Transport dynamics below the localization length in the 3-d. Anderson model

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3-d. Anderson Hamiltonian:

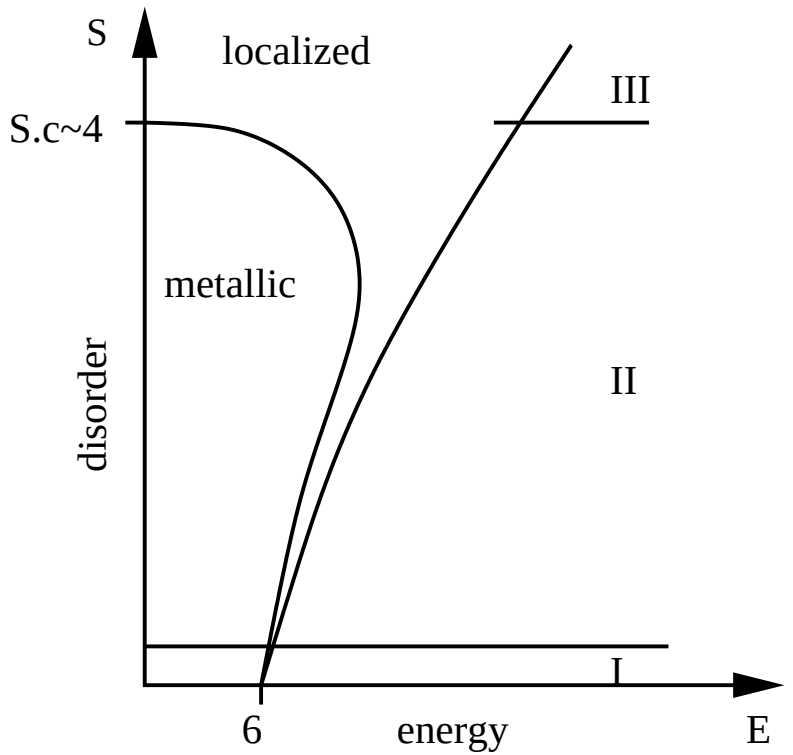
$$\hat{H}=\sum_{\mathbf{r}}\epsilon(\mathbf{r})\,\hat{a}^{\dagger}(\mathbf{r})\,\hat{a}(\mathbf{r})+\sum_{NN}\hat{a}^{\dagger}(\mathbf{r})\,\hat{a}(\mathbf{r}')+\text{h.c.}$$

$\epsilon(\mathbf{r})$: random numbers, $\sigma^2 = \langle\epsilon^2\rangle$

Transport dynamics below localization length?

Diffusive? Diffusion coefficient?

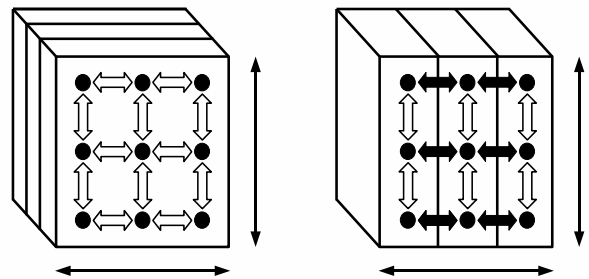
Different disorder regimes, different analyzation methods $\Rightarrow$



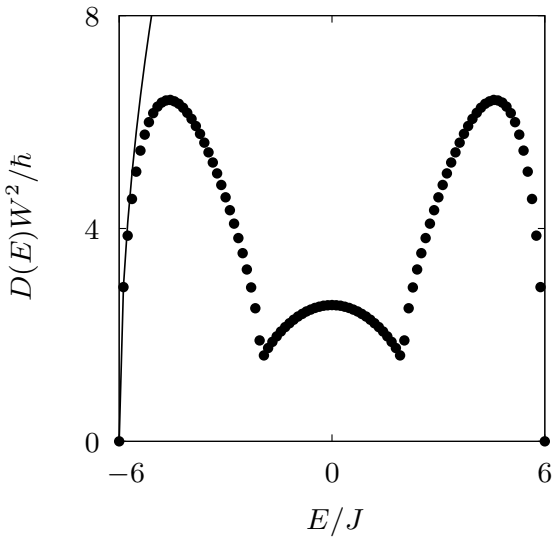
I: $\sigma << 1$: weak disorder, scattered lattice electrons, map onto Boltzmann equation

II: $\sigma \approx 1$: Diagonalize disconnected slabs, weak "inter-slab hopping", map onto discrete diffusion equation

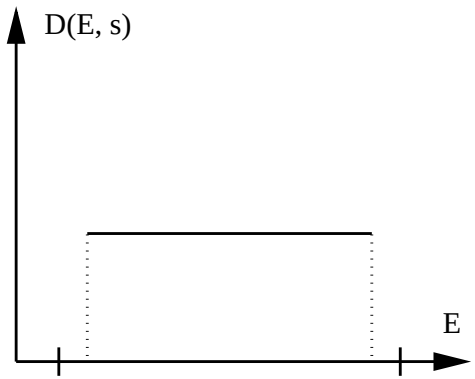
III: $\sigma > \sigma_c \approx 4$: no long range diffusion



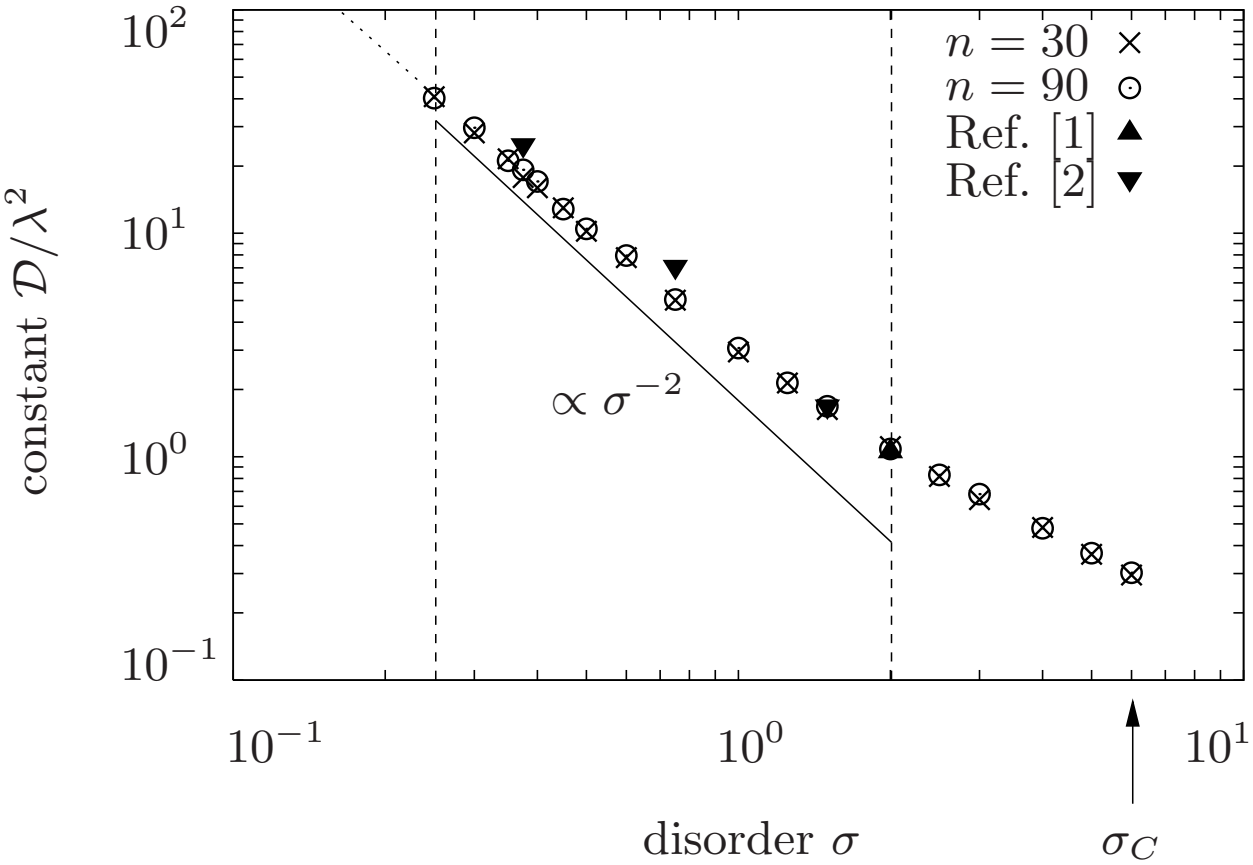
I: weak disorder



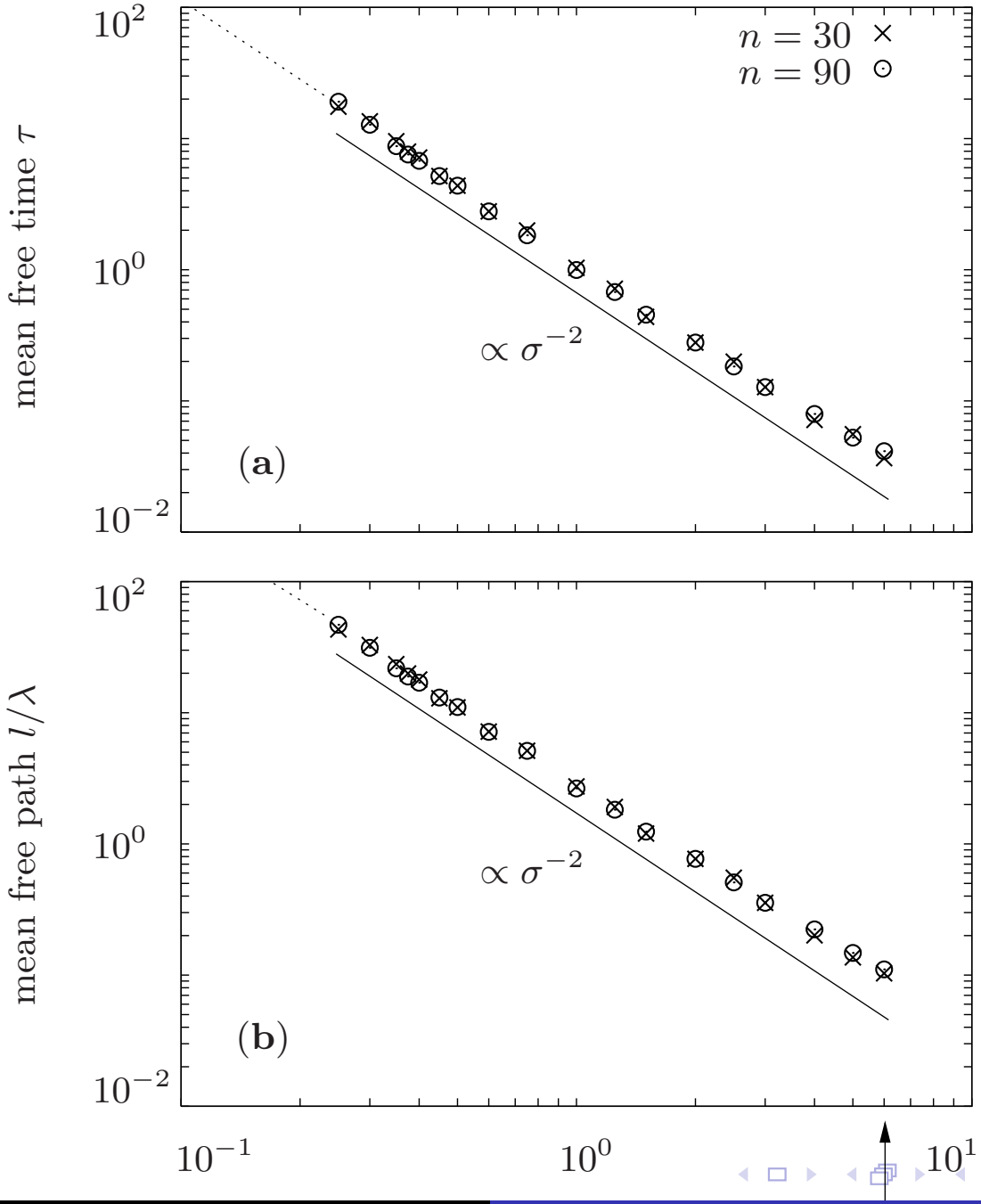
II: strong disorder



(mean) diffusion coeffient vs. disorder



Thank you for your attention !


10^2
10^0
10^{-2}
mean free time τ
$n = 30$ ×
$n = 90$ ⊙
$\propto \sigma^{-2}$
(a)
10^2
10^0
10^{-2}
mean free path l/λ
$\propto \sigma^{-2}$
(b)
10^{-1}
10^0
10^1