Contribution Title:	MEASUREMENT-BASED QUANTUM COMPUTATION WITH CLUSTER STATES
Authors:	R. Raussendorf
Presenting author:	Raussendorf R.
Affilation:	University of British Columbia, Vancouver, Canada
E-mail:	raussen@phas.ubc.ca
Invited speaker:	Topical session
YRS seminar:	NO

I give an introduction to cluster state quantum computation [1], state the main open problems and describe recent developments in the field which are interesting both from the viewpoint of Physics and Mathematics.

Cluster state quantum computation is not driven by unitary evolution but rather by projective local measurements. The scheme uses a highly entangled multi-qubit cluster state as resource for universal computation. As the computation proceeds the entanglement in the resource state is progressively destroyed. Any quantum algorithm can be implemented on a sufficiently large cluster state, by appropriate choice of the local measurement bases. The result of the computation is revealed in correlations of the individually random measurement outcomes.

From the viewpoint of physics, interesting is the fact that quantum correlations emerge as a central notion for the processing of information with cluster states [1,2]. Further, connections with fundamental aspects of quantum mechanics arise such as the Einstein-Podolsky-Rosen paradox and the Kochen-Specker Theorem.

From the viewpoint of Mathematics, to date connections with two areas of Mathematics have been established, namely Graph Theory and Topology. Graph theory arises in entanglement-based criteria for the hardness of classical simulation of cluster state quantum computation [3], and topology in fault-tolerance [4].

[1] R. Raussendorf and H.J. Briegel, PRL 86, 5188 (2001).
[2] J. Anders and D.E. Browne, Phys. Rev. Lett. 102, 050502 (2009).
[3] M. Van den Nest, W. Duer, G. Vidal, H. J. Briegel, PRA 75, 012337 (2007).
[4] R. Raussendorf, J. Harrington, PRL 98, 190504 (2007).