

Roll Measurements of Tevatron Dipoles and Quadrupoles

James T Volk
L Elementi, K Gollwitzer, H. Jostlein, V
Shiltsev, R Stefanski
Fermilab

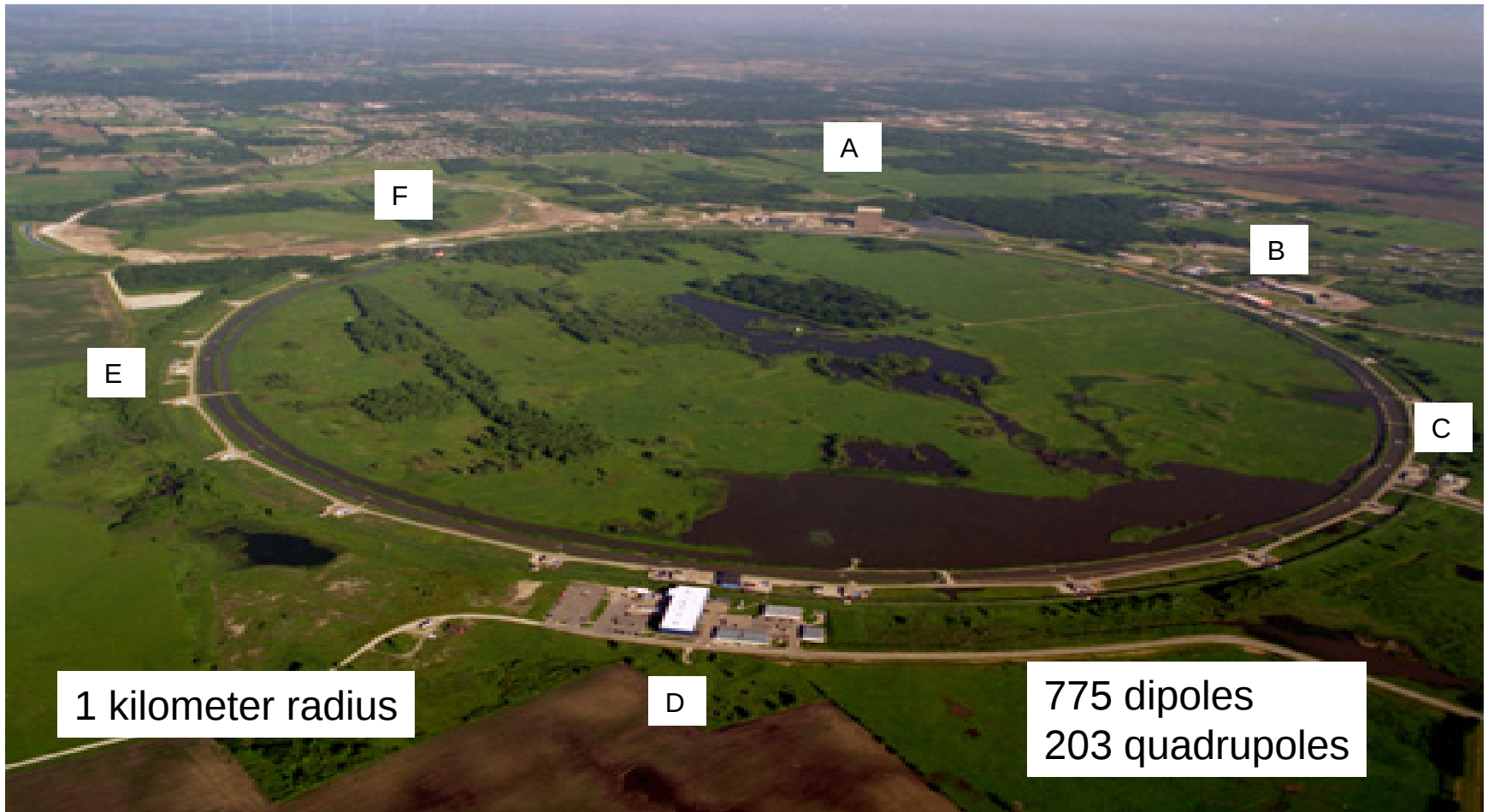
The Tevatron in 2003

- Luminosity was below expectations
- Multiple problems in entire accelerator complex
- Tevatron corrector magnets all running near maximum values
- Horizontal and vertical coupling observed

Problem and Solution

- One issue was alignment of Tevatron
- Need to rapidly check rolls of all dipoles and quadrupoles
- Limited access time did not allow for conventional survey magnets
- Develop a simple method to check rolls

The Tevatron Looking North West



Sept 2006

James T Volk Fermilab

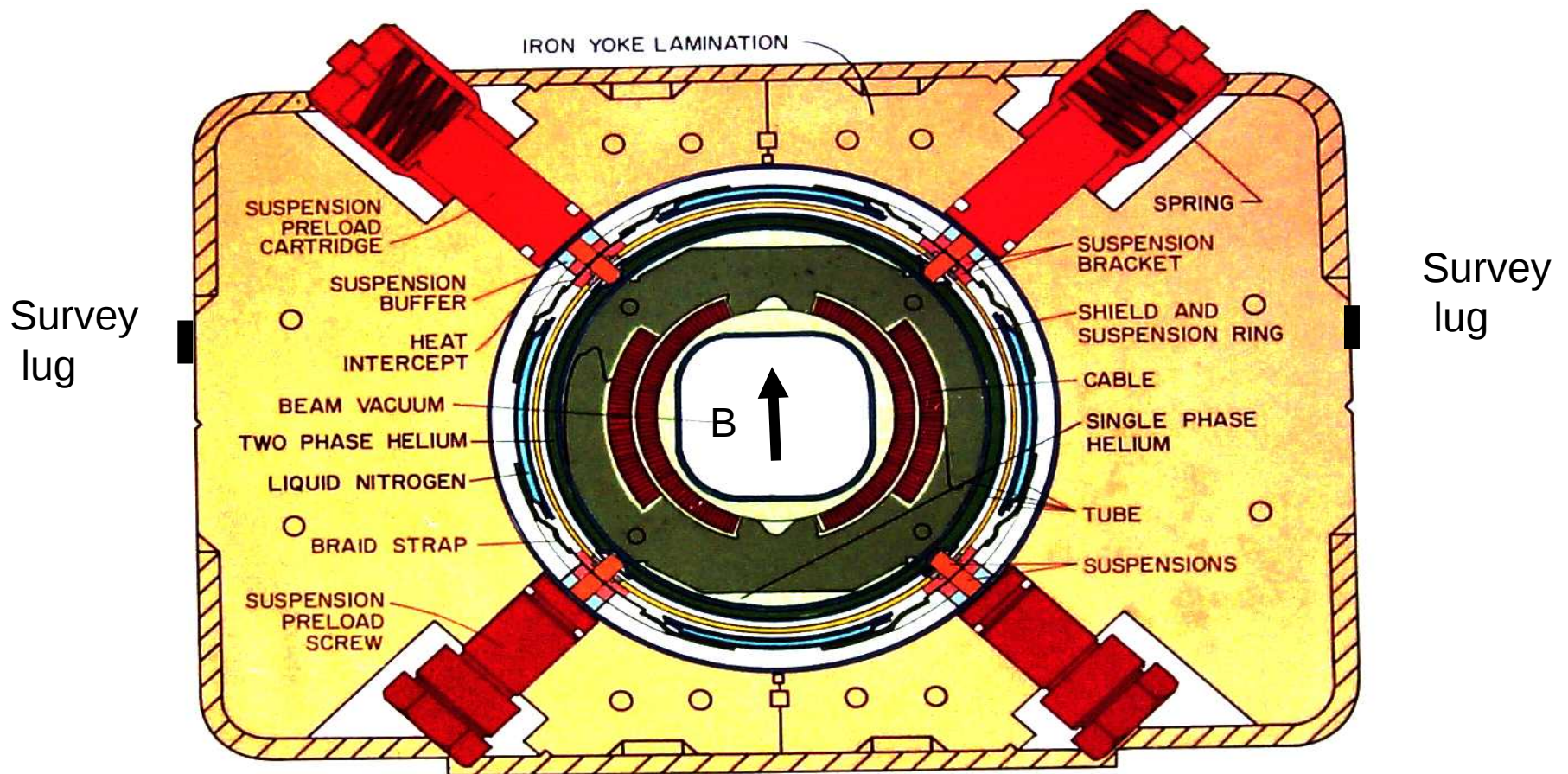
Rusted Stand



Sept 2006

James T Volk Fermilab

Cross section of Tevatron Dipole



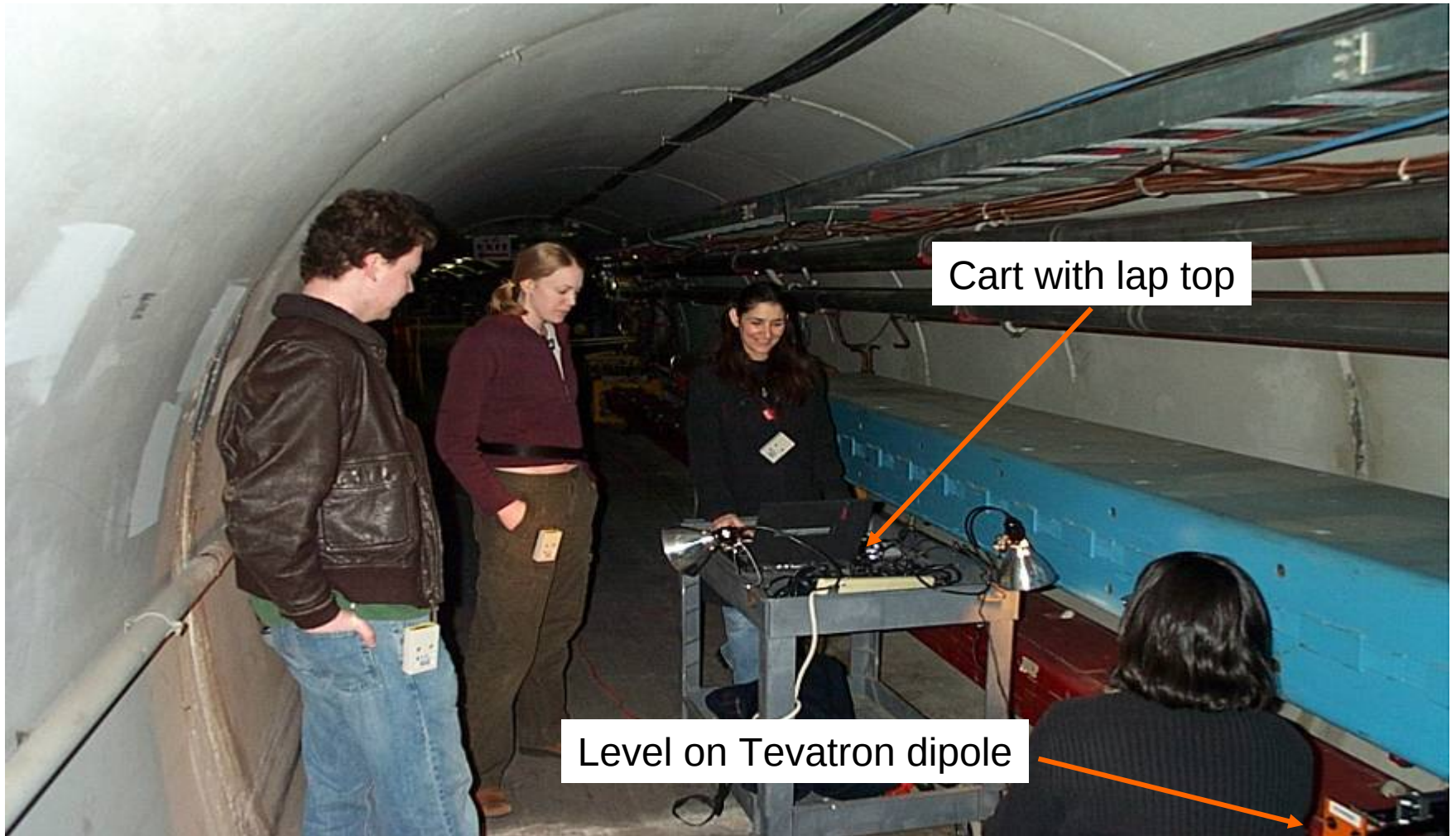
Tevatron Magnet Roll Fixture



Sept 2006

James T Volk Fermilab

Roll measurement equipment



Sept 2006

James T Volk Fermilab

Digital level on Tevatron Dipole



Sept 2006

James T Volk Fermilab

Operator Name

Jim Volk



CONTINUE


Magnet Roll Measuring System

Tunnel Position:

N9901F

A-10-4

0.000

0.000

0.000

[illegible]

Now Measure:

N9901F at A-10-4

OK

SKIP

SELECT STARTING MAGNET

STOP



Ready to measure N9901F at A-10-4

STOP!

Ready to measure N9901F at A-10-4

STOP!

N9901F at A-10-4

UpStream Ave = 0.000 mrad

DwnStrm Ave = 0.000 mrad

Any Comments?

REMEASURE

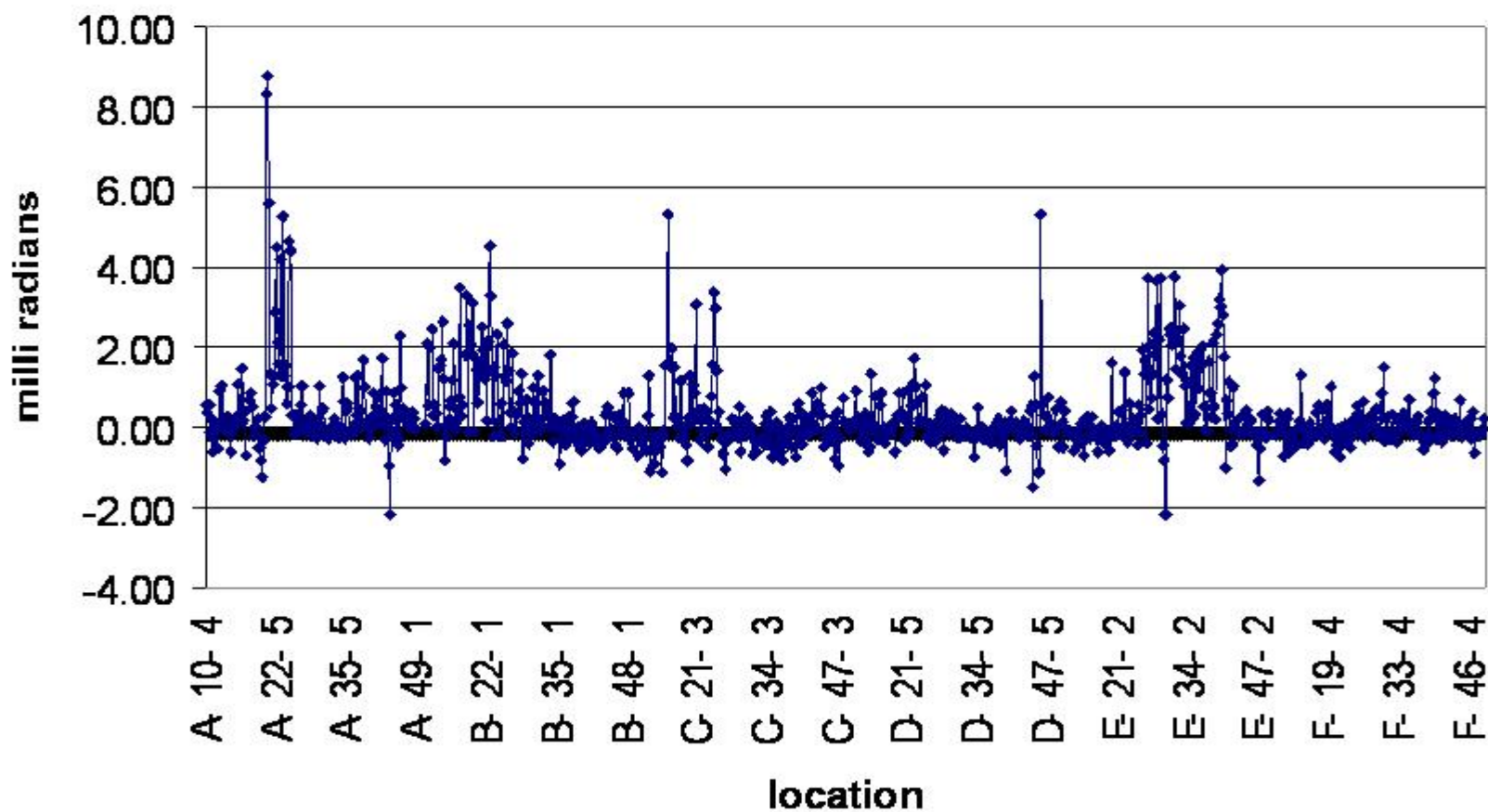
ACCEPT

STOP

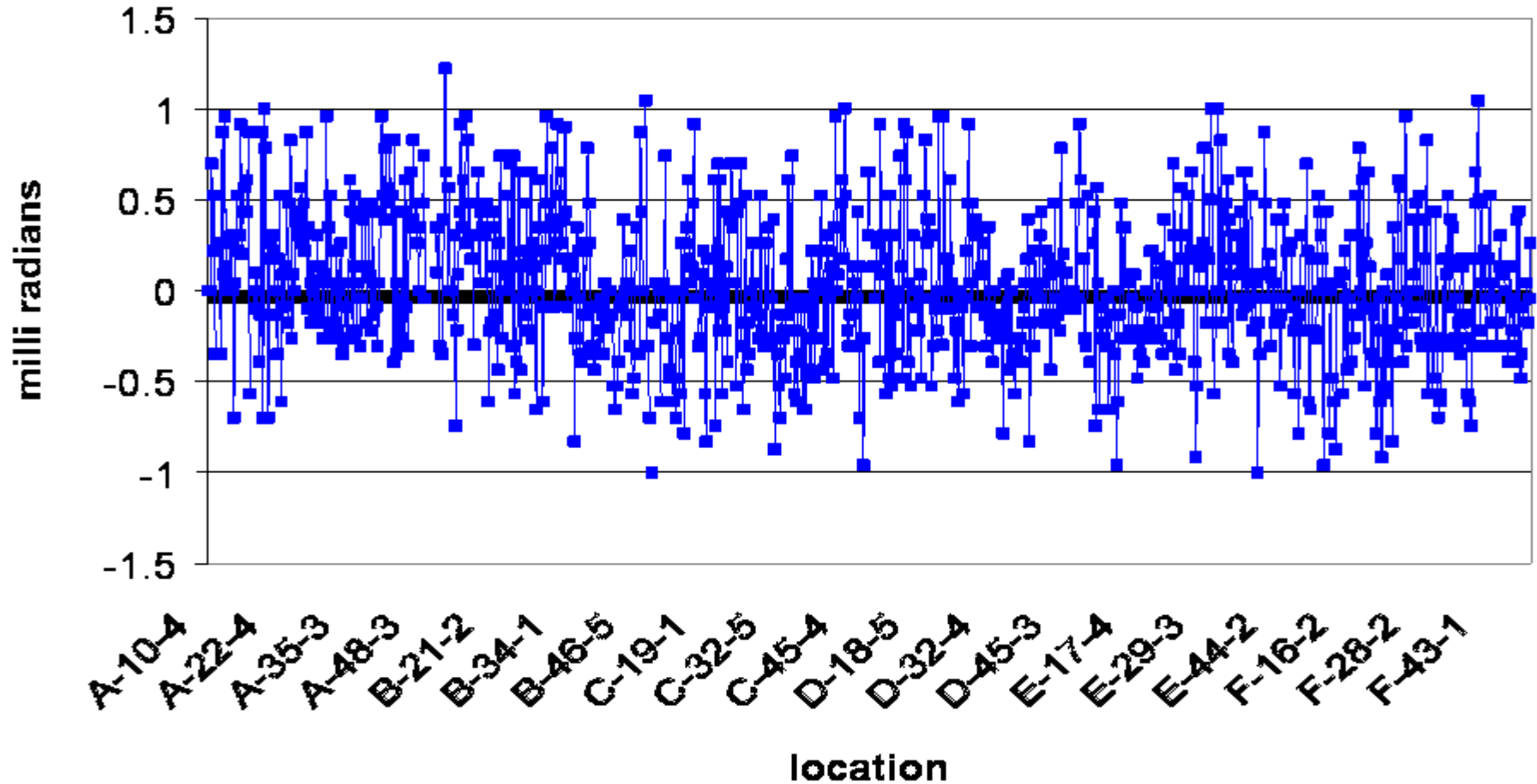
Data in EXCEL Spread Sheet

Magnet Name	Position	Time	Upstream Forward	Upstream Reverse	Tilt ave Mr	Downstream Forward	Downstream Reverse	Tilt ave mr	Total Ave mr	Operator-Comments
TB0689	A-11-2	8:44:51 AM	0.175	-1.047	0.611	0.349	-0.698	0.524	0.567	
TB0934	A-11-3	8:46:35 AM	-0.175	-0.873	0.349	-0.349	0.000	-0.175	0.087	
TC0385	A-11-4	8:48:08 AM	0.000	-0.698	0.349	0.175	-1.222	0.698	0.524	
TB1092	A-11-5	8:49:29 AM	-0.524	-0.524	0.000	-0.873	-0.349	-0.262	-0.131	
V2504D	A-12-1	11:21:33 AM	-0.175	0.698	-0.436	0.698	0.698	0.000	-0.218	No downstream measurement.
TB1120	A-12-2	11:23:49 AM	0.000	-0.349	0.175	0.000	0.000	0.000	0.087	
TB0367	A-12-3	11:25:47 AM	0.000	-0.349	0.175	0.349	-0.349	0.349	0.262	
TC0536	A-12-4	11:28:04 AM	-0.524	0.524	-0.524	-0.524	0.698	-0.611	-0.567	
TC0521	A-12-5				-0.15			0.08	-0.350	corrected
TQ059F	A-13-1	11:34:25 AM	1.047	-0.349	0.698	-0.175	0.698	-0.436	0.131	
TC0783	A-13-2	11:36:21 AM	0.873	-0.698	0.785	0.524	-0.524	0.524	0.654	
TC0411	A-13-3	11:37:41 AM	0.000	-0.175	0.087	-0.698	0.524	-0.611	-0.262	
TB0346	A-13-4	11:39:32 AM	0.000	0.000	0.000	-0.524	0.349	-0.436	-0.218	
TB0321	A-13-5	11:41:56 AM	0.524	0.000	0.262	-0.349	0.349	-0.349	-0.044	
TQ146D	A-14-1	11:44:11 AM	-0.349	0.349	-0.349	0.175	0.175	0.000	-0.175	
TB1109	A-14-2	11:45:56 AM	1.047	-0.698	0.873	-0.524	0.698	-0.611	0.131	
TB0549	A-14-3	11:47:20 AM	-0.349	0.000	-0.175	0.000	0.349	-0.175	-0.175	
TC0490	A-14-4	11:48:50 AM	-1.222	0.524	-0.873	-0.349	0.698	-0.524	-0.698	
TC0529	A-14-5	11:50:37 AM	-0.175	0.524	-0.349	0.175	0.000	0.087	-0.131	
TQ027F	A-15-1	11:52:38 AM	0.698	-0.698	0.698	1.047	-1.222	1.134	0.916	
TC0527	A-15-2				-0.390			0.150	-0.120	corrected
TC0483	A-15-3	11:56:43 AM	0.698	-1.047	0.873	1.047	1.396	-0.175	0.349	

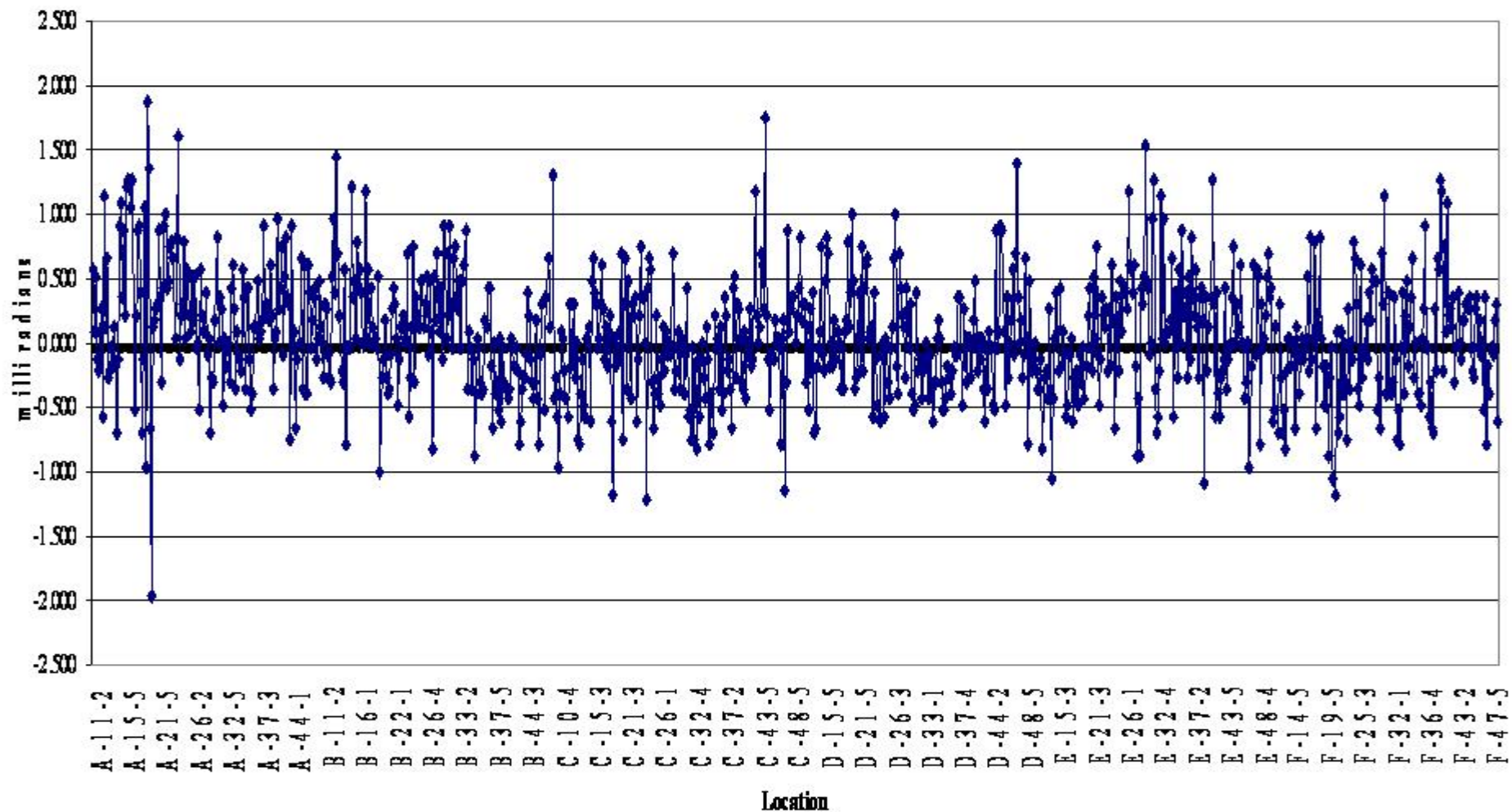
Roll Measurements October 2003 all magnets



Roll Measurements November 2004 all magnets



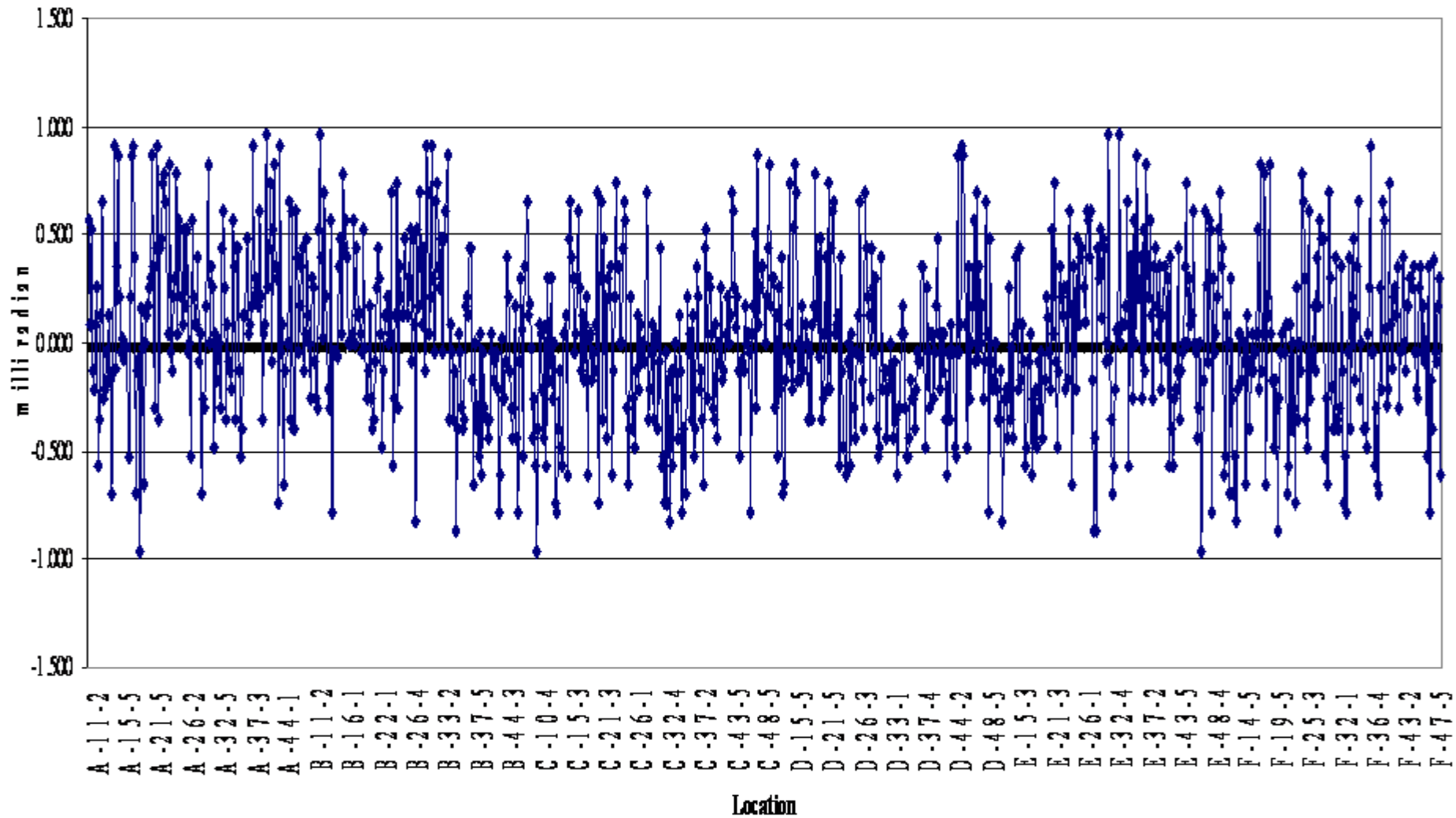
Roll as measured March 06



Sept 2006

James T Volk Fermilab

Corrected Roll dipoles and quads



Conclusions

- Magnets move due to ground motion and other cultural factors
- We have developed a fast and simple method to check rolls of dipoles and quadrupoles
- In 3 days 775 dipoles and 203 quadrupoles can be checked
- Reduced coupling in the Tevatron and allowed for higher luminosity