The Effect of Reshimming of the Tevatron Dipoles (Fall, 2004) to Correct the a_1 Moment on the Calculated Skew Quadrupole Correctors.
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A program to reshim Tevatron dipoles resulted from the realization that the observed coupling in the Tevatron was primarily due the a_1 (skew quadrupole) moment of the dipoles. The large value of a_1 is the result of the movement of the coil within the magnet after the magnet had been shimmed during production. The coils moved relative to the magnet yoke due to the relaxation of the G11 supports. This movement resulted in the addition of ≈ 1.4 units to the a_1 moment. The reshimming was undertaken to correct this problem.

In a note last summer (**BD-1249**) I attempted to calculate the currents in the skew quadrupole correctors after the repairs done up to two different dates. The calculated skew quadrupole currents are determined by minimizing the tune split. Since then 412 more dipoles have been reshimmed. I have repeated the calculations, described in **BD-1249**, taking into account the newly reshimmed magnets.

The only skew quadrupole circuits varied in the minimization of the tune split were the **sq** and **sqa0** circuits. The other skew circuits were left at the values found in the fits described in **BD-1249**. Good solutions were found. The results for the currents in the skew correctors **sq** and **sqa0** are shown in Table I. The previously calculated values are also shown for comparison.

Table I
Fitted Values of the Parameters- Injection Optics 150 Gev.
After Various Numbers of Magnets Have Been Reshimmed.[1]

	Fitted Values (A)			
Parameter	**No reshim**	**Step 1**	**Step 2**	**Step 3**
sq	**2.72**	**2.41**	**2.41**	**0.85**
sqa0	**-3.66**	**-2.22**	**-2.60**	**-0.97**

As can be seen from the calculation, we expect a significant reduction in the currents in the skew quadrupole currents resulting from the last reshimming. The first and second reshims were intended to reduce the current in the **sqa0** circuit and they had the desired effect. The last reshimming was intended to reduce the current in the **sq** circuit and we see that the current in this circuit was reduced by, almost, a factor of three. As a desirable, and not unexpected, byproduct the current in **sqa0** was also reduced, in this case by nearly the same factor.

In addition to the reduction in the currents in the skew quadrupoles, there is also a reduction in the calculated vertical dispersion, as can be seen by comparing Figure 1 with Figure 2. Not only has the maximum vertical dispersion been reduced by approximately a factor of 2, but the distribution is more uniform around the ring.

It is very clear that the reshimming of the dipoles should significantly reduce the coupling in the Tevatron, as well as the currents in the correctors. The rest of the dipoles should be reshimmed as soon as possible.

[1] After step 1 106 dipoles had been reshimmed. At the end of April 2004 (step 2) a total of 118 magnets had been reshimmed. At present 530 of the 776 cold dipoles in the tunnel have been reshimmed.

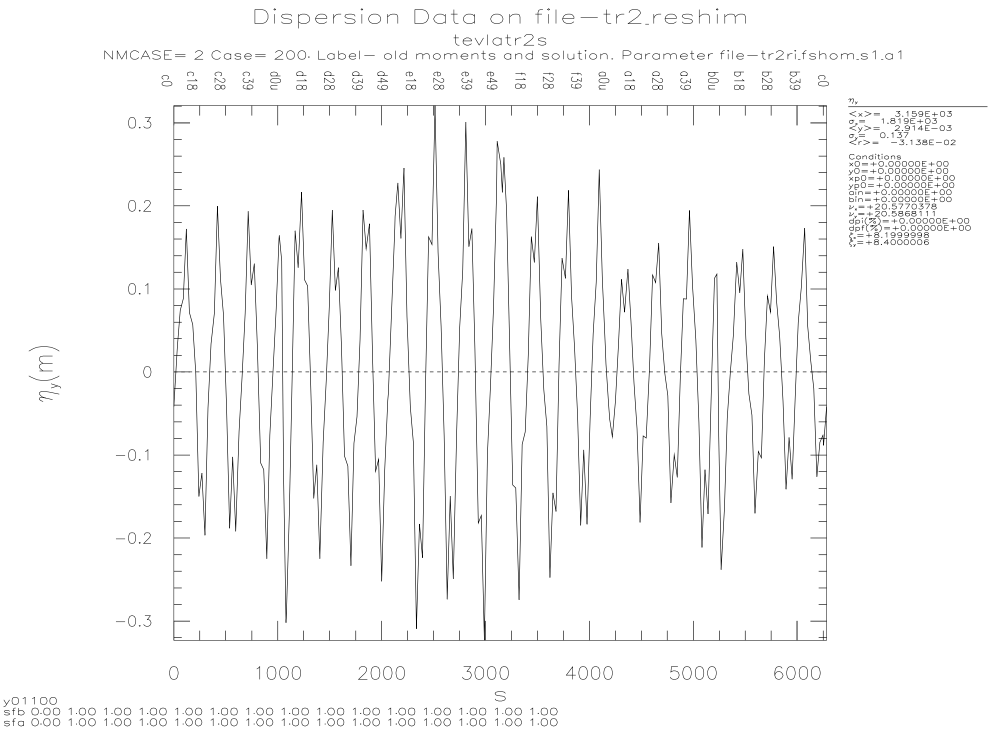

Figure 1: Calculated Vertical Dispersion Before the Reshim in 9-11/2004.

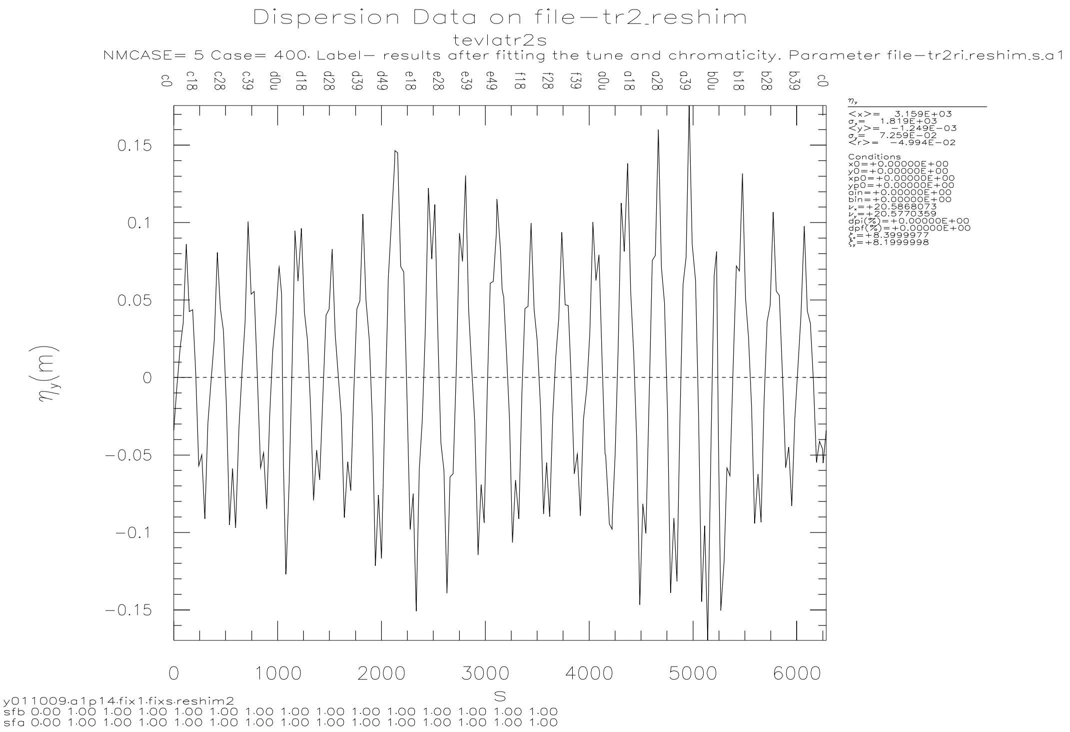

Figure 2: Calculated Vertical Dispersion After the Reshim in 9-11/2004.