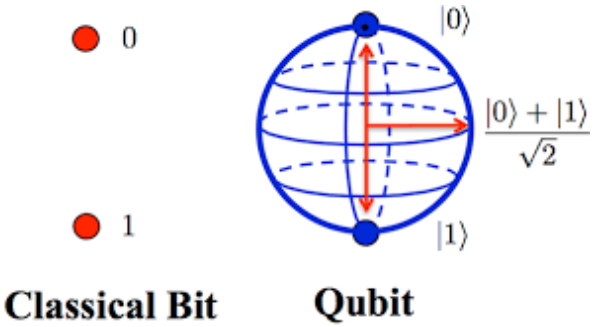
Reviving the African Physical Society
A Tribute to Professor Francis Allotey

INACK Estelle Maéva
ICTP/SISSA



Statistical Physics SISSA

The Abdus Salam International Centre for Theoretical Physics

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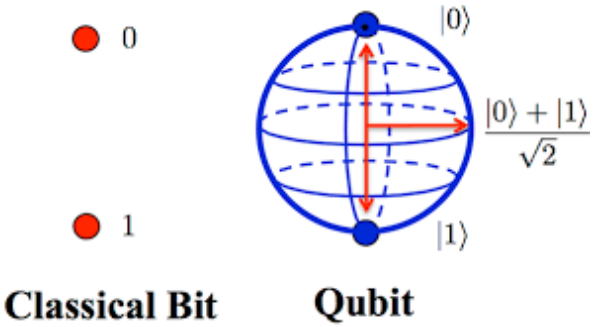
Reviving the African Physical Society
A Tribute to Professor Francis Allotey

INACK Estelle Maéva
ICTP/SISSA → Perimeter institute
Francis Allotey *postdoc Fellow*



Statistical Physics SISSA

The Abdus Salam International Centre for Theoretical Physics

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About me ...

Cameroon

- 2010: BSc in Physics and Computer Science
- 2013: MSc in Physics

LaRAMaNS

Laboratory of Research on Advanced Materials and Nonlinear Sciences

MSc Thesis: *Localized Nonlinear Excitations in Diffusive Hindmarsh-Rose Neural Networks*

- Yamakou, Inack and Moukam Kakmeni, Nonlin. Dyn. ***10***, 1–14 (2015)
- Moukam Kakmeni, Inack and Yamakou, PRE ***89***, 052919 (2014)

About me ...

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- 2014: Postgraduate Diploma in Condensed Matter Physics
- 2018: PhD in Statistical Physics

Diploma Thesis: *Simulated quantum annealing for optimization problems*

PhD Thesis: *Simulating quantum annealing via projective quantum Monte Carlo algorithms*

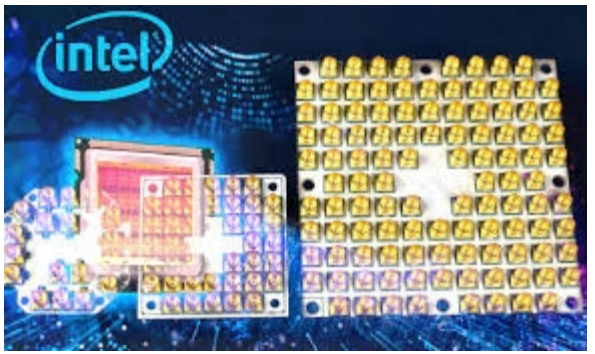
- Inack and Pilati, PRE ***92***, 053304 (2015)
- Inack, Giudici, Parolini, Santoro and Pilati, PRA ***97***, 032307 (2018)
- Inack, Dell'Anna, Santoro, Pilati, arXiv:1809.03562v1

The advent of quantum computers

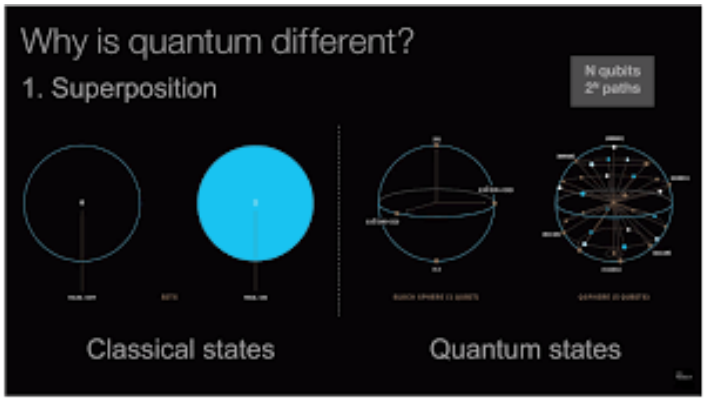
Google

IBM

Intel



Microsoft



Rigetti

Some are accessible on the cloud … so go ahead

…

DWave quantum annealer

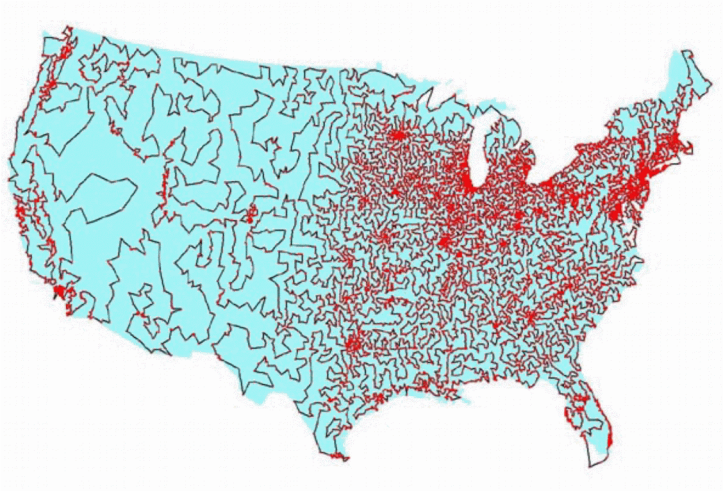
$$H_{cl} = -\sum J_{ij} \sigma_i^z \sigma_j^z$$

$$H_{kin} = -\Gamma(t) \sum_i \sigma_i^x$$

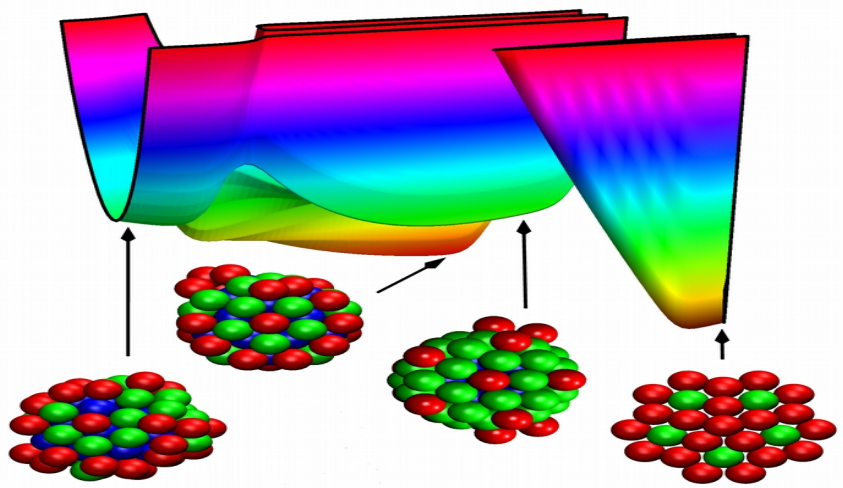
$$\Gamma(t) = \Gamma_o \left(1 - \frac{t}{t_f}\right)$$

Solving optimization problems

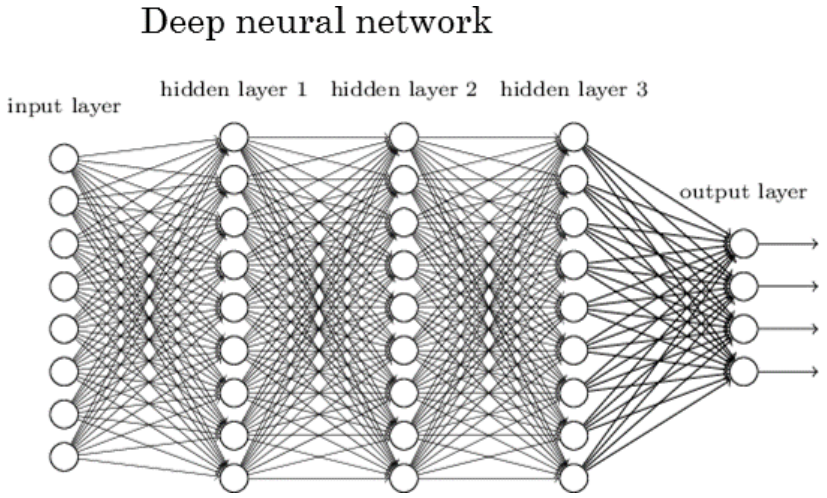
Traveling salesman



Clusters of atoms



Machine Learning

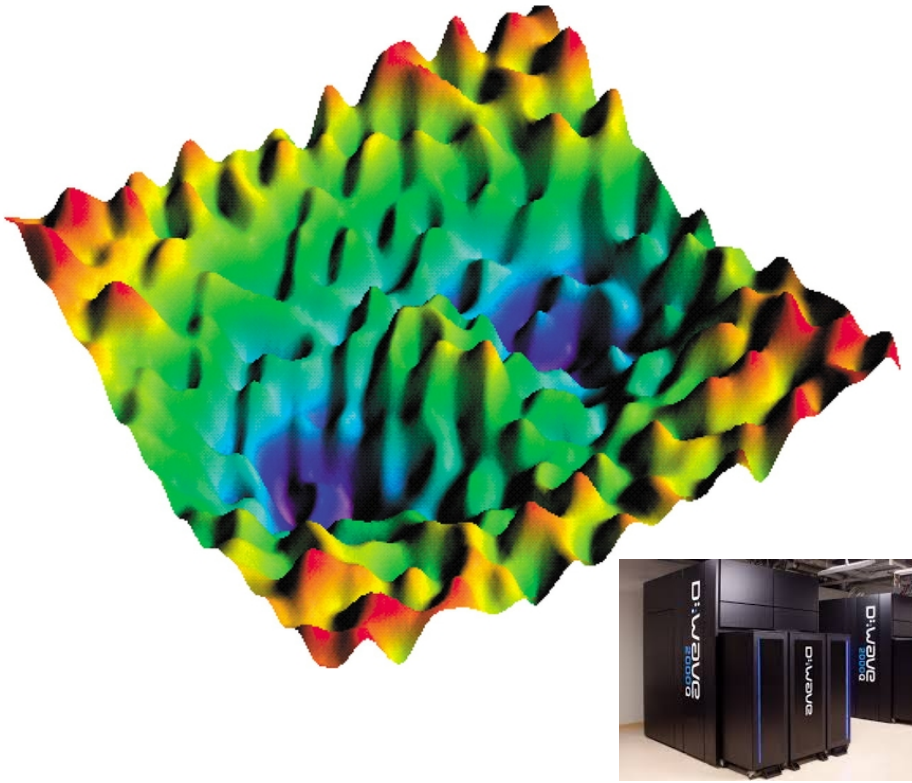


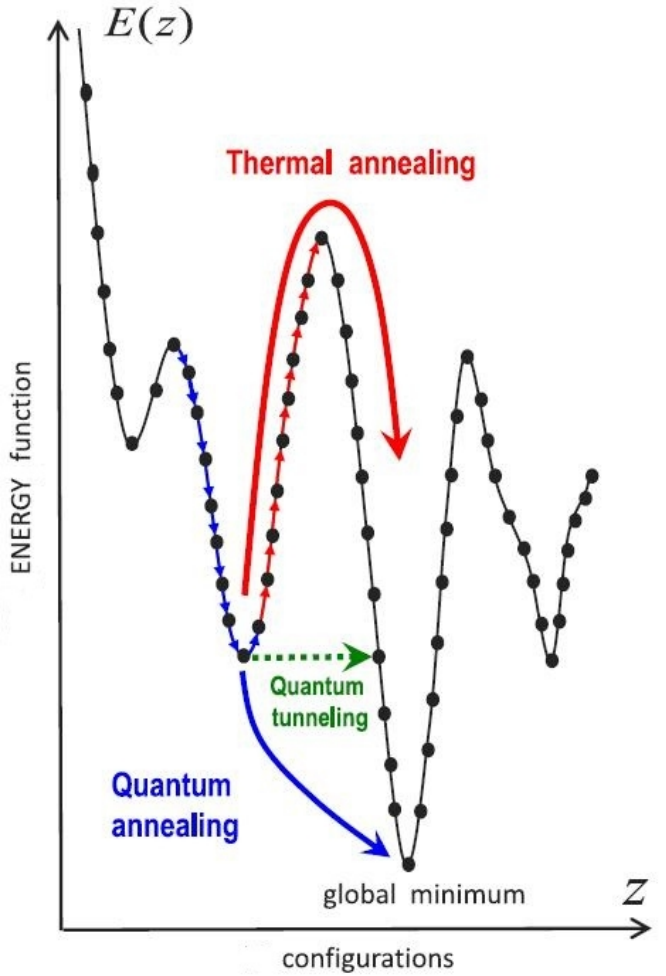
Luggage handling

Etc ...

Quantum annealing ideas

Rugged and exponentially large





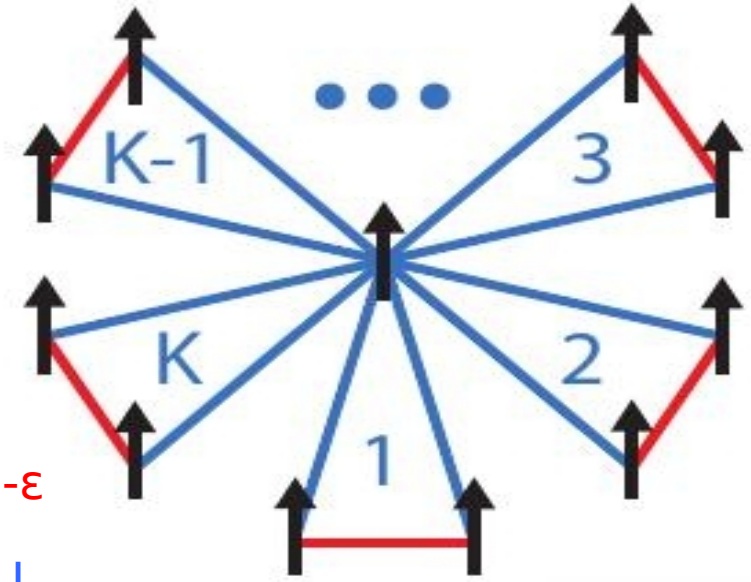
- Kadowaki and Nishimori, PRE 58, 5355 (1998)
- Farhi, Goldstone, Gutmann, Lapan, Lundgren, and Preda, Science 292, 472 (2001)
- Santoro, Martonak, Tosatti, and Car, Science 295, 2427 (2002)

Shamrock: A model of frustrated rings

Can quantum Monte Carlo simulate quantum annealing?

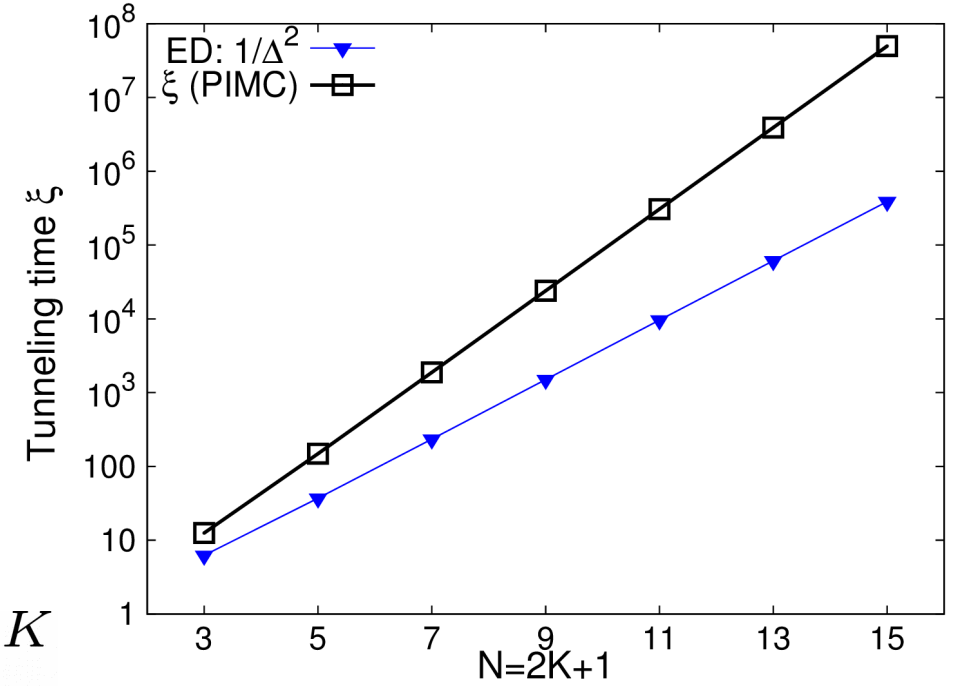
Evgeny Andriyash[1] and Mohammad H. Amin[1,2]
[1]D-Wave Systems Inc., 3033 Beta Avenue, Burnaby BC Canada V5G 4M9
[2]Department of Physics, Simon Fraser University, Burnaby, BC, Canada V5A 1S6

Currently implemented by Google



$J_{AFM}=J-\varepsilon$

$J_{FM}=-J$



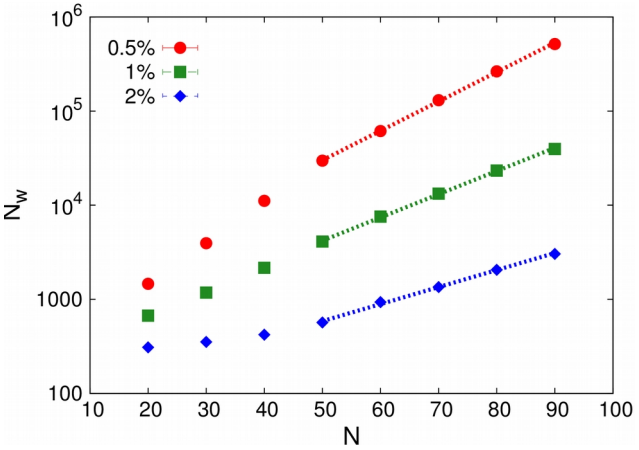
Number of spins

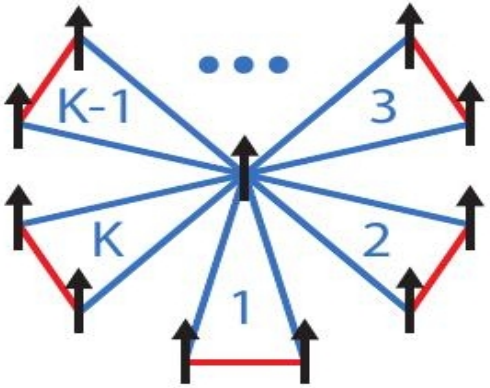
$$\xi_{PIMC} \propto \frac{2^K}{\Delta^2}$$

PIMC dynamics slows down due to “topological” obstructions,
It is slower than QA!

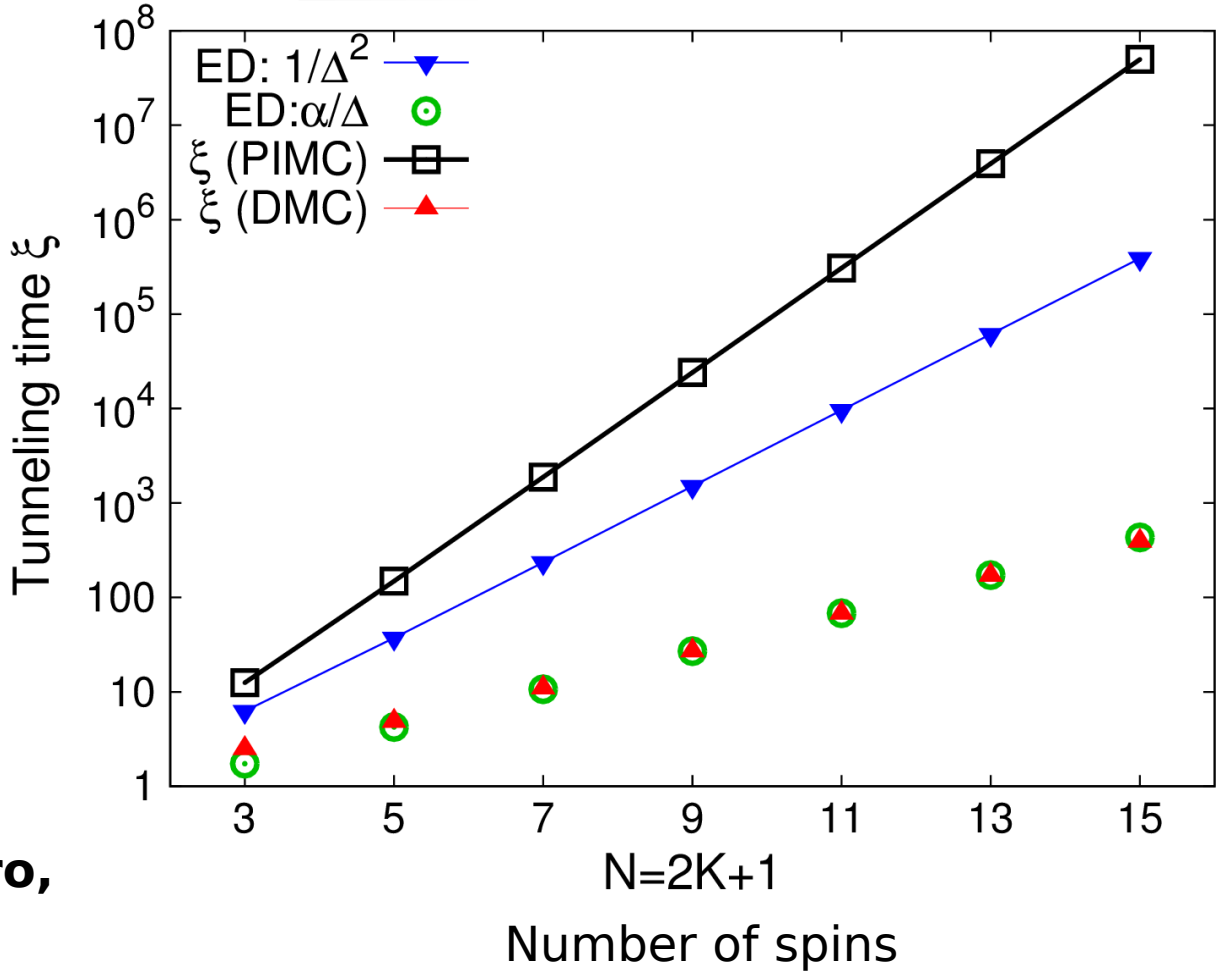
M. B. Hastings, Quantum Inf. Comput. 13, 1038 (2013)

Tunneling time in Shamrock model





Diffusion Monte Carlo results



Inack, Giudici, Parolini, Santoro, Pilati, PRA (2018)

- PIMC dynamics slows down due to "topological" obstructions, **It is slower than QA!**
- DMC dynamics scales like $1/\Delta$ (i.e., **"faster" than QA**)

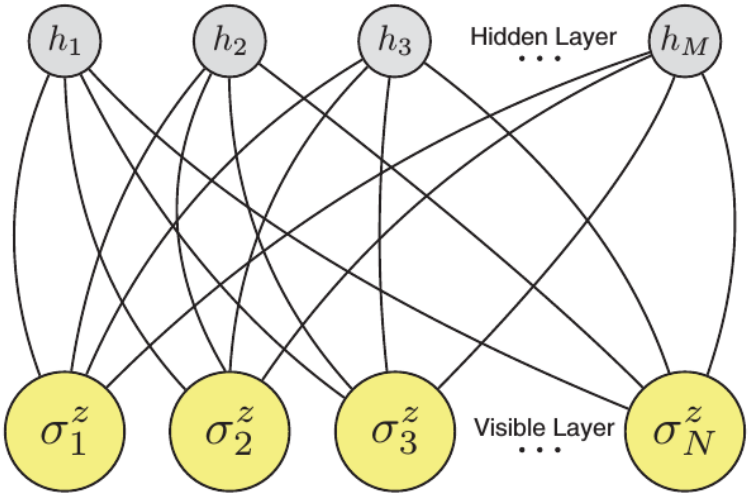
Boosting projective QMC with artificial neural networks

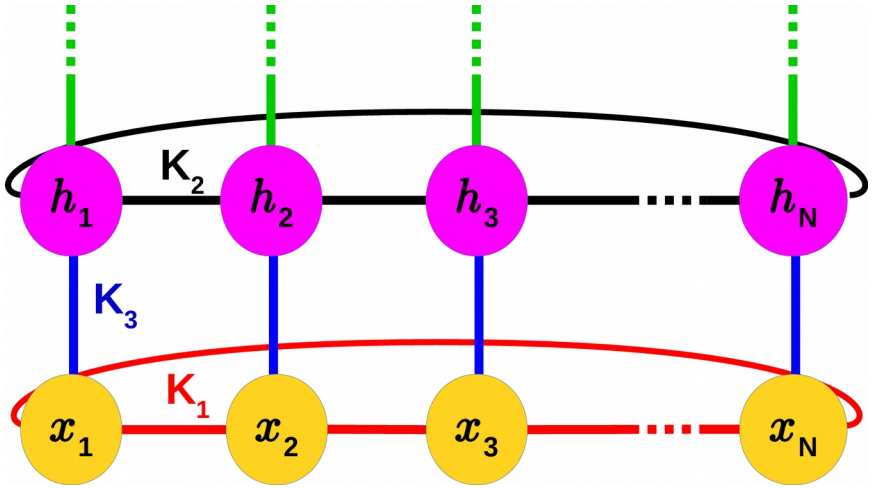
RESEARCH ARTICLE

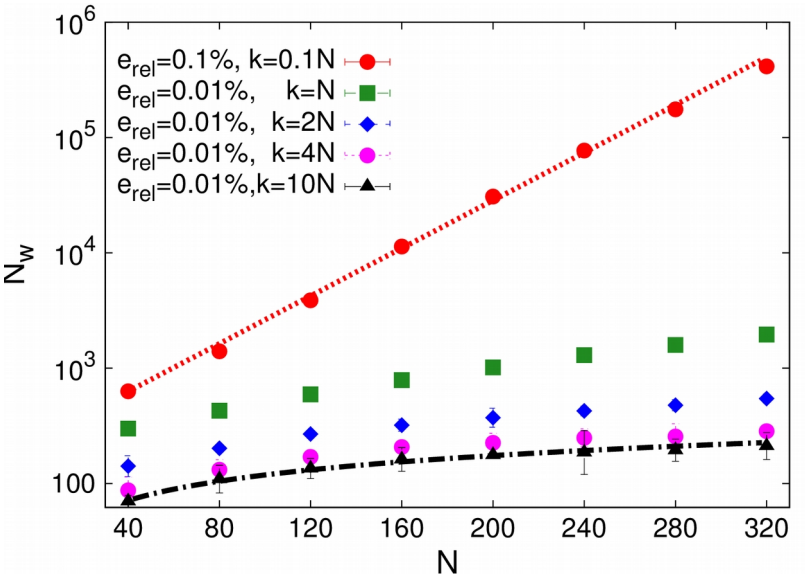
MANY-BODY PHYSICS

Solving the quantum many-body problem with artificial neural networks

Giuseppe Carleo[1]* and Matthias Troyer[1,2]



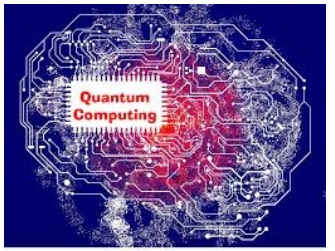




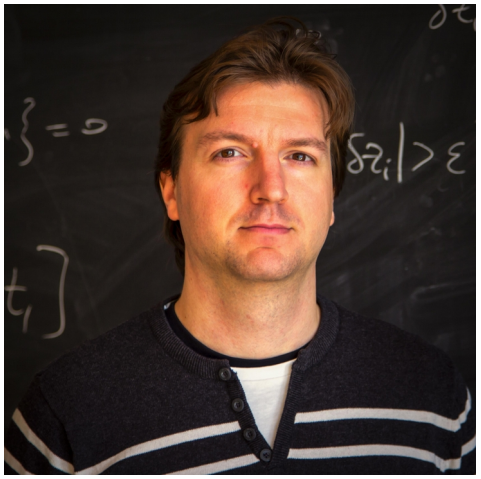
Inack, Dell'Anna, Santoro, Pilati, arXiv:1809.03562v1

What I want to see in Africa

- Africans earning prestigious recognitions eg. Dirac medal, Nobel prize
- More funds for research and good resource management in Africa. More bridges between academia and industry/government?
- More collaborations among African scientists. Database of African scientists? Who is doing what, where.
- Improvement of researchers status in Africa. Less brain drain?
- People jumping into research for passion rather than by chance. More science dissemination. Role models for young people
- Less administrative problems for young scientists to travel. Researcher passport?
- Africans participating in the quantum computing era The future is quantum!



ACKNOWLEGMENTS



Sebastiano Pilati
University of Cammerino

Giuseppe Santoro
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The Abdus Salam International Centre for Theoretical Physics

INFN

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Thank you for your kind attention!