

Curriculum Vitae

Dr. Shai Machnes

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Current areas of interest

- Pulsed control of quantum systems
- Quantum optimal control theory and its applications.
- Exploring the nature of information in a multipartite quantum-state using a hypergraph representations, resource optimization formulations and other methods.
- Enabling exploration of quantum information theory and quantum technology concepts and ideas through the use of computer algorithms and algorithmic non-commuting algebra.

Academics

2011-present: **Post-doc position, Institute of theoretical physics, Ulm university**

Research areas include:

- Cooling of nano-mechanical systems
- Algorithms for optimal control

2005-2011: **Ph.D. in Physics (Quantum Information), Tel-Aviv University**

Quantum Information group, under the supervision of Dr. Benni Reznik.

Research areas include:

- Algorithmic optimal control for use in ion-trap cooling (presented at the QIon09 and ICSSUR 2009 conferences)
- Experimental quantum information theory through the use of computer algorithms.
- Quantum games and protocols
- Multipartite correlations and entanglement

Summer 2009: **Singularity University** – A two-month interdisciplinary program at the graduate & post-graduate levels, hosted & sponsored by NASA and co-sponsored by Google, with the goal of creating a common language for people of different scientific disciplines (genetics, medicine, engineering, physics, nano-technology, computer science, etc), so that together we may attempt to reach new insights

stemming from cross-fertilization. The program accepted 40 students this year from over 1200 applicants. I have been lucky enough to be accepted with full scholarship.

2002-2005: M.Sc. in Physics (Quantum Information), Tel-Aviv University

Final GPA: 90, with Honors

Date of entitlement: May 2005

Quantum Information group, under the supervision of Dr. Benni Reznik.

Thesis subject: Structure of Entanglement in Spin-Chain.

We attempted to deconstruct the Heiseberg chain entanglement into mode-mode coupling. In the process, several measures of entanglements have been applied to chain locations and blocks. The resultant mode where non-local in nature, and therefore not as enlightning as we had hoped.

Other research subject: vacuum entanglement

It has been well known for some time that both the Fermionic and Bosonic free fields are entangled. The goal of our work was to calculate the amount of entanglement between space-like separated regions of space. We conducted numerical optimization in high-dimentional space to search for optimal modes in each region.

Other research subject: locality and entanglement criteria (Svetlichney inequalities)

1995-1998: B.Sc. in Physics at Tel-Aviv University, TAU

Final GPA: 96, Summa Cum Laude

Dean's list: 3/97, 3/99

Date of entitlement: Dec 1998

Jul-Sep, 1997: Summer student research program at the Weizmann Institute of Science, department of high-energy physics, under the supervision of Prof. Ehud Duchovni. Research topic: Search for 3rd generation Flavor Changing Neutral Currents in OPAL data from CERN.

1990-1995: B.A in computer science from The Open University

Final GPA: 96. Summa Cum Laude.

Top 1% of graduating students.

Dean's list: 6/95. President's list: 2/92, 6/94.

Date of entitlement: April 1995

(Concurrent with military service)

IT experience

2004-2009: **Consultancy**. Focusing on three fields:

- Mathematically intense programming, such as error correction algorithms for wireless communication and image processing.
- Construction an review of business plans
- Patents: Prior art search, authoring, Office Actions.

1998 - 2003: **Trivnet Ltd.**, various positions.

2002-2003– **CTO**

In charge of Trivnet's long-term vision (in technology, product, markets, etc). Technology studies. Participation in industry working groups & standardization efforts. Handling IP issues. Technical competitive analysis. Providing additional technical depth to Sales & Strategic Alliances

2000-2002– **Product manager, Mobile payment systems**

Adding technical know-how to Trivnet's product management team, and using that knowledge to shape the company's current offering and vision.

1998-2000 - Senior software engineer and team leader

Setting up and leading the web applications team, with emphasis on security of Web-based applications over insecure protocols and localization of applications to multiple, concurrent markets.

1995-1998: **Senior software engineer at Tiltan Systems Engineering**

Project: Real-time, photo-realistic flight simulation for the Israeli Defense Forces.

1989-1995: **Military service** (navy).

Various positions as **software engineer**. Member of a project team responsible for a project of primary importance to the navy.

2/94: Second place in the Chief Naval Officer's (CNO's) 'creative thinking' competition (as part of the project team).

4/94: **Personal commendation from the CNO** (Chief Naval Officer), Admiral Ami Ayalon for 'devotion, dedication and excellence'.

Publications

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1. *Pulsed Laser Cooling for Cavity-Optomechanical Resonators*
Javier Cerrillo, Shai Machnes, Markus Aspelmeyer, Witlef Wieczorek, Martin B. Plenio, Alex Retzker
Accepted for publication, *Physical Review A*
[arXiv/1104.5448](#)
2. *Study of a self-adjoint operator indicating the direction of time within standard quantum mechanics*
Y. Strauss, J. Silman, S. Machnes, L.P. Horwitz
[arXiv/1101.3969](#)
3. *Transition Decomposition of Quantum Mechanical Evolution*
Y. Strauss, J. Silman, S. Machnes, L.P. Horwitz
[International Journal of Theoretical Physics, vol. 50, no. 7, p. 2179-2190 \(2011\)](#)
[arXiv/1101.4180](#)
4. *Comparing, Optimising and Benchmarking Quantum Control Algorithms in a Unifying Programming Framework*
S. Machnes, U. Sander, S.J. Glaser, P. de Fouquieres, A. Gruslys, S. Schirmer, T. Schulte-Herbrueggen
Accepted for publication, *Physical Review A*
[arXiv/1011.4874](#)
5. *Superfast Cooling*
S. Machnes, M. B. Plenio, B. Reznik, A. M. Steane, A. Retzker
[Phys. Rev. Lett. 104, 183001 \(2010\)](#)
[arXiv/1001.2714](#)
6. *An Arrow of Time Operator for Standard Quantum Mechanics*
Y. Strauss, J. Silman, S. Machnes, L.P. Horwitz
[arXiv/0802.2448](#)
7. *The EPR experiment in the energy-based stochastic reduction framework*
J. Silman, S. Machnes, S. Shnider, L. P. Horwitz, A. Belenkiy
[J. Phys. A 41, 255303 \(2008\)](#)
[arXiv/0710.4894](#)

8. *On the relation between Bell inequalities and nonlocal games*
J. Silman, S. Machnes, N. Aharon
[Physics Letters A 372 21 \(2008\)](#)
[arXiv/0710.3322](#)
9. *QLib - A Matlab Package for Quantum Information Theory Calculations, with Applications*
S. Machnes, [arXiv/0708.0478](#)

Featured by the EU Integrated Project Qubit Applications (QAP) in the [Research Highlights](#) section (September 2008), and has been presented at [Paraty 2007](#), [IPS 2007, Imperial Collage London](#) and [QCCQI 2008](#).

10. *Continuous input nonlocal games*
N. Aharon, S. Machnes, B. Reznik, J. Silman and L. Vaidman
To appear in Nat. Comput.
[arXiv/0706.2159](#)