Quantum simulation of the Anderson Hamiltonian with an array of coupled nanoresonators: delocalization and thermalization

Marcos C. de Oliveira

University of Campinas

São Paulo - Brazil

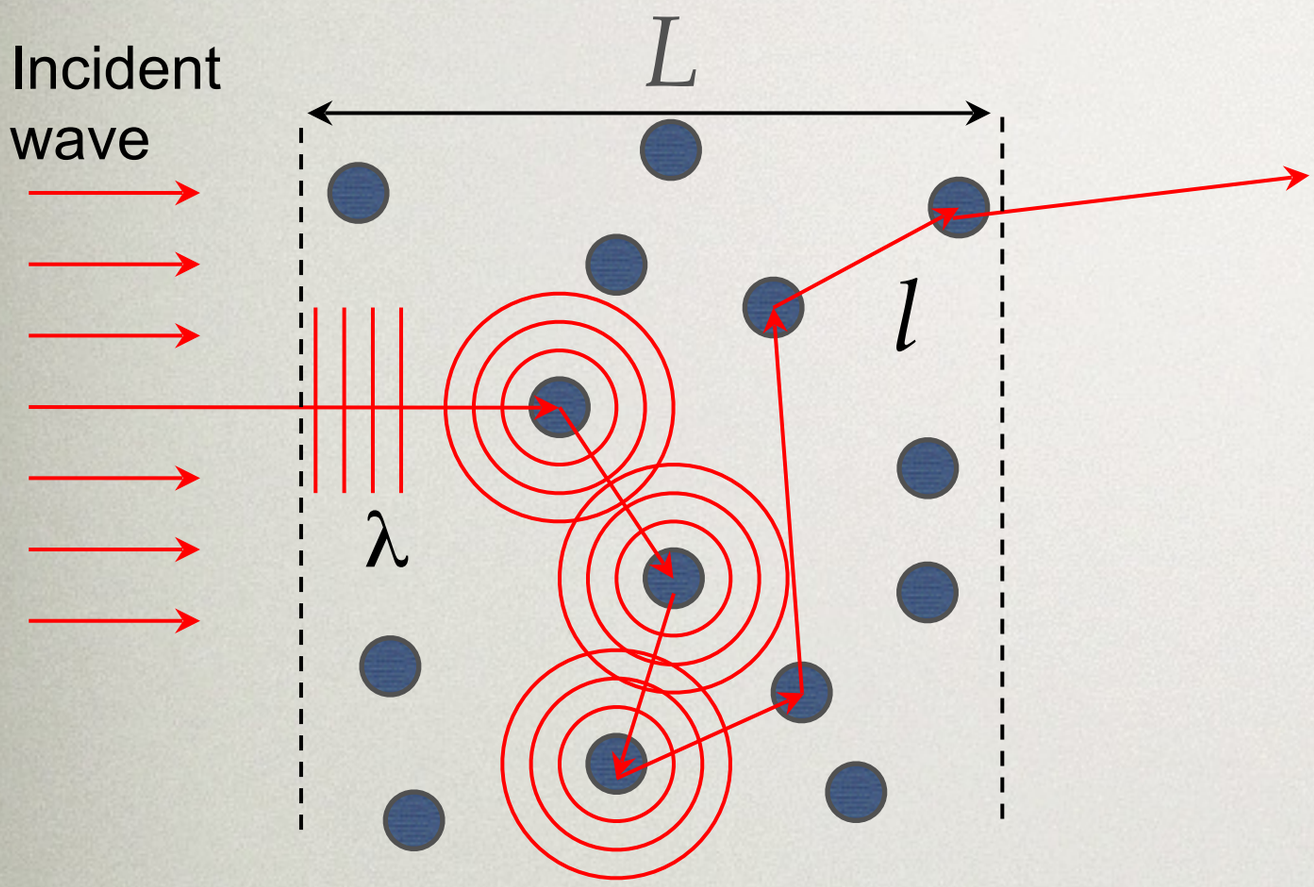
* In collaboration with J.Lozada-Vera, A. Carrillo, O. P. de Sá Neto, J. K. Moqadam (UNICAMP)

and M. D. LaHaye (Syracuse University)

WTPAQCQS - Trieste -24/08/2016

Anderson Localization

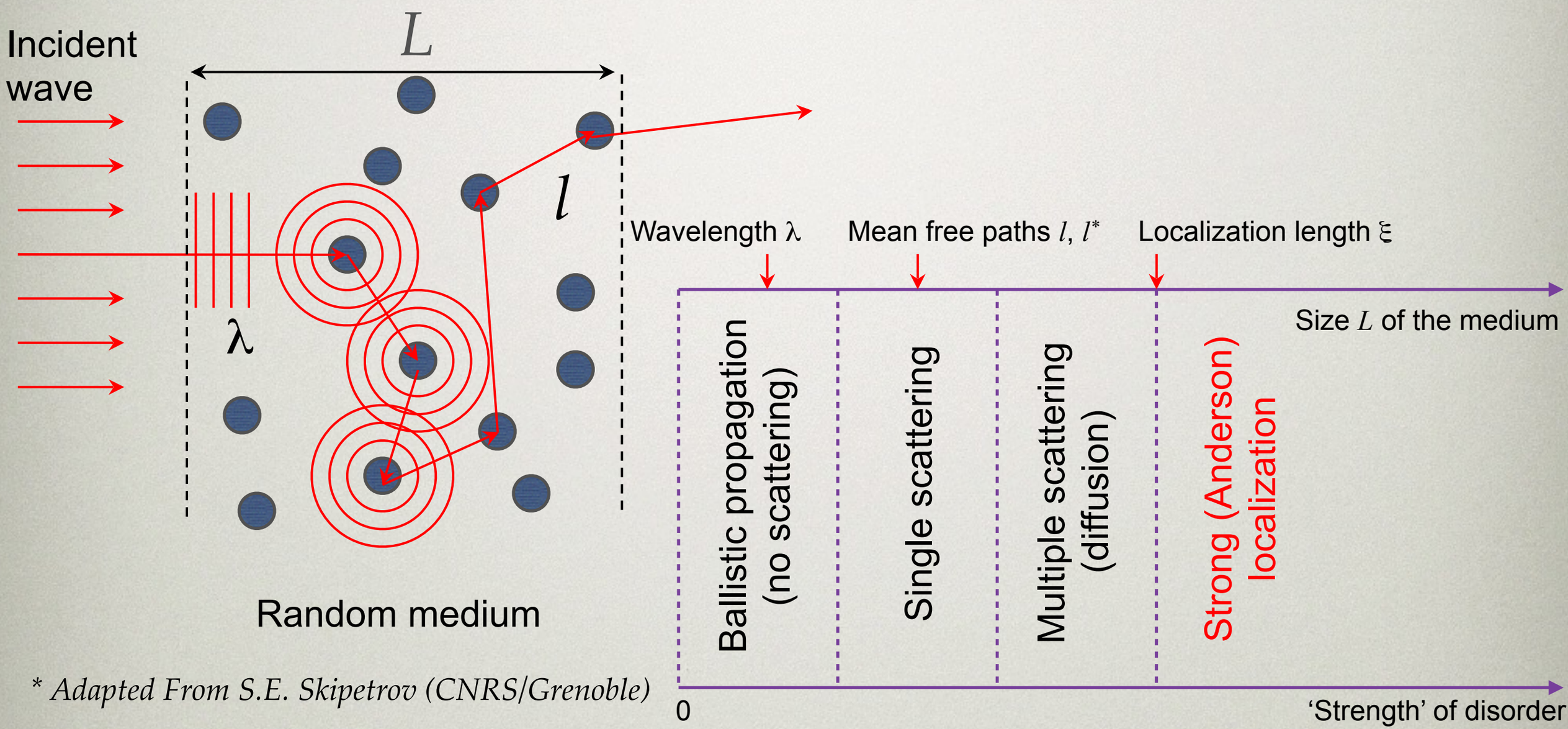
- Absence of diffusion of waves in a disordered medium.



Random medium

Anderson Localization

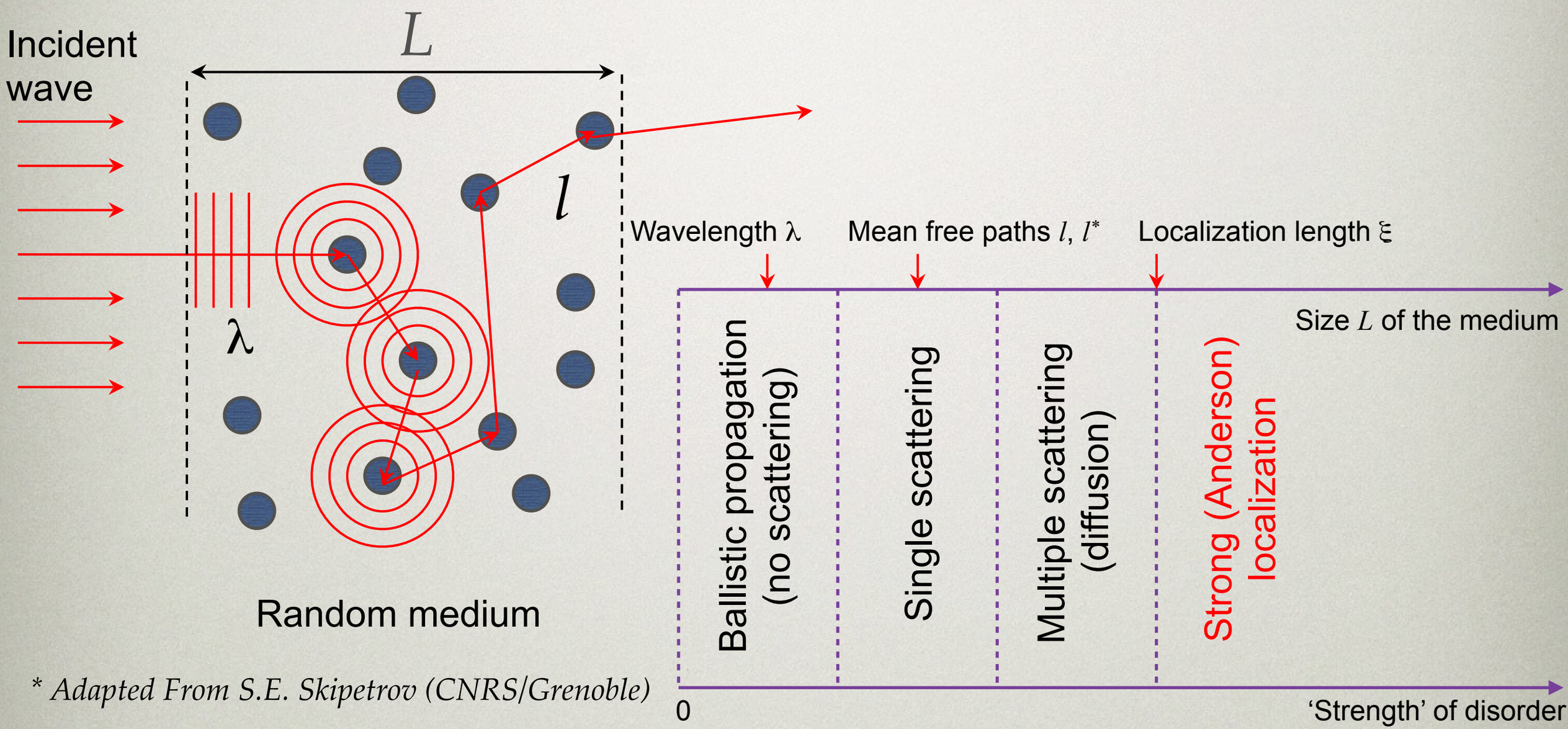
- Absence of diffusion of waves in a disordered medium.



* *Adapted From S.E. Skipetrov (CNRS/Grenoble)*

Anderson Localization

- Absence of diffusion of waves in a disordered medium.



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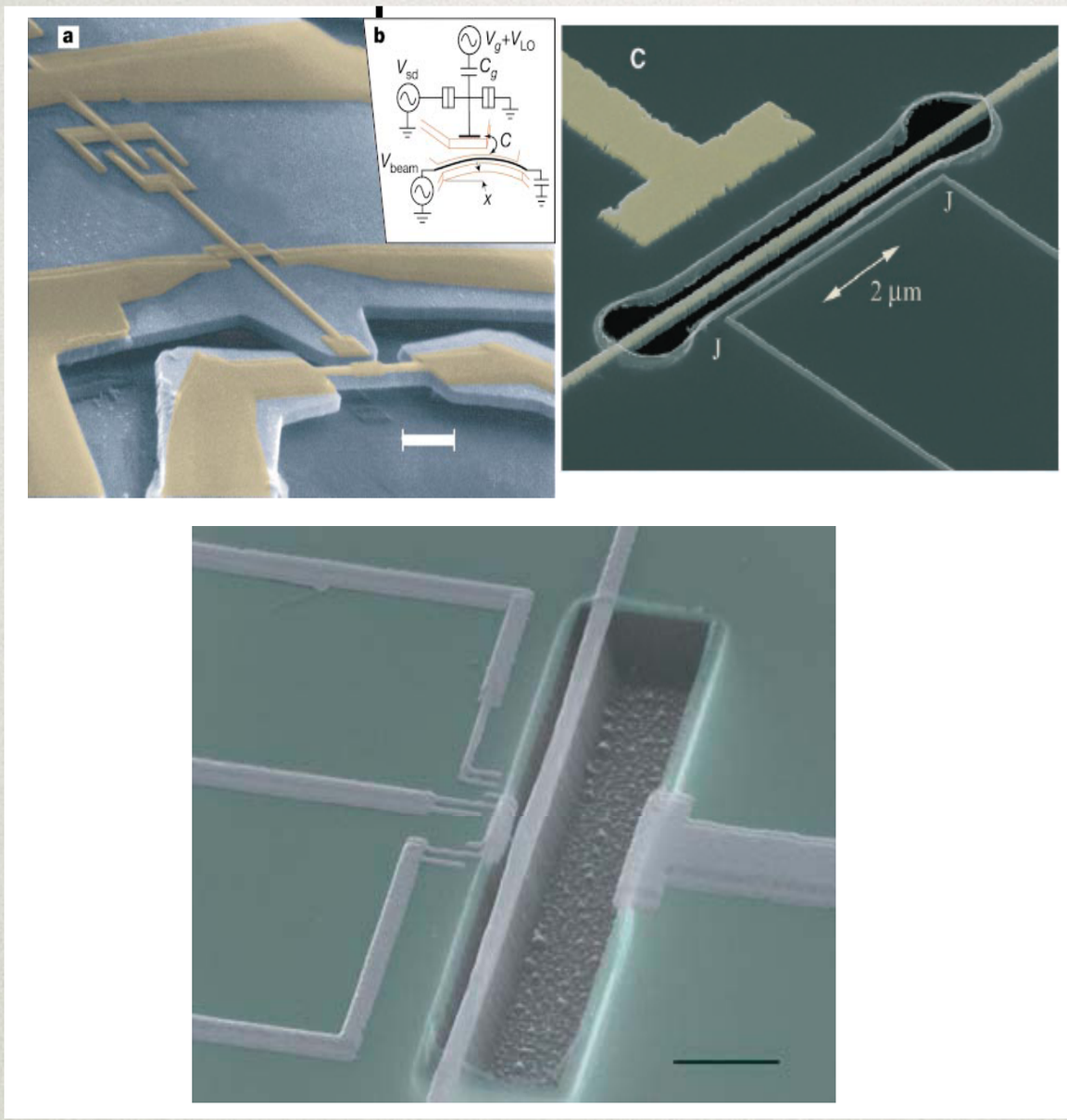
- Is a general wave phenomenon, applying to the transport of electromagnetic waves, acoustic waves, quantum waves, spin waves, etc. .

Electromechanical Resonators



$$\hbar\nu > k_B T$$

A. Gaidarzhy et al., PRL **94**, 030402 (2005); PRL **95**, 248902 (2005); K. C. Schwab et al., PRL **95**, 248901 (2005); R. L. Badzey and P. Mohanty, Nature (London) **437**, 995 (2005); W. K. Hensinger et al., PRA **72**, 041405(R) (2005); M. D. LaHaye et al., Science **304**, 74 (2004); X. M. H. Huang et al., Nature (London) **421**, 496 (2003); R. G. Knobel and A. N. Cleland, Nature (London) **424**, 291 (2003).

PHYSICAL REVIEW A **90**, 023843 (2014)

Capacitive coupling of two transmission line resonators mediated by the phonon number of a nanoelectromechanical oscillator

O. P. de Sá Neto,[1,2,*] M. C. de Oliveira,[2,†] F. Nicacio,[2] and G. J. Milburn[3]

[1]*Coordenação de Ciência da Computação, Universidade Estadual do Piauí, CEP 64202220 Parnaíba, Piauí, Brazil*

[2]*Instituto de Física Gleb Wataghin, Universidade Estadual de Campinas, 13083-970 Campinas, São Paulo, Brazil*

[3]*Centre of Excellence in Engineered Quantum Systems, University of Queensland, Queensland 4072, Brisbane, Australia*

(Received 6 May 2014; published 25 August 2014)

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PAPER

Temperature measurement and phonon number statistics of a nanoelectromechanical resonator

O P de Sá Neto[1,2], M C deOliveira[2] and G J Milburn[3]

[1] Coordenação de Ciência da Computação, Universidade Estadual do Piauí, CEP: 64202220, Parnaíba, Piauí, Brazil

[2] Instituto de Física 'Gleb Wataghin', Universidade Estadual de Campinas, 13083–970, Campinas, São Paulo, Brazil

[3] Centre for Engineered Quantum Systems, School of Mathematics and Physics., University of Queensland, QLD 4072, Brisbane, Australia

Lozada-Vera et al. *EPJ Quantum Technology* (2016) 3:9
DOI 10.1140/epjqt/s40507-016-0047-3

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Quantum simulation of the Anderson Hamiltonian with an array of coupled nanoresonators: delocalization and thermalization effects

John Lozada-Vera[1], Alejandro Carrillo[1], Olimpio P de Sá Neto[2], Jalil K Moqadam[1], Matthew D LaHaye[3] and Marcos C de Oliveira[1*]

Quantum Inf Process (2015) 14:3595–3611
DOI 10.1007/s11128-015-1079-9

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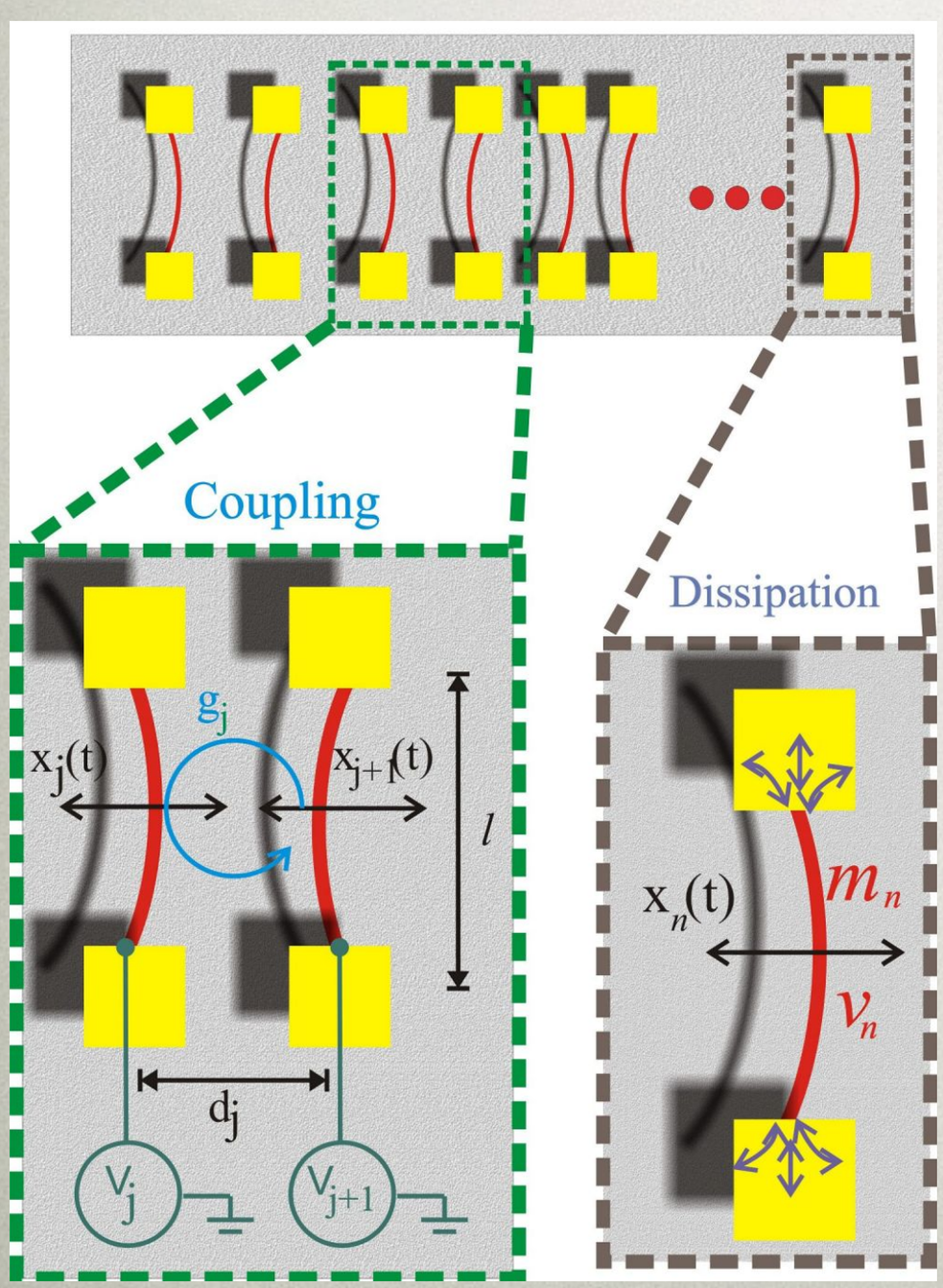
Quantum walks on a circle with optomechanical systems

Jalil Khatibi Moqadam[1,2] · Renato Portugal[1] · Marcos Cesar de Oliveira[3]

Array of Electromechanical Resonators



$$\mathcal{H} = \sum_{j=1}^{N} \hbar\omega_j a_j^\dagger a_j - \sum_{j=1}^{N-1} \hbar g_j (a_j^\dagger a_{j+1} + a_j a_{j+1}^\dagger)$$

ω_j randomly distributed over

$$[\overline{\omega} - \Delta, \overline{\omega} + \Delta]$$

Δ: disorder intensity

$$\Delta \ll \overline{\omega} \qquad \overline{\omega} \gg g_j \equiv J$$

Anderson tight-binding Hamiltonian: single excitation

$$\mathcal{H}_A = \sum_{j=1}^{N} \omega_j \left|j\right\rangle \left\langle j\right| + J(\left|j\right\rangle \left\langle j+1\right| + H.c.)$$

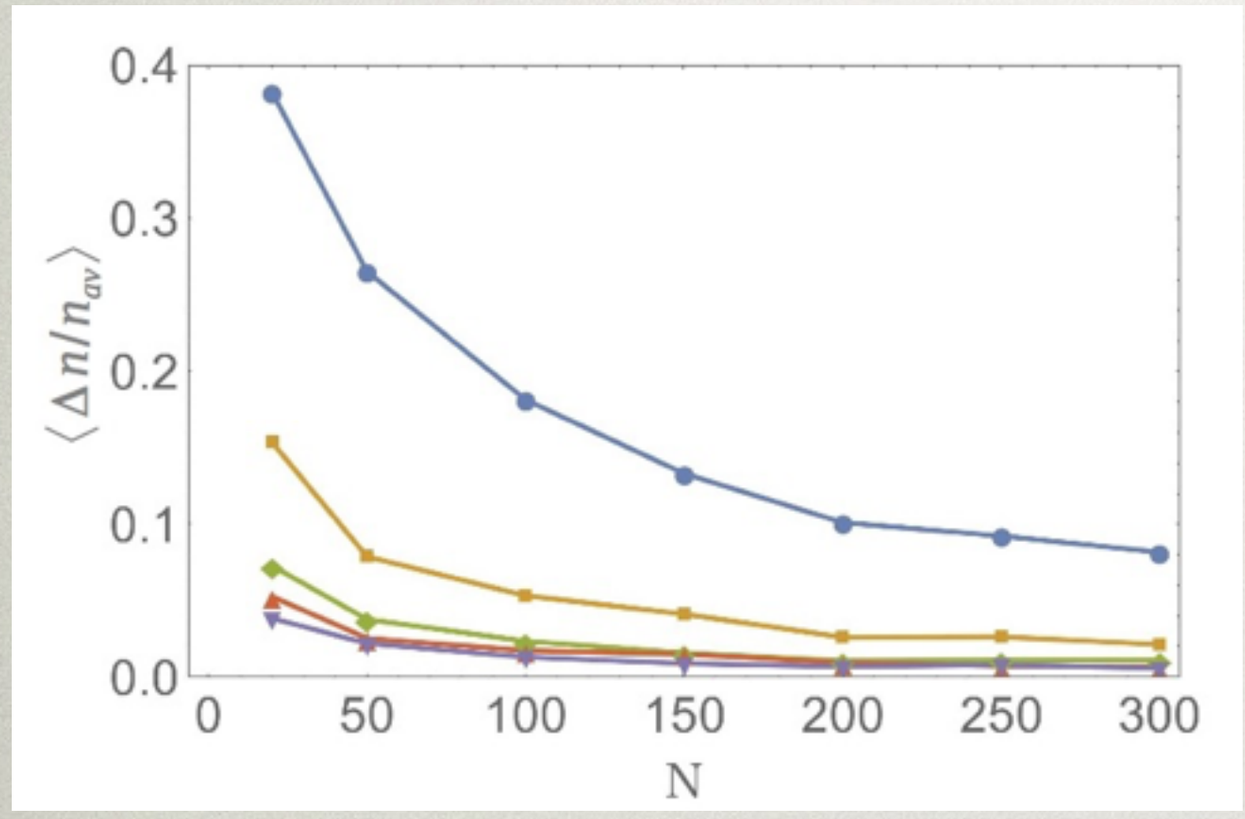
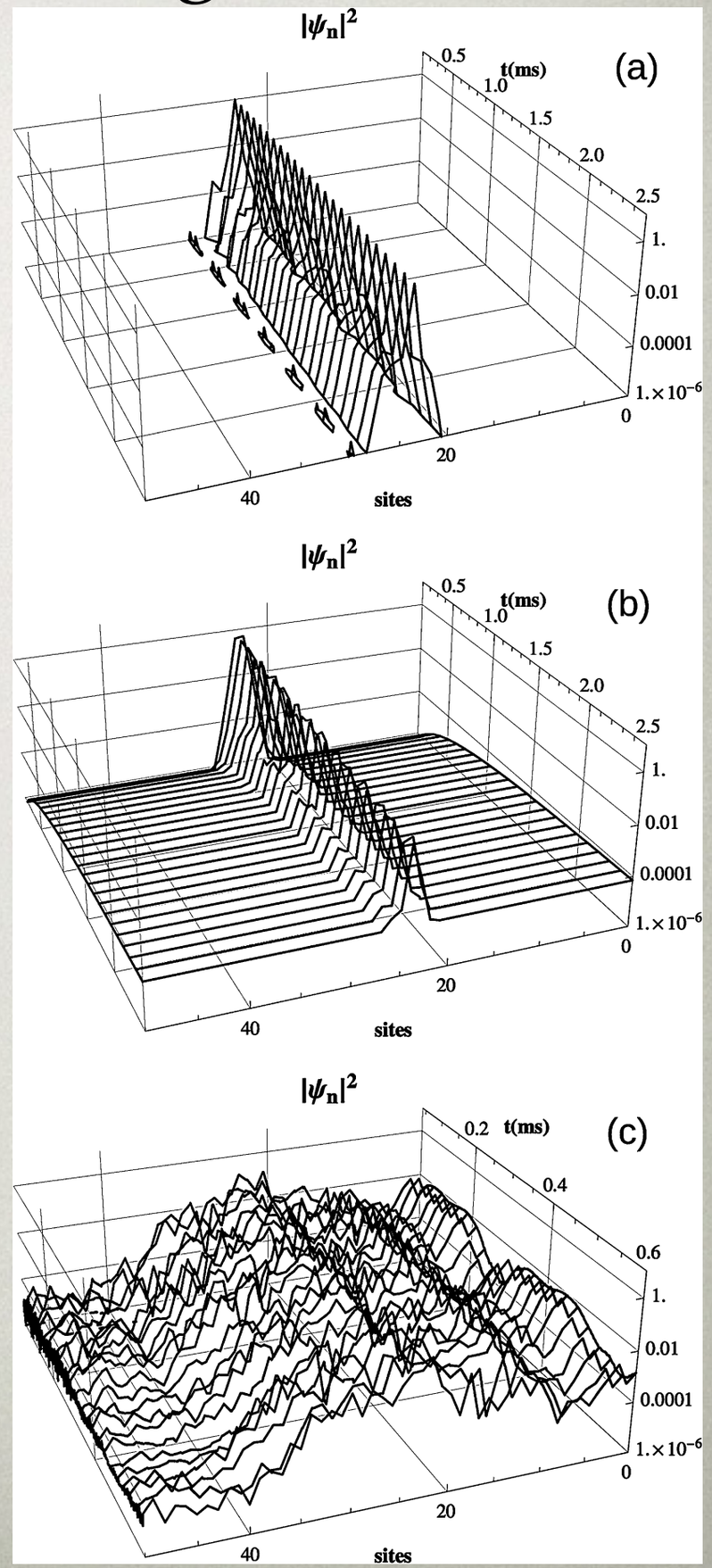
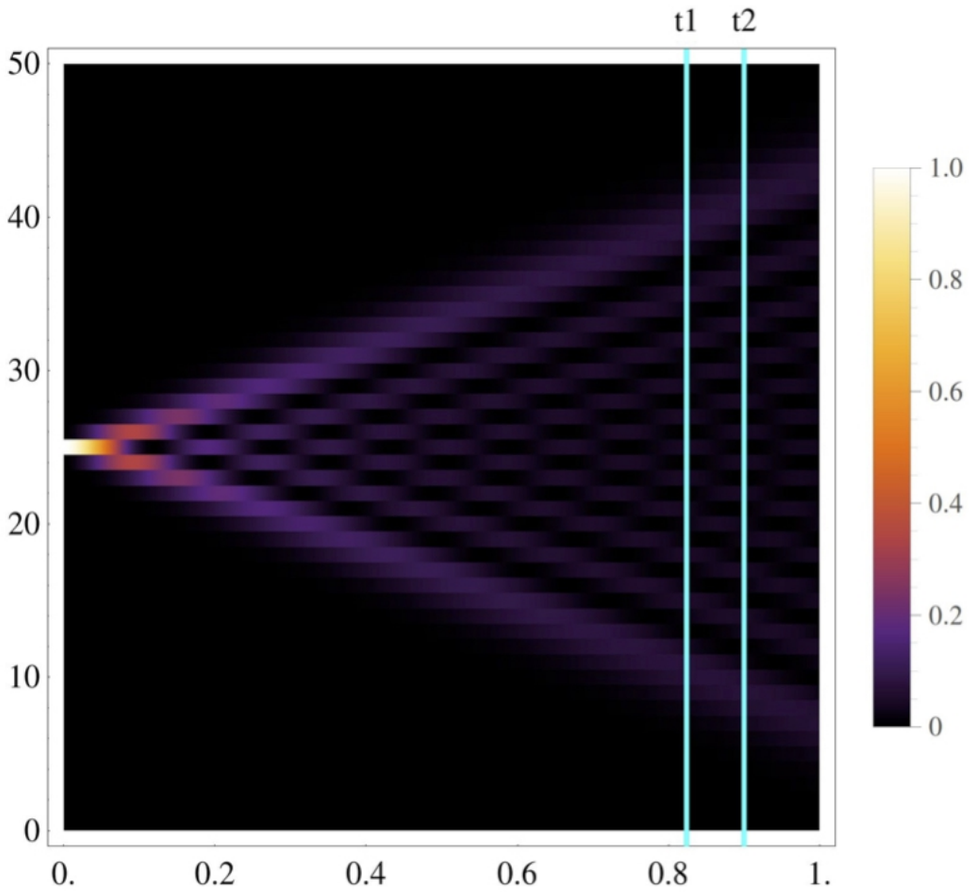
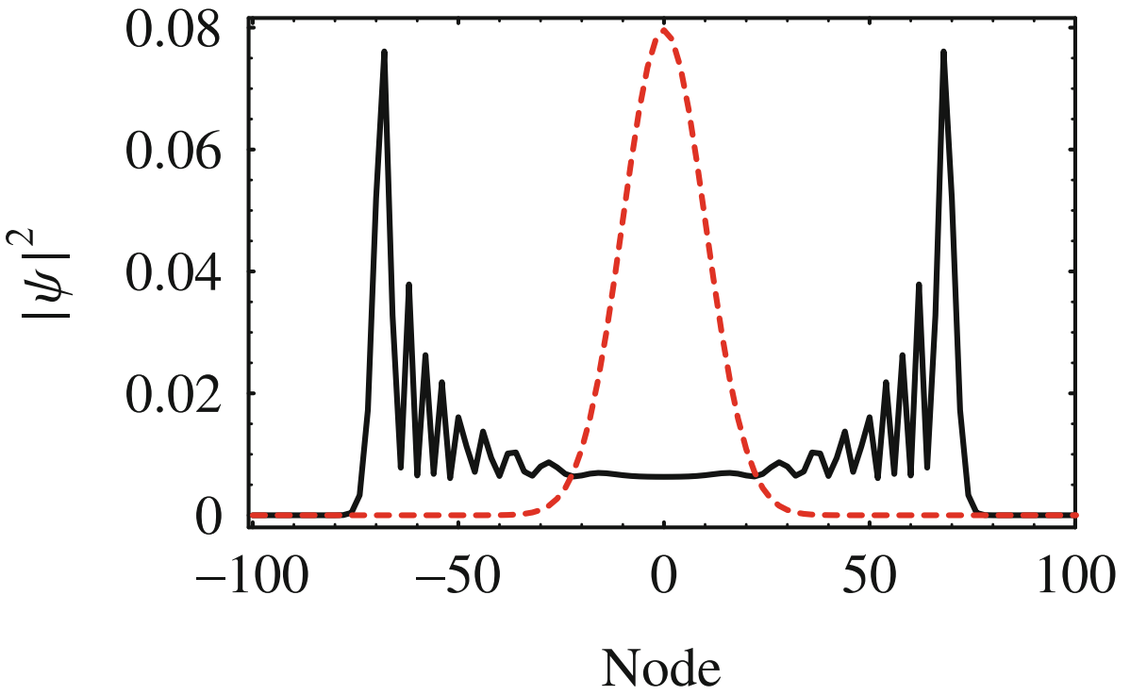


Figure 2 Population second moment. Average over 500 disorder realizations of the relative second moment in the population distribution $\Delta n/n_{\mathbf{av}}$ for the ground state of the Anderson Hamiltonian, as a function of the system size N and for different disorder intensities (from top to bottom $\Delta/J = 2, 5, 10, 15, 20$) showing the convergence of the dispersion of the population as the number of sites is increased.



Continuous Quantum walk

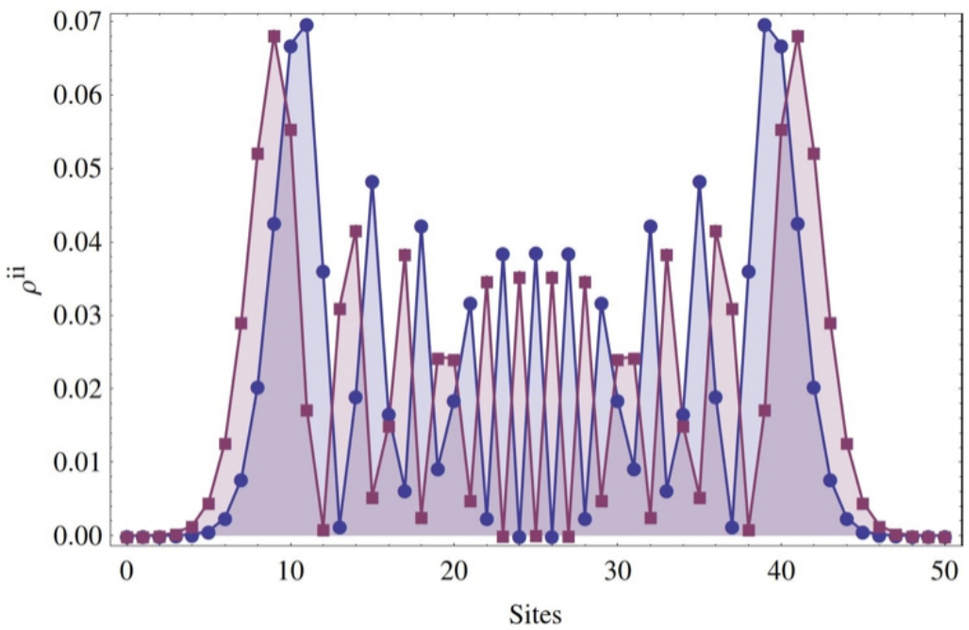


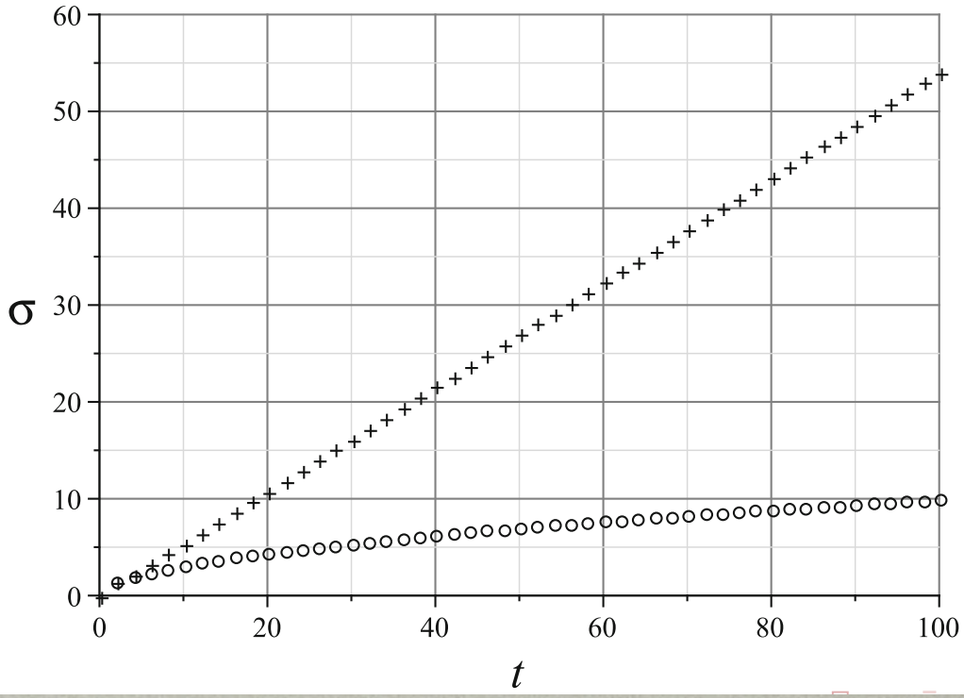


Standard deviation

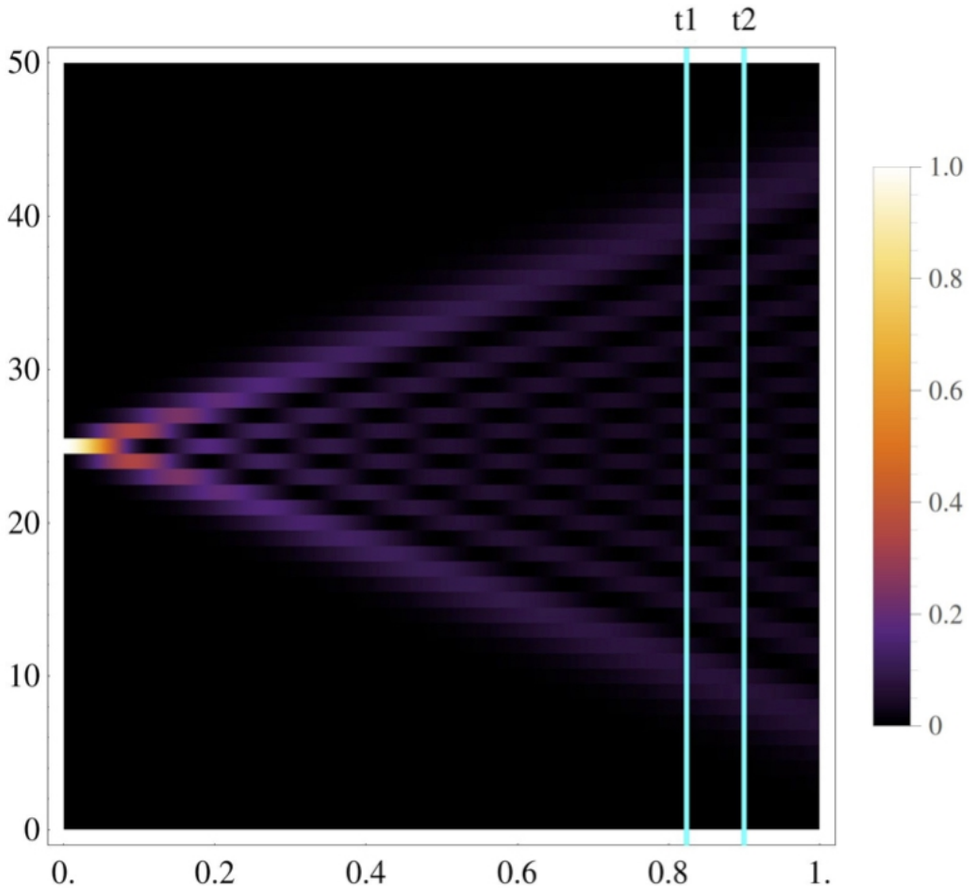
$\sigma_{\text{classical}} \sim \sqrt{t}$ (t: number of steps)

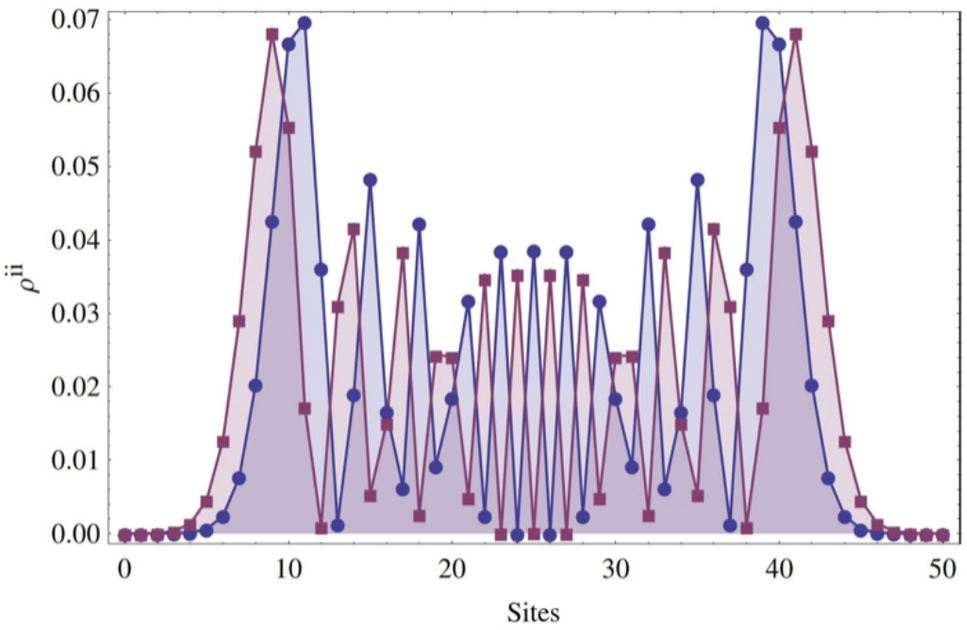
$\sigma_{\text{quantum}} \sim t$





Continuous Quantum walk





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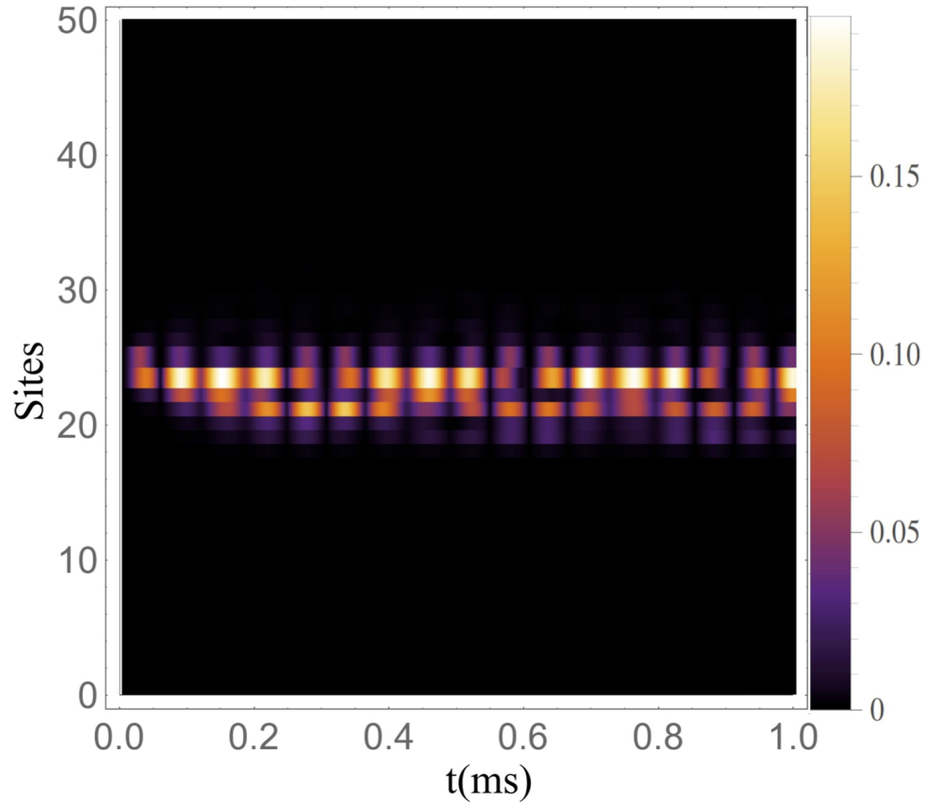

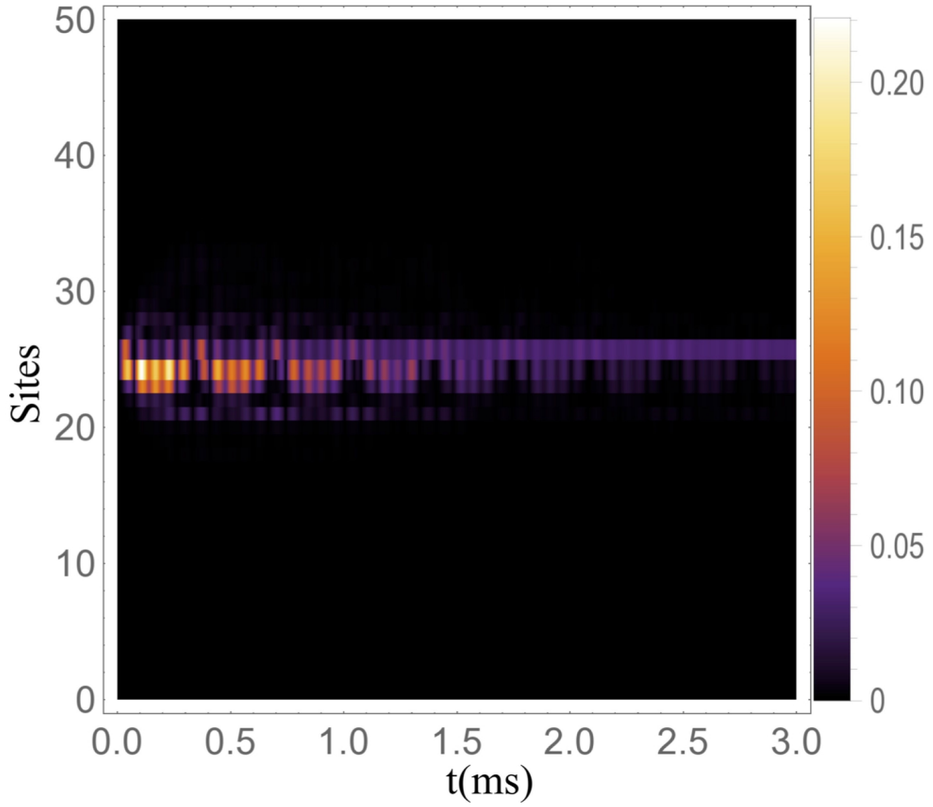

Quantum Information Theory

Quantum Technology

Measurement and control of quantum states

Alejandro Carrillo

Quantum optomechanical and electromechanical resonators

Olimpio P. de Sá Neto

Quantum phenomena in biological systems

John. J. Lozada-Vera

Control of dynamics in ultra cold atoms

Quantum walks in opto- and electromechanical systems

Foundations

Non-classicality and complementarity

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Quantum correlations and entanglement theory

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