

## Twisted Dipoles

S. Peggs

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Collider Accelerator Department  
**Brookhaven National Laboratory**

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## Twisted Dipoles

Recently, arc dipole magnets such as DRG516 have demonstrated as much as 8 mrad twist from one end to the other. How big can this angle,  $\phi$ , be?

An arc dipole has a length  $L \approx 10$  m, a bend angle  $\theta \approx 38$  mrad. Suppose that half of it is twisted by  $-\phi/2$ , and the other half by  $+\phi/2$ . Then this magnet induces a vertical dispersion step given by

$$|\Delta\eta_{\text{VERT}}| \simeq \theta \frac{L}{2} \frac{\phi}{2} \approx 0.1\phi \text{ [m]}$$

Replacing  $\phi$  by its rms value  $\sigma_\phi$ , adding randomly for  $N \approx 165$  dipoles, and ignoring a factor of 2

$$\langle \eta_V^2 \rangle^{\frac{1}{2}} \simeq \sqrt{N} 0.1 \sigma_\phi \simeq 1.3 \sigma_\phi \text{ [m]}$$

Adopting a conservative criterion that

$$\langle \eta_V^2 \rangle^{\frac{1}{2}} \leq 0.01 \text{ [m]}$$

gives

$$\sigma_\phi \leq 10 \text{ mrad}$$

1. This is fairly easy to achieve
2. This assumes that the average roll is accurately removed
3. The words “vertical dispersion” and the symbol “ $\eta_V$ ” can be everywhere replaced by “vertical closed orbit” and “ $y_{co}$ ”.