[QMS2020 plenary talk]

Novel Quantum Phases and Order Fractionalization

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Fractionalization is the well-established phenomenon whereby excitations inside quantum matter develop fractional quantum numbers, such as the excitations of Polyacetylene[1], the anyons of the fractional quantum Hall state[2], spinons in the 1D Heisenberg antiferromagnet[3], Majorana fermions in Kitaev magnets[4]. Fractionalization is also thought to occur at novel "deconfined" quantum critical points[5].

I will discuss the possibility that fractionalized excitations can actually condense, giving rise to "Order Fractionalization"[6]. The proposed mechanism provides a route to new classes of quantum phase in which the order parameter itself fractionalizes into half-integer bosons. Support for this conjecture derives from various sources: from experiment, from large N expansions, from numerical renormalization and lastly from the direct construction of a solvable two channel Kondo lattice model which explicitly exhibits this effect.

Ramifications of this novel mechanism may affect a broad class of quantum materials. The possibility of order fractionalization in particle physics will also be briefly discussed.

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[3] M. Mourigal et al, Nature Physics **9**, 435-441 (2013)
[4] Y. Kashara et al, Nature **559**, 227-231 (2018).
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[6] Y. Komijani, Anna Toth, Premala Chandra, Piers Coleman, arXiv:1811.11115.