

**Physics 850: Soft Condensed Matter Physics, Fall04**  
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**Lecture 6: Adjustments to the freely-jointed chain model.**

Corrections to Ideal chain model

- 1) What is the random walk length?  
 (Kuhn length,  $b$ )

linear hydrocarbon polymers rotate by  
 alternation between trans & gauche  
 (Kleiman Fig 15.1)

Polyethylene:  
 C-C bond length  $\approx 1.5 \text{ \AA}$

Kuhn length,  $b \approx 14 \text{ \AA}$  because of correlations

DNA (double helix)

$b \approx 100 \text{ nm}$  (70x larger than PE)

- 2) Excluded volume: 2 chain segments cannot overlap

Result:  $\sqrt{\langle r^2 \rangle} = a \cdot N^{3/5}$  (not  $\frac{1}{2}$ , as in ideal model)

(Flory theory)

see Kleiman Fig. 15.1, showing trans and gauche conformations of polyethylene.

See homework #2 for a simplified 'derivation' of this result