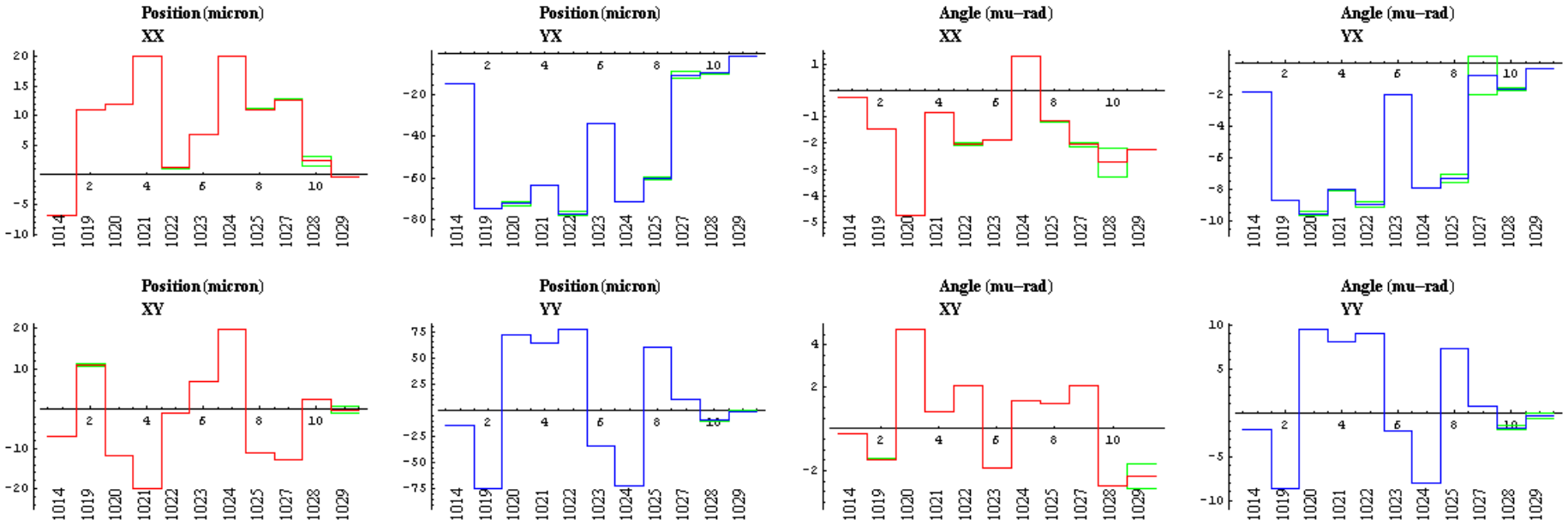




Emphasis Now is on Efficiency, Speed and Robustness

- Timely and deterministic setup procedure is highly desirable.
- Frequently changing transport throughout the machine may need to be acted upon frequently.
- An efficient and robust procedure at all times would be necessary in this case.
- Signal quality is also important.

Position & Angle at TARGET Using only IPM1H04A and IPM1H04B
All plots show fitted X & Y position & Angle from X PZT in row 1, and the same from Y PZT in row 2 in μm.
Spreads of fit are shown in green



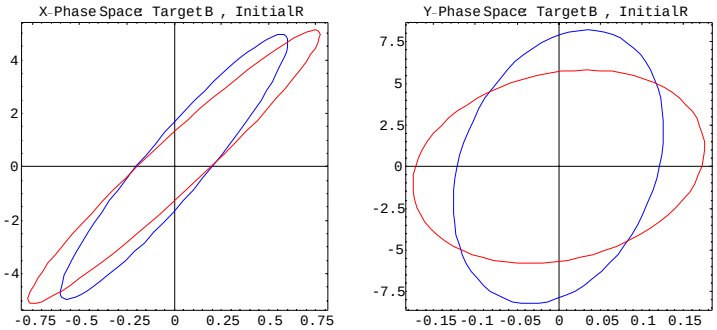
We need to come up with an OPS procedure complete with working tools, such that this process can be run by OPS like the 30 hz CS matching.

Development/Testing before March to Meet this Demand

Automatch for PZT

We have all the ingredients for this. Need to put all empirical processes together

	Design Input Twiss	Empirical Input Twiss
Design Transport	**Lattice design tools**	**BPAM**
Empirical Transport	**OTAM** **30 hz CS** **RayTrace**	**Matching PZT from 60 MeV to** • **NL** • **Arc 1/2** • **Hall A/C**



2003 Measurement of 60 MeV to 3 GeV Transport

Algorithm/Software: Chao One week
MD beam based: 8 hours plus possible 4-hour iteration

PZT Booster

This frees us from multiple constraints under which we must operate now; it also promises much better signal quality and robustness.

Hardware: Helicity magnets driven by 30 hz generator / Synchronization with 30 hz BPM's: ???
Algorithm/Software: Two FTE weeks ???
Software testing: 1 hour
MD beam based: 6 hours plus possible 2 hour iteration.
Detail to be worked out (Grames, Spata, Chao, ……)

An OPS procedure needs be developed shortly after these are successfully tested.

Less-Critical Tasks

Modularized Injector Coupling Correction

Current scheme seems to do the job

Algorithm: Chao Two weeks
MD beam based: 4 hours without verification. 8 hours with verification.

Resolve Signal Latency Issue with Averaged CW PZT Zoom Signal

No longer care if we have PZT Booster

Task: ???
MD beam based: ???

Correlate PZT Transport Changes with Changes in Machine State

Have daily information and baseline mug shots. Need to mine machine/operation data.
Not extremely urgent if more efficient Injector matching tools/procedures are available.

Example: Capture phase/Amplitude affects transport considerably (Parmela by Zhang; observed in the machine by Spata)

Task: ???
MD beam based: ???

Measure Transport in Main Accelerator

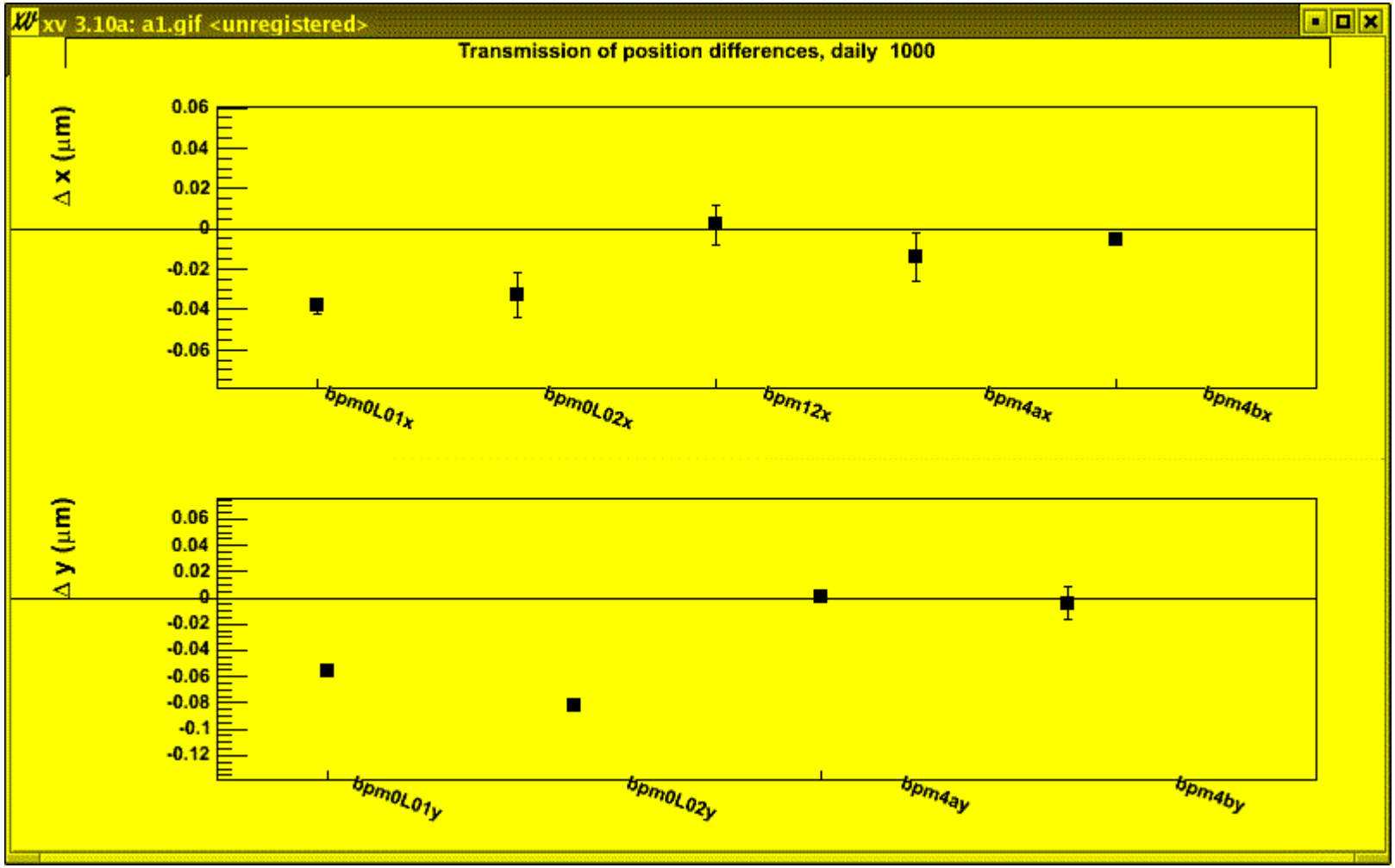
Do not really expect surprises
2003 example:

Damping of phase space area 0R-3C (all SQRT**)**

Theoretical	X measured	Y measured	4 X 4 measured
0.137656	**0.137271**	**0.138735**	**0.136716**

Amplitude mismatch 0R-3C: (all SQRT**)**

Theoretical	X Max. CS	Y Max. CS
1	**1.476**	**1.418**


xv 3.10a: a1.gif <unregistered>
Transmission of position differences, daily 1000
Δ x (μm)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
bpm0L01x
bpm0L02x
bpm12x
bpm4ax
bpm4bx
Δ y (μm)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
bpm0L01y
bpm0L02y
bpm4ay
bpm4by