Fakultätsöffentliche Präsentation Fakultät für Physik
Date: Thursday, 22 February 2018
Place: Ernst-Mach lecture hall, 2nd floor, Boltzmanngasse 5, 1090 Wien
Time: from 9 a.m.

Time	Slot	Topic	Supervisor	Begonnen
9:00-9:10	--	Introduction by Thomas Pichler		
9:10-9:25	Lepenik Christopher	Heavy Quark Masses from Jets with Effective Field Theorie Methods	Hoang André	01.03.2016
9:25-9:40	Hauff-Achleitner Andrea Silvia	Energieerhaltung in der Sekundarstufe 1 - Entwicklung und Evaluierung eines Unterrichtskonzepts	Hopf Martin	01.10.2017
9:40-9:55	Semmelrock Lukas	Self-Interacting dark matter moduls and their implications on structure	Hoang André Pradler Josef	01.10.2016
9:55-10:25	**Krenn Mario**	**On Computer-Designed Quantum Experiments**		
10:25-10:45	PAUSE			
10:45-11:00	Ziarkash Abdul	Multiplexed QKD system for multi-party quantum communication	Zeilinger Anton	01.10.2017
11:00-11:15	Wengerowsky Sören	Two-photon polarization entanglement for quantum communications	Zeilinger Anton	01.10.2013
11:15-11:30	Fink Matthias	Applications of a rigid source of	Zeilinger Anton	01.03.2016
11:30-12:00	**Weiss Lisa B.**	**How to separate linear and ring**		
12:00-13:00	PAUSE			
13:00-13:15	Neumann Sebastian Philipp	Experimental Approaches to Long-Distance Quantum Key Distribution	Zeilinger Anton	01.03.2016
13:15-13:30	Handsteiner Johannes	Towards a Cosmic Bell Test	Zeilinger Anton	01.03.2016
13:30-13:45	Brilke Sophia	Ground-based particle size distribution measurements in Austria and Cyprus	Winkler Paul	01.10.2016
13:45-14:00	Fellinger Jakob	Mid infrared frequency comb	Heckl Oliver	01.03.2017
14:00-14:20	PAUSE			
14:20-14:35	Holzweber Katharina	Investigating beam-induced atomic motion with coherent X-rays	Sepiol Bogdan	01.10.2017
14:35-14:50	de Liano Elisa	Computational Design of Functional DNA Nanostructures and ist	Dellago Christoph	01.03.2017
14:50-15:05	Lahnsteiner Jonathan	Dynamics in perovskite photovoltaics	Bokdam Menno Kresse Georg	01.10.2016
15:05-15:20	Strömberg Teodor	Single- and multi-photon experiments in a programmable nanophotonic waveguide	WALTHER Philipp	01.03.2017
15:20-15:35	Dollner Maximilian	Global distributions of coarse-mode aerosol and clouds during the Atmospheric Tomography Mission (A Tom)	Weinzierl Bernadett	01.03.2016

On Computer-Designed Quantum Experiments

Mario Krenn

Designing experimental setups for high-dimensional multipartite entangled states is a notoriously difficult feat. For that reason, we have developed the computer algorithm Melvin which is able to find new experimental implementations for the creation and manipulation of complex quantum states [1]. The discovered experiments use unfamiliar and asymmetric techniques which are challenging to understand intuitively. Melvin autonomously learns from solutions for simpler systems, which significantly speeds up the discovery rate of more complex experiments. Several of the computer-designed experiments have already been successfully implemented in our laboratories.

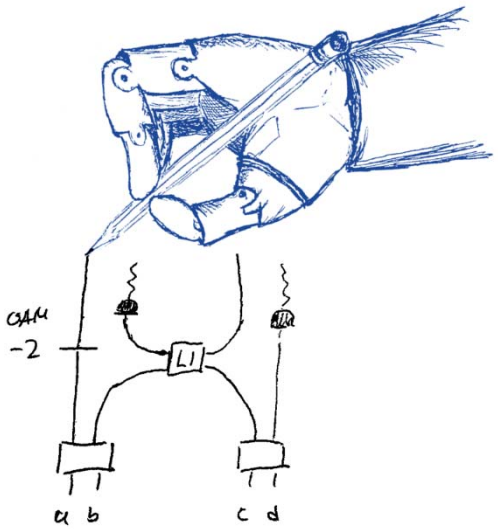
By analysing Melvin's proposal for an unexpected quantum state, we discovered novel techniques for well controlled generation of entanglement [2,3]. Surprisingly, these techniques only use elements which were available already for 25 years, but it has been discovered only now by a computer algorithm. This shows that computer designed quantum experiments can be inspirations for new techniques and ideas.

[1] M Krenn, M Malik, R Fickler, R Lapkiewicz, A Zeilinger "Automated Search for new Quantum Experiments", Physical Review Letters 116 (9), 090405 (2016).

[2] M Krenn, A Hochrainer, M Lahiri, A Zeilinger "Entanglement by Path Identity", Physical Review Letters 118 (8), 080401 (2017).

[3] M Krenn, X Gu, A Zeilinger "Quantum Experiments and Graphs:

Multiparty States as coherent superpositions of Perfect Matchings", Physical Review Letters 119 (24), 240403 (2017).



How to separate linear and ring-shaped polymers?

Lisa B. Weiss

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Cyclic macromolecules, i.e., microscopic chains having their ends tied together, are an important class of biological and synthetic polymers [1, 2]. These ring polymers consist of the same type and number of building blocks as their linear counterparts but show many distinct properties on the nano scale on the basis of their distinct topology alone. For example ring DNA is less prone to degradation, since it lacks free ends, a mechanism exploited by viral DNA. Furthermore, linear and ring molecules show distinct behavior when sheared [3]. The whole area is fascinating and demanding at the same time, since it underlines in an impressive way the importance topological constraints have on physical properties. At the same time, topology is notoriously hard to incorporate into Hamiltonians, let alone to deal with analytically in a proper many-body, statistical mechanical theory. On the applications side, we still lack reliable, topology-sensitive separation techniques, since the type and number of building blocks are identical and chemistry is of little or no use in this sense. Therefore, we explore in this computer simulation approach possible mechanisms to separate linear and ring polymers in micro-fluidic devices, taking hydrodynamics into account via an explicit solvent. We find that in bare channels there is only minor difference in the migration behavior, which is not sufficient for separation. In contrast decorating the channel walls with attractive spots results in a reliable and novel strategy for separation that takes full advantage of the different topologies of the polymers [4]. Those spots effectively capture and immobilize linear chains, while forcing ring polymers to change their preferred orientation close to the walls. In doing so, ring polymers are enabled to roll along the spots with a finite velocity. Extensions to more concentrated solutions as well as possible approaches to construct knot-sensitive filters for ring polymers will also be briefly discussed.

References

[1] Lasda, E.; Parker, R. RNA 2014, 20, 1829–1842.
[2] McLeish, T. Science 2002, 1740, 2001–2002.
[3] Kapnistos, M.; Lang, M.; Vlassopoulos, D.; Pyckhout-Hintzen, W.; Richter, D.; Cho, D.; Chang, T.; Rubinstein, M. Nat. Mater. 2008, 7, 997–1002.
[4] Weiss, L. B.; Nikoubashman, A.; Likos, C. N. ACS Macro Letters 2017, 1426–1431.